

HUME HIGHWAY BYPASSES

HOLBROOK - NOISE ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 07277-H EA
VERSION E

WILKINSON  MURRAY

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PREPARED FOR

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17.7 Blasting Assessment**86****APPENDIX A – Glossary of Terms****APPENDIX B – Noise Measurement Results****APPENDIX C – Traffic Volume Diagrams****APPENDIX D – Night Time Predictions at Receivers 2022****APPENDIX E – Night Time Noise Contours, Bypass Only, 2022, Before Mitigation****APPENDIX F – Night Time Noise Contours, Bypass Only, 2022, After Mitigation****APPENDIX G – Receiver Locations**

1 INTRODUCTION

As part of the Hume Highway upgrade a bypass is proposed for the village of Holbrook. Currently, the Hume Highway traverses the centre of the village. Traffic flow is reduced in speed and number of lanes, and properties in the village are exposed to high levels of noise.

A range of corridor and route options have been evaluated and a preferred route option has been selected. As such, an Environmental Assessment (EA) under Part 3A of the Environmental Planning & Assessment Act is currently being prepared. Wilkinson Murray Pty Ltd has been contracted by the Roads and Traffic Authority (RTA) to conduct a noise assessment as part of the EA.

The noise assessment incorporated the following stages:

Stage 1	Identification of noise sensitive receivers and establishing noise catchment areas;
Stage 2	Measurement of existing noise levels;
Stage 3	Validation of traffic noise model for existing conditions;
Stage 4	Determining operational traffic and construction noise criteria for the project;
Stage 5	Detailed traffic noise modelling methodology;
Stage 6	Calculation and assessment of noise for future scenarios without mitigation;
Stage 7	Review of traffic noise mitigation options;
Stage 8	Assessment of maximum noise levels during operation; and
Stage 9	Assessment of construction noise and vibration.

2 DESCRIPTION OF THE PROJECT

The proposed bypass is approximately 9.5km long and passes west of Holbrook and the existing Hume Highway. The corridor is shown on Figure 2-1. Access to the bypass will be provided both north and south of the village via two new interchanges.

Figure 2-1 Route and Key Features of the Project



3 DIRECTOR-GENERAL'S REQUIREMENTS

The Director-General's Requirements for the project, in relation to noise assessment and impacts, are:

- *Construction noise and vibration, including construction traffic noise and blasting impacts;*
- *Operational road traffic noise impacts including consideration of local meteorological conditions (as relevant) and any additional reflective noise impacts from proposed noise mitigation barriers; and*
- *The assessment must take into account the following guidelines as relevant: Environmental Criteria for Road Traffic Noise (EPA, 1999); Environmental Noise Management Manual (RTA, 2001); Draft Construction Noise Guideline, Construction Sites (formerly published as Chapter 171 of the EPA's Environmental Noise Control Manual; Assessing Vibration: A Technical Guideline (DEC,2006); and Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZECC, 1990).*

In a subsequent letter from the Department of Planning to the RTA, it was indicated that construction noise assessment should take into account Chapter 171 of the *Environmental Noise Control Manual*, rather than the Draft Construction Noise Guideline cited above.

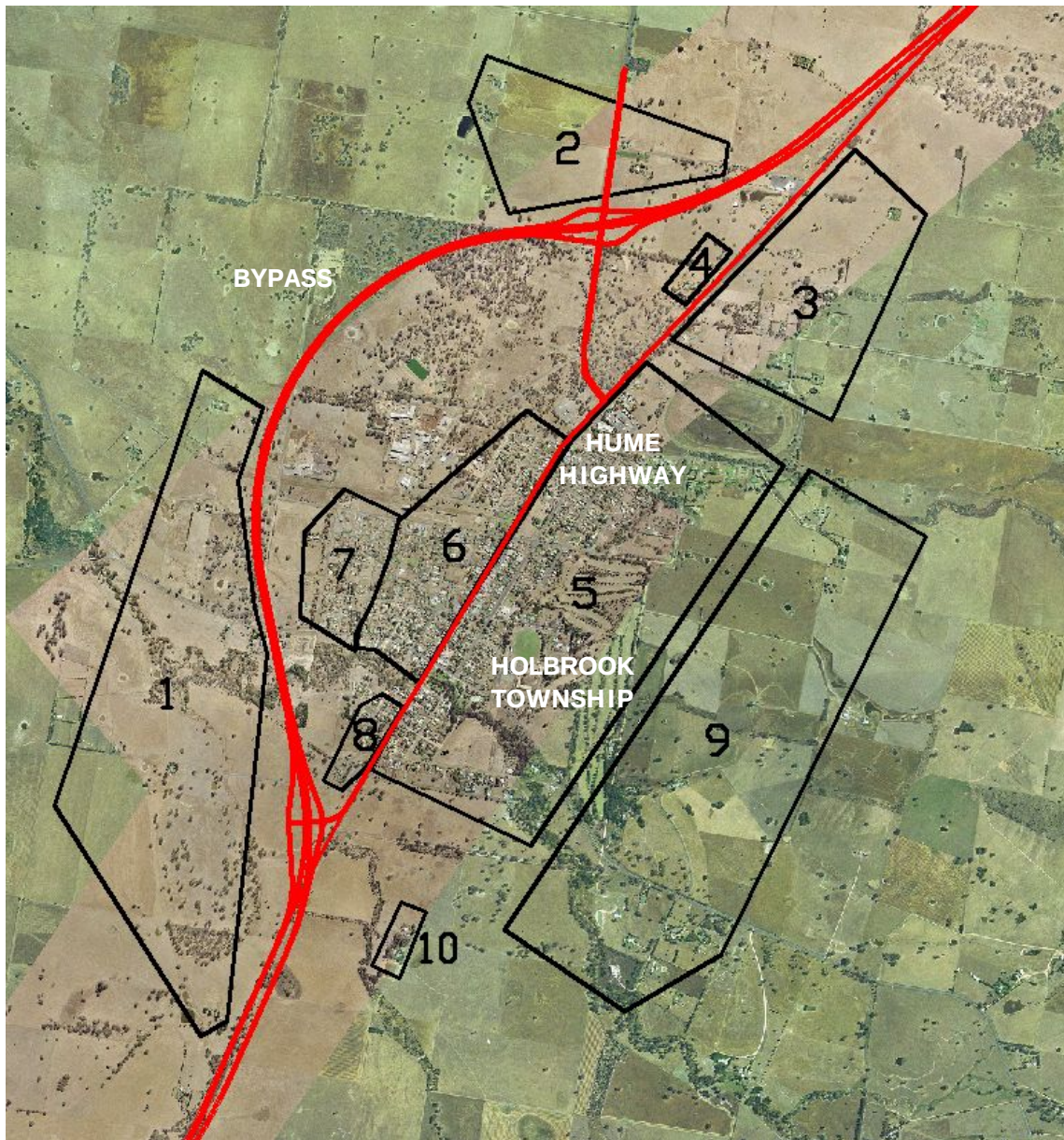
4 NOISE SENSITIVE RECEIVERS

4.1 Residential Receivers

All residential locations potentially affected by the Proposal are included in the noise assessment. A total of 591 houses are included and each location is identified by a unique number. For ease of reference, specific areas of the project have been grouped together into 10 noise catchment areas (NCAs). The figures in Appendices F and G show all location identification numbers as well as the various NCAs. Table 4-1 describes the location of each NCA (shown in Figure 4-1). Individual receiver locations are shown in Appendix G.

Table 4-1 Noise Catchment Areas

NCA	Location	Receiver Numbers	Type of Residences	Non Residential Receivers
1	Western side of Bypass	1-7	Isolated	
2	Northern side of Bypass	8-11	Isolated	
3	Eastern side of Bypass, northern side of Holbrook	291-298 580-583 587	Isolated	
4	Between Bypass and Hume Highway, northern side of Holbrook	256-257	Isolated	
5	Holbrook town on eastern side of Hume Highway	299-447 449-579	Village	Holbrook Hospital Knox Uniting Church Golf Course Holbrook Public School
6	Holbrook town on western side of Hume Highway	42-43 77-99 101-112 117-145 147-148 151-251 276-281	Village	St Patrick's School Our Lady of Sorrows Church Anglican Church (Young St)
7	Holbrook rear of town, between Bypass and Hume Highway	12-41 44-49 100 113-116 146 252-254 258-288	Village	
8	Between Bypass and Hume Highway, southern side of Holbrook	50-76	Isolated	
9	Eastern side of Hume Highway, eastern side of Holbrook	448 584-586 588-589 594 596-600	Isolated	
10	Eastern side of Hume Highway, south side of Holbrook	290-291	Isolated	

Figure 4-1 Noise Catchment Areas

4.2 Other Sensitive Land Uses

Non-residential receivers are:

- St Patrick's School – Receiver 149
- Our Lady of Sorrows Church – Receiver 150
- Anglican Church in Young Street – Receiver 255
- Holbrook Hospital – Receiver 606
- Holbrook Public School – Receiver 508
- Knox Uniting Church – Receiver 607
- Golf Course – Receiver 605

The location of non-residential receivers is shown on Figure 4-2.

Figure 4-2 Location of Non-Residential Receivers

5 TRAFFIC NOISE CRITERIA

5.1 Noise Criteria for Receivers

Criteria for assessment of road traffic noise are set out in the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)*. The RTA has also published the *Environmental Noise Management Manual (ENMM)* to assist in implementing the ECRTN.

Under the *Environmental Criteria for Road Traffic Noise*, road developments are classified as either “new road” or “redevelopment of an existing road”. Practice note (i) of the *Environmental Noise Management Manual* describes the circumstances under which each of these applies. This Proposal would be classified as a “*new freeway or arterial road corridor*”. Three receivers (Recs 1, 289 and 290) in the study area is south of where the bypass rejoins the Hume Highway, and it would be considered “*redevelopment of existing freeway/arterial road*”. The criteria set out in Table 5-1 would therefore apply.

Table 5-1 Environmental Criteria for Road Traffic Noise Criteria for Operational Traffic Noise - Receivers

Type of Development	Noise Level Criterion		Where Criteria are Already Exceeded
	Day (7.00am-10.00pm)	Night (10.00pm-7.00am)	
New freeway or arterial road corridor	L _{Aeq,15hr} 55dBA	L _{Aeq,9hr} 50dBA	The new road should be designed as not to increase existing noise levels by more than 0.5dB. <i>Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies.</i>
Redevelopment of existing freeway/arterial road	L _{Aeq,15hr} 60dBA	L _{Aeq,9hr} 55dBA	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2dB. <i>Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies.</i>

In applying Table 5-1, the noise level criterion applies to the predicted noise level at a time 10 years after opening of the project (design year), which in this case is the year 2022. The “existing” noise levels are described in the *Environmental Noise Management Manual* as “future existing” levels – that is, noise levels due to traffic on existing roads as predicted at a time immediately before opening of the project.

Where the “base” criteria in Table 5-1 are already exceeded, Practice Note (iv) of the *Environmental Noise Management Manual* provides further discussion of situations where provision of additional controls would be considered “feasible and reasonable”. In particular, for “new freeways or arterial roads” it is generally *not* considered reasonable to take action to reduce noise levels to the target noise levels if the noise levels with the proposal, ten years after project opening, are predicted to be:

- Within 2dBA of “future existing” noise levels; *and*
- No more than 2dBA above the target noise levels set out in the Table 5-1.

The RTA's Environmental Practice Note 24 “Noise assessment for acute levels of noise – redevelopment of existing roads” confirms the following:

“Application of all feasible and reasonable noise mitigation to aim to achieve the ECRTN noise criteria where, following a road redevelopment:

- There is predicted to be a noticeable increase in road traffic noise, or
- Road traffic noise levels are predicted to be acute.”

The RTA has a Noise Abatement Program for existing roads where the RTA targets locations or lengths of existing roadways where road traffic noise levels are very high and are considered excessive for noise sensitive land uses. Noise affected sites are not currently given priority for noise treatment unless road traffic noise levels are at least 65dBA $L_{Aeq,15hr}$ or 60dBA $L_{Aeq,9hr}$. These noise levels are termed acute noise levels.

A further point should be noted in applying the RTA policy. The *ECRTN* indicates (technical note ix) that if the existing noise level is below the criterion but within 2dB of the criterion, then the 2dB allowance may also be applied. Hence, the exclusion above is also taken to apply to cases where an existing noise level below the “base” criterion is predicted to increase by 2dBA or less.

5.2 Noise Criteria for Other Noise Sensitive Land Uses

5.2.1 Noise Criteria for Schools

The *ECRTN* has two criteria for schools: internal levels and playgrounds

- Internal: $L_{Aeq(1h)}$ 45dBA during school hours; and
- Playgrounds: $L_{Aeq,15hr}$ 55dBA.

For the external noise level, the discussion from the previous section with respect to “reasonable and feasible” mitigation is also relevant.

5.2.2 Noise Criteria for Places of Worship

For places of worship, only an internal noise is considered in the *ECRTN*. The criterion is that the $L_{Aeq,1hr}$ should not exceed 40dBA during times when the place of worship would be in use.

5.2.3 Noise Criteria for Hospitals

For hospital wards only an internal noise is considered in the *ECRTN*. The criterion is that the $L_{Aeq,1hr}$ should not exceed 35dBA at any time.

5.2.4 Noise Criteria for Active Recreation Areas

For active recreation areas like the identified golf course the criterion is $L_{Aeq,15hr}$ 60dBA.

6 NOISE MONITORING

There are two reasons why noise monitoring was conducted, namely:

- provide background noise levels to set appropriate criteria for construction noise assessment; and
- allow validation of the computational noise model used to determine existing traffic noise levels at receivers in Holbrook.

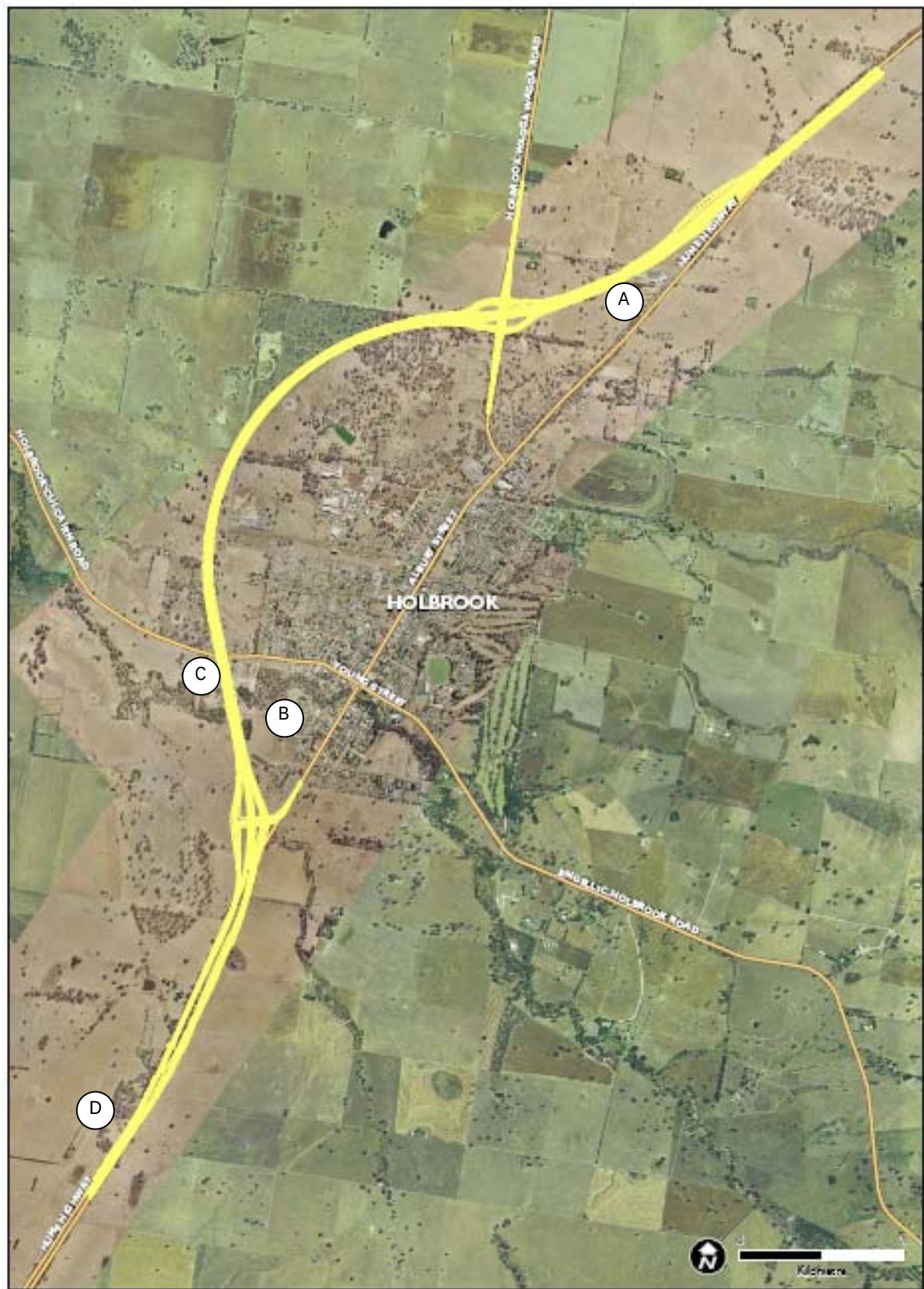
6.1 Monitoring locations

Noise monitoring was conducted at four locations, namely:

- A. Sydney Road, Holbrook (DP840255 Lendon Condon);
- B. 19 Nyhan Street, Holbrook;
- C. Burra Hereford Stud, Culcairn Road, Holbrook (DP5540); and
- D. Montpellier, Hume Highway (DP830535).

The monitoring locations are shown on Figure 6-1. All four monitoring sites were suitable to establish background noise levels so that appropriate construction noise criteria can be established. However, only locations A, B and D were suitable to establish existing traffic noise levels along the existing highway to validate the computational noise model. Location C was too far from the existing highway to establish noise levels from the existing highway.

Figure 6-1 Noise Monitoring Locations



6.2 Monitoring and Analysis Procedures

The noise monitoring equipment used for these measurements consisted of environmental noise loggers set to A-weighted, fast response continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1} , L_{A10} , L_{A90} and L_{Aeq} levels of the existing noise environment. The L_{A1} , L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The L_{A90} level is normally taken as the background noise level. The L_{Aeq} level is the Equivalent Continuous Sound Level and has the same sound energy over the sampling period as the actual noise environment with its fluctuating sound levels. Whilst the L_{A10} has in the past been used as a descriptor for traffic noise, the L_{Aeq} is now the standard descriptor for traffic noise.

Noise monitoring was carried out from 5 November to 28 November 2008. The batteries of the equipment were replaced on the 18th of November. Between 13th and 18th of November some days were not logged at Location 1 and 4 due to battery exhaustion. Taking the whole period into consideration, at least 7 days of valid data was collected at all locations as required by RTA guidelines.

To describe background noise levels, the measure currently recommended in NSW is the Rating Background Level (RBL) based on the L_{A90} as defined in the NSW Department of Environment, Climate Change & Water (DECCW) *NSW Industrial Noise Policy (INP)*. A glossary of terms is provided in Appendix A.

Meteorological data for the relevant periods was obtained from the nearest weather station at Wagga Wagga. Periods in which it was likely to be raining, or when wind speeds exceeded 5 metres per second at microphone height, were excluded from analysis, in accordance with principles agreed by the DECCW.

Further review of the data was performed to exclude sources of extraneous noise. These sources are not always identifiable; however those 15 minute periods in which the L_{Aeq} level is significantly higher than the L_{A10} level and corresponds to an unusually high maximum level are unlikely to be 'normal' traffic noise and have therefore been excluded from the statistical analysis of logger data.

6.3 Summary of Monitoring Results

The long term background noise levels, in terms of Rating Background Level, are given in Table 6-1.

Additionally, the measured L_{Aeq} levels over the periods used for assessing traffic noise (daytime 0700 to 2200, and night time 2200 to 0700) are presented in Table 6-1. As noted earlier, Location C is so distant from the highway that the L_{Aeq} is not dominated by traffic noise. Other sources such as animals and agricultural noise, and traffic on Culcairn Road significantly affect the L_{Aeq} at that location.

The results of the noise survey are shown in graphical form in Appendix B.

Table 6-1 Summary of monitoring results

Location	Day	Night	RBL (dBA)		
	L _{eq} , 15hr (dBA)	L _{eq} , 9hr (dBA)	Day	Evening	Night
A. Sydney Road	62	64	43	44	37
B. 19 Nyhan Street	51	49	38	41	32
C. Burra Stud	-	-	38	34	33
D. Montpellier	57	59	40	41	35

All measured noise levels were consistent with the site location in relation to the existing highway. For Location C where measured levels were not affected by highway traffic noise, the background levels are consistent with those typical to rural areas.

7 NOISE MODELLING

7.1 Modelling Methodology

Noise levels for the existing road alignment were calculated using procedures based on the *CoRTN* prediction algorithms. The standard *CoRTN* prediction procedures were modified in the following ways:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the *CoRTN* algorithms using the well-validated approximation $L_{Aeq,1hr} = L_{A10,1hr} - 3$.
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representing typical values for Australian vehicles. Noise from a heavy vehicle exhaust was assessed as 8dBA lower than the noise from the engine. The combined noise from heavy vehicle exhaust and engine gives the sound level as defined in *CoRTN*. The acoustical energy for the various sources is then derived from speed, road surface and traffic volume.
- The Australian correction of -1.7dBA was applied to façade predictions (April 1983 Australian Road Research Board report - Research Report ARR No.122)
- Where there are no barriers present, ground was taken to be 50% soft. With barriers hard ground is assumed as required under the *CoRTN* procedures.
- *CoRTN* procedures were used to incorporate effects of reflections from barriers and other obstacles.
- The models were implemented using *ROADent* software, based on road design points at 10m intervals along both the existing route and proposed design. Inputs to the model are listed in Table 7-1.

Table 7-1 Summary of *ROADent* Modelling Inputs

Input Parameter	Data Source
Road Design	Existing and proposed alignment supplied by the RTA.
Topographical Data	Contours at 10m intervals supplied by the RTA.
Traffic Volumes & Mix	Supplied by Parsons Brinckerhoff.
Vehicle Speeds	For existing roads, posted speed limit (i.e 110kph, 100kph, 70kph, 50kph and 100kph) For proposal, 110kph on bypass, 80kph on ramps except for the southbound on-ramp section at the south interchange where the assumed speed is 90kph. 50kph on the Hume Highway section passing through town, Holbrook Wagga Wagga and Holbrook Culcairn Roads.
Receiver Locations	Based on surveys (aerial photos & ground verification) undertaken by Wilkinson Murray Pty Ltd.
Height of Receivers	Residential receivers are generally single-storey houses and a height of 1.5m above floor was assumed.
Road Surface	Existing roads: chipseal (CoRTN correction 1.5-2.5dB depending on percentage of heavy vehicle and speed). New Roads: Hessian-dragged transverse tyned concrete (CoRTN correction 2-3dB

Input Parameter	Data Source
	depending on percentage of heavy vehicle and speed).

7.2 Meteorological Effects

The Director General's requirements state that local meteorological conditions should be assessed for their impact on noise transmission from the bypass.

The *ENMM* discusses assessment of traffic noise under changing meteorological conditions. It has been suggested that the *NSW Industrial Noise Policy (INP)* of the DECCW be used to undertake the qualitative assessment of meteorological effects.

The *INP* discusses the effect of temperature inversions and wind. Both temperature inversions and wind can enhance noise propagation from a source to receiver. The *INP* discusses procedures for this assessment. For the best confidence in the assessment it is required to have meteorological data for the area under consideration. In this case, we have been unable to find meteorological data for Holbrook. In such cases, the default conditions of the *INP* can be applied. The default conditions are temperature inversions of 3° per 100 metres in combination with a drainage wind of 2 metres per second from source to receiver where the receiver is below the noise source. In this case, the receivers are typically at the same height as the bypass or higher, hence the drainage wind has not been considered.

The prediction of traffic noise under different meteorological conditions is not well understood. The *CoRTN* algorithms used for prediction in this study do not include any methodology for different meteorological conditions. The following procedure was used to estimate the effect of these conditions:

- Noise propagation from the bypass was predicted using the Environmental Noise Model (ENM) from RTA Technology.
- A line source (to simulate the flow of traffic) representing the bypass was used and noise was predicted at all receivers under various meteorological conditions. We then calculated the noise at any receiver from the bypass under isothermal still conditions and under a temperature inversion of 3° per 100 metres. The difference in these two levels is typically 1 to 4dBA, depending on the location of the receiver with respect to the highway. This difference was then added to the predicted traffic noise level calculated from the *CoRTN* algorithms. In this way, the traffic noise level under various meteorological conditions was estimated.

The analysis shows that the temperature inversion increases noise levels by up to 3dBA at any receiver. This increase in noise level exists only for the time of the temperature inversion.

The *INP* suggests that temperature inversions most likely occur for the hour immediately before and after sunrise. So while there may be a significant increase in noise level during those periods, the effect over the entire 9 hour period of night time is an increase in $L_{Aeq, 9 \text{ hour}}$ by only 1dBA at most receivers.

With respect to wind, there would be an increase in noise level up to 3dBA if there were a continuous low velocity wind blowing toward a receiver.

7.3 Modelling scenarios

The three scenarios modelled are summarised in Table 7-2.

Table 7-2 Modelling scenarios

Scenario	Road Alignment	Traffic Environment	Purpose
Model Validation	Existing Hume Highway alignment	Based on 2008 traffic counts	Test integrity of noise model by comparing predicted levels with measured levels from noise loggers
Prior to Opening	Existing Hume Highway alignment	Predicted 2012 traffic volumes (immediately prior to anticipated opening of Proposal)	Assist in mitigation design process
Design	Proposed bypass, existing Hume Highway alignment going through town and other nearby roads	Predicted 2022 traffic volumes (10 years after anticipated opening)	Assess traffic noise associated with Proposal

7.4 Traffic Volumes for Assessment

The model validation scenario (2008) was based on the traffic counts (Section 7) representing the existing traffic conditions. As well as the AADT numbers shown in the following tables, the data was analysed by vehicle type to provide hourly flows throughout the day. Tables provided in the traffic report for 2012 and 2022 allowed analysis by each hour to determine 15hour and 9hour traffic flows, as well as percentage of heavy vehicles in each period.

Predicted traffic volumes and Ausroads vehicle classification were provided by Parsons Brinkerhoff during preparation of the traffic report for the Project, since issued as the draft *SH2 Hume Highway Holbrook Bypass Traffic Study, August 2009*. Appendix D of that document allowed traffic data to be derived for the following scenarios:

- 2012 'Do nothing' scenario (Table 7-3)
- 2022 'Design' scenario with Bypass (Table 7-4)

Predicted 2022 flows on ramps are shown in Table 8-5. In addition, predicted 2022 flows for the existing Hume Highway going through town and other existing roads are shown in Table 7-6.

A diagram showing the locations of each Hume Highway and Bypass section is included in Appendix C.

The traffic report discusses two scenarios for traffic flow: a "high diversion" scenario and a "low diversion" scenario. This noise study is based on the "high diversion" scenario, giving highest noise predictions from the bypass, and most conservative estimates of noise mitigation requirements.

Table 7-3 Predicted 2012 Traffic Flows - Do-Nothing Scenario

Road	Direction	Day (7.00am-10.00pm)			Night (10.00pm-7.00am)			24-hr Total (2-way)
		Light	Heavy	% HV	Light	Heavy	% HV	
Hume Highway - Sections A, B & C	NB	1,476	803	35%	208	497	70%	5,932
	SB	1,459	794	35%	192	503	72%	
Hume Highway - Section D	NB	1,626	842	34%	229	521	69%	6,398
	SB	1,608	833	34%	212	527	71%	
Hume Highway - Section E	NB	2,147	877	29%	303	543	64%	7,687
	SB	2,122	867	29%	279	549	66%	
Hume Highway - Sections F, G, H & I	NB	1,582	781	33%	223	483	68%	6,101
	SB	1,564	773	33%	206	489	70%	
Holbrook Culcairn Road	Both directions	1,347	116	8%	184	182	50%	1,829
Holbrook Wagga Wagga Road	Both directions	500	115	19%	68	179	72%	862

Table 7-4 Predicted 2022 Traffic Flows –Design Scenario (Bypass)

Bypass Section	Direction	Day			Night			24-hr Total (2-way)
		(7.00am-10.00pm)			(10.00pm-7.00am)			
		Light	Heavy	% HV	Light	Heavy	% HV	
Section N	NB	2,218	1,002	31%	313	618	66%	8,489
	SB	1,979	1,281	39%	260	819	76%	
Section O	NB	1,204	632	34%	170	390	70%	4,932
	SB	1,075	808	43%	141	512	78%	
Sections P & Q	NB	1,286	641	33%	181	395	69%	5,141
	SB	1148	819	42%	151	519	78%	

Table 7-5 Predicted 2022 Traffic Flows – Design Scenario (Ramps)

Ramp	Day			Night			24-hr Total
	(7.00am-10.00pm)			(10.00pm-7.00am)			
	Light	Heavy	% HV	Light	Heavy	% HV	
South Interchange – NB off-ramp	88	15	15%	56	40	42%	199
South Interchange – NB on-ramp	3	1	25%	0	0	n/a	4
South Interchange – SB off-ramp	3	1	25%	0	0	n/a	4
South Interchange – SB on-ramp	82	17	17%	59	44	43%	202
Holbrook Wagga Wagga Road Interchange – NB off-ramp	6	1	14%	3	2	40%	12
Holbrook Wagga Wagga Road Interchange – NB on-ramp	79	16	17%	56	42	43%	193
Holbrook Wagga Wagga Road Interchange – SB off-ramp	84	20	19%	66	51	44%	221
Holbrook Wagga Wagga Road Interchange – SB on-ramp	3	0	0%	1	0	0%	4

Table 7-6 Predicted 2022 Traffic Flows – Existing Hume Highway going through Town and other Nearby Roads

Road	Direction	Day (7.00am-10.00pm)			Night (10.00pm-7.00am)			24-hr Total (2-way)
		Light	Heavy	% HV	Light	Heavy	% HV	
Hume Highway - Section A	NB	2,218	1,002	31%	313	618	66%	8,483
	SB	1,979	1,281	39%	260	812	76%	
Hume Highway – Section B & C ¹	NB	-	-	-	-	-	-	-
	SB	-	-	-	-	-	-	-
Hume Highway - Section D	NB	1,080	365	25%	152	225	60%	3,673
	SB	963	466	33%	126	296	70%	
Hume Highway - Section E	NB	1,689	395	19%	238	244	51%	5,097
	SB	1,508	505	25%	198	320	62%	
Hume Highway - Sections F & G	NB	1,090	334	23%	154	206	57%	3,583
	SB	973	427	31%	128	271	68%	
Hume Highway - Section I	NB	2,377	975	29%	335	601	64%	8,723
	SB	2,121	1,246	37%	278	790	74%	
Holbrook Culcairn Road	Both directions	122	10	8%	51	25	33%	208
Holbrook Wagga Wagga Road – Section J	Both directions	171	35	17%	123	92	43%	421
Holbrook Wagga Wagga Road – Section K	Both directions	106	22	17%	76	57	43%	261
Holbrook Wagga Wagga Road – Section L	Both directions	51	10	16%	34	25	42%	120

Note 1: Traffic on the cul-de-sac section will be insignificant.

8 TRAFFIC NOISE MODEL VALIDATION

8.1 Method and Assumptions

Simultaneous traffic count and noise monitoring allowed validation of the model used in the noise study for the bypass.

Noise levels were predicted using the procedure outlined in Section 7.

While the RTA's *Environmental Noise Management Manual (ENMM)* requires reporting of noise levels in whole numbers, the predicted and measured levels have not been rounded in the tables. Since we are most interested in the "difference" column, pre-rounding of the results would distort the comparison.

8.2 Traffic Count

Traffic noise is described in two time periods: daytime (0700 to 2200) and night time (2200 to 0700).

As the intention of monitoring traffic noise was partly to validate the noise model, simultaneous traffic counts were conducted at two locations in Holbrook during the second week of the monitoring. The traffic count data was used to predict noise over the monitoring period. The average count over the monitoring period is given in Table 8-1. The raw data from the count was provided to Parsons Brinckerhoff and has been included in the traffic report for the project.

Table 8-1 Average of all Monitored Days

Location	15hr Daytime (7.00am to 10.00pm)				9hr Night Time (10.00pm to 7.00am)			
	Northbound (vehicles per hr)		Southbound (vehicles per hr)		Northbound (vehicles per hr)		Southbound (vehicles per hr)	
	Total		Total		Total		Total	
	vehicles	% heavy	vehicles	% heavy	vehicles	% heavy	vehicles	% heavy
	(light + heavy)	vehicles	(light + heavy)	vehicles	(light + heavy)	vehicles	(light + heavy)	vehicles
South of Young Street	149	32	144	31	82	67	81	65
North of Young Street	154	34	141	36	87	62	72	82

8.3 Results

The results of traffic noise measurement and prediction for the monitoring period for which traffic count and noise measurement coincide are given in Table 8-2. Note that measured levels are usually rounded to integer levels. They are shown to one decimal place here to minimise rounding effects.

Table 8-2 Results for Whole Monitoring Period

Location	Measured and Predicted Traffic Noise Levels					
	Daytime $L_{Aeq,15hr}$			Night time $L_{Aeq,9hr}$		
	Measured	Calculate	Difference	Measured	Calculate	Difference
A. Sydney Road	62.0	61.7	0.3	63.6	61.2	2.4
B. 19 Nyhan Street	51.4	49.6	1.8	48.8	49.7	-0.9
D. Montpellier	56.9	58.1	-1.2	58.5	57.7	0.8

8.4 Discussion

At Locations A, B and D the predicted noise levels are within 2dBA of the measured noise levels except for the night time noise at Location A, indicating that the noise model generally gives valid noise predictions.

At Location A during night time hours the measured level was 2.4dBA higher than the predicted level. This may be due to increased speed of trucks during night time hours.

9 ASSESSMENT OF 2022 PREDICTED NOISE LEVELS & REVIEW OF NOISE MITIGATION MEASURES AT RESIDENTIAL RECEIVERS

9.1 Overview

The proposed bypass is approximately 9.5km long and passes west of Holbrook and the existing Hume Highway. The area is generally flat and most of the bypass will be on raised embankment across the Ten Mile Creek floodplain. There will be a bridge across Ten Mile Creek.

Access to the bypass will be provided both north and south of the village via two new interchanges.

The northern interchange is at the Wagga Wagga Road overpass near NCA2 (Wagga Wagga Road will pass over the bypass). The elevation of Wagga Wagga Road will have little impact on traffic noise as it carries much less traffic than the bypass.

The southern interchange will be near NCA 8. The ramps at this interchange affect the design of noise mitigation for NCA 8 as the design of noise barriers needs to suit the ramps.

There is only one area of significant cut at the north of the project. NCAs 2, 3 and 4 potentially receive some acoustic shielding from this cut, but the reduction in noise is minimal.

9.2 Assessment Methodology

Noise level predictions for year 2012 and year 2022 have been calculated at all potentially affected residential locations. Detail of existing and future night time noise levels at individual receivers is shown in Appendices D.

It is important to note that receivers located between the existing Hume Highway alignment and the proposed bypass (NCAs 4, 6, 7 and 8) will potentially be affected by traffic noise coming from both the eastern and western sides. For those receivers, it is necessary to assess noise impact on both eastern and western facades separately.

Shielding from nearby residential structures was also accounted for in the noise model. This is particularly relevant within Holbrook.

Receivers located beyond 2kms from any modelled road were excluded from the assessment.

Based on the outputs for each model, exceedances of *ECRTN* criteria at receivers were highest at night and accordingly, mitigation measures designed to meet relevant criteria at night would also meet them during daytime. For this reason, when considering management of noise impacts at receivers in the discussion below, only night-time noise levels are considered.

9.3 Feasible and Reasonable Noise Mitigation Measures

Where the 'base' criteria in Table 5-1 are already exceeded, Practice Note (iv) of the *ENMMM* provides further discussion of situations where provision of additional controls would be considered 'feasible and reasonable'. It should be acknowledged that these considerations apply only if it can be demonstrated that all 'feasible and reasonable' traffic management and other road design opportunities for reducing traffic noise have been exhausted.

For 'new freeways or arterial roads' it is generally not considered reasonable to take action to

reduce noise levels to the base noise levels if the noise levels with the proposal, ten years after project opening, are predicted to be:

- Within 2dBA of 'future existing' noise levels; and
- No more than 2dBA above the base noise levels set out in the Table 5-1.

For road 'redevelopments' where existing noise levels already exceed the base noise levels, it is generally not considered reasonable to apply additional treatments (after opportunities for noise control have been incorporated into the road design) if predicted design year noise levels:

- Do not exceed the *ECRTN* allowance of 2dBA over 'future existing' noise levels, and
- Will not be 'acute' (i.e. do not exceed 65dBA $L_{Aeq,15h}$ and 60dBA $L_{Aeq,9h}$).

The ENMM (technical note ix) indicates that if the existing noise level is below the criterion but within 2dB of the criterion, then the 2dB allowance may also be applied. Hence, the exclusion above is also taken to apply to cases where an existing noise level below the 'base' criterion is predicted to increase by 2dBA or less.

9.4 Operational Noise Impacts

A total of 591 receivers in 10 catchment areas have been identified and noise levels predicted at each location 10 years after the adopted opening date for the proposed highway upgrade in accordance with guidelines set out in the *Environmental Noise Management Manual (ENMM)*.

Detailed noise predictions at individual receivers are given in Appendix D. Where exceedance of the criteria is noted in this section, this refers to the guidelines of the ENMM with regard to consideration of reasonable and feasible mitigation. The base criteria of the ENCM are listed in Appendix D.

9.4.1 Noise Impact at NCA 1

This NCA is adjacent to the bypass on the western side. It consists of seven isolated receivers. Exceedances of the noise criterion are predicted at five receivers. The exceedances are at Receiver 3 (1dBA), Receiver 4 (10dBA), Receiver 5 (12dBA), Receiver 6 (6dBA) and Receiver 7 (5dBA). Receiver 1 is considered against the road redevelopment criteria.

9.4.2 Noise Impact at NCA 2

This NCA is adjacent to the bypass on the western side. It consists of four isolated receivers.

Exceedances of the noise criterion are predicted at three receivers. The exceedances are at Receiver 9 (8dBA), Receiver 10 (8dBA) and Receiver 11 (12dBA).

9.4.3 Noise Impact at NCA 3

This NCA is east of the existing Hume Highway north of Holbrook.

There are 13 isolated residences in the NCA. No exceedance of the noise criterion is predicted at these residences due to their distance from the project.

These receivers currently experience noise from the existing Hume Highway. As traffic will be

reduced on the Hume Highway the noise levels are predicted to be reduced after opening of the project.

9.4.4 Noise Impact at NCA 4

This NCA is west of the existing Hume Highway north of Holbrook. There are 2 isolated residences in the NCA. No exceedance of the noise criterion is predicted at western or eastern facades these residences.

These receivers currently experience noise from the existing Hume Highway on their eastern facades. As traffic will be reduced on the Hume Highway the noise levels are predicted to be reduced after opening of the project.

9.4.5 Noise Impact at NCA 5

This NCA comprises the Holbrook residences east of the existing Hume Highway. Noise was assessed at 280 residential receivers in this NCA.

While traffic noise will decrease due to the reduction of traffic on the Hume Highway, acute noise levels are predicted at 13 receivers close to the highway. The noise contribution from the bypass is insignificant at these receivers.

9.4.6 Noise Impact at NCA 6

This NCA comprises Holbrook residences west of the existing Hume Highway north of Young Street. They are between the Hume Highway and the bypass, so noise was assessed at both eastern and western facades of these houses. These residences are located less than approximately 400m from the Hume Highway, but more than 500m from the bypass. Noise was assessed at 178 residential receivers in this NCA.

While traffic noise will decrease due to the reduction of traffic on the Hume Highway, acute noise levels are predicted at 16 receivers close to the highway. Three exceedances are predicted at the western facade (Receivers 42, 43 and 99).

9.4.7 Noise Impact at NCA 7

This NCA comprises Holbrook residences west of the existing Hume Highway north of Young Street. They are between the Hume Highway and the bypass, so noise was assessed at both eastern and western facades of these houses. NCA 7 is more significantly impacted from the bypass than is NCA 6.

Noise was assessed at 178 residential receivers in this NCA.

Noise from the bypass is predicted to exceed the noise criterion at 40 residences in this NCA. The exceedances range from 1dBA to 9dBA.

9.4.8 Noise Impact at NCA 8

This NCA comprises Holbrook residences west of the existing Hume Highway and south of Young Street. They are between the Hume Highway and the bypass, so noise was assessed at both eastern and western facades of these houses. NCA 8 includes the caravan park at the south of Holbrook. The caravan park was considered as residential for this assessment. Noise

was assessed at 27 residential receivers in this NCA.

Noise from the bypass is predicted to exceed the noise criterion at 9 residences in this NCA. The exceedances range from 5dBA to 8dBA.

9.4.9 Noise Impact at NCA 9

This NCA comprises isolated residences east of Holbrook. They are at least 900m from both the Hume Highway and the bypass. Noise was assessed at 12 receivers in this NCA. No exceedances are predicted at this NCA.

9.4.10 Noise Impact at NCA 10

This NCA comprises two isolated residences southeast of Holbrook. They are at least 470m from both the Hume Highway and the bypass. Both receivers comply with the criteria for road redevelopments.

9.4.11 Summary of Predicted Exceedances

In NCAs 7 and 8 there are groups of closely spaced residences where noise from the bypass is predicted to exceed the noise criterion.

In NCAs outside Holbrook the exceedances are at isolated residences.

In Holbrook, except in NCA 7 and 8, exceedances are due to proximity of residences to the existing Hume Highway. Even when some traffic is removed onto the bypass there are still exceedances at residences close to the existing Hume Highway.

Table 9-1 gives a summary of the number of residences exceeding the night time noise criterion in each NCA, as well as those with acute noise levels. More details and numbers of residences are given in Table 9-2.

Table 9-1 Operational Noise Impacts 2022

NCA	Type of Residences	Receivers where mitigation considered	Receiver Exposed to Acute Levels
1	Isolated	5	2
2	Isolated	3	1
3	Isolated	0	0
4	Isolated	0	0
5	Village	0	13
6	Village	3	16
7	Village	40	0
8	Isolated	9	3
9	Isolated	0	0
10	Isolated	0	0

Table 9-2 Details of Exceedances in Each NCA

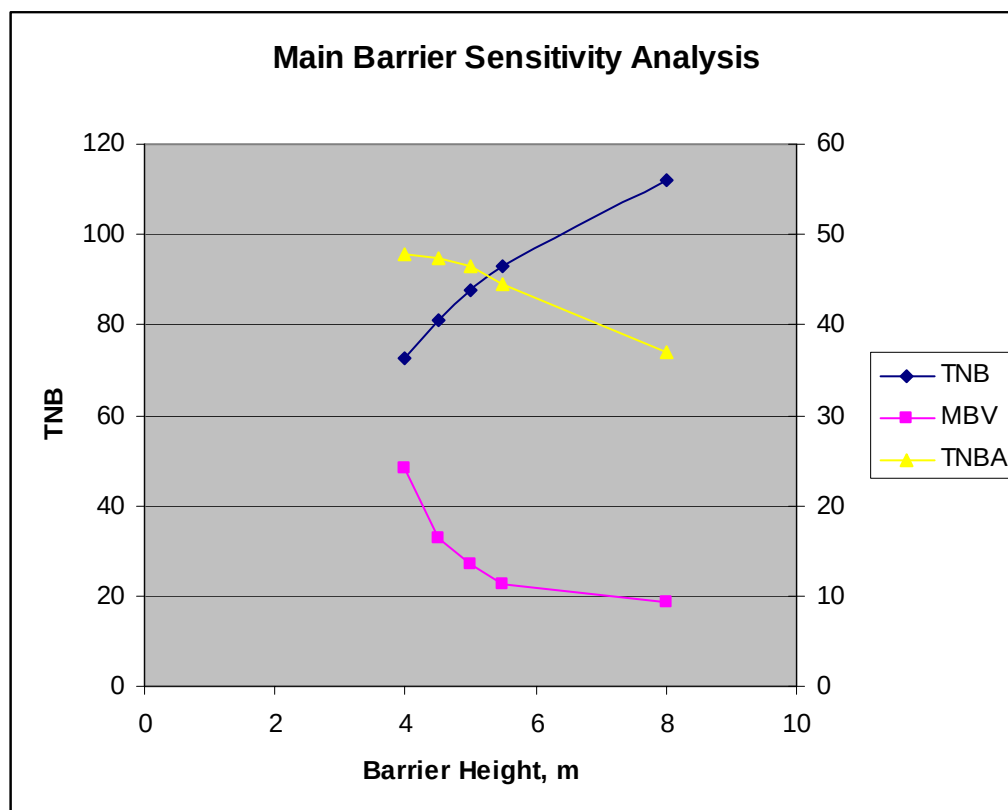
NCA	Impact	Receivers considered for mitigation	Number of receivers exposed to acute levels (receiver numbers)
1	Five receivers would require consideration of mitigation.	5 (3, 4, 5, 6, 7)	2 (4, 5)
2	Three receivers would require consideration of mitigation, one of which with acute noise levels.	3 (9, 10, 11)	1 (11)
3	Noise levels in this catchment are found to decrease and are not predicted to be acute.	0	0
4	No receivers would require consideration of mitigation as noise levels are within the allowance criteria and do not generate acute levels.	0	0
5	Noise levels in this catchment are found to decrease, however 13 receivers would be exposed to acute noise levels from the existing highway.	0	13 (411, 419, 420, 451, 452, 453, 458, 459, 460, 461, 462, 463 & 464)
6	Three receivers would require consideration of mitigation due to noise from the proposed bypass on their western façade. At the eastern façade, noise levels in this catchment are found generally to decrease, however 16 receivers would be exposed to acute noise levels from the existing highway.	3 (42, 43, 99)	16 (95, 96, 138, 139, 140, 141, 194, 195, 197, 198, 199, 200, 201, 202, 203 & 204)
7	Forty receivers would require consideration of mitigation due to noise from the proposed bypass on their western façade. Noise levels exceed the criteria at the eastern façade at two receivers,	Western façade 40(12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 44, 45, 46, 47, 100, 146, 285, 286, 287, 288) Eastern façade 2 (15,16)	0
8	Nine receivers would require consideration of mitigation due to noise from the proposed bypass on their western façades. Three receivers would be exposed to acute noise levels from the existing highway.	9 (51, 52, 53, 54, 55, 56, 57, 59, 61)	Eastern facade 2 (73, 75) Western facade 1 (64)
9	Noise levels in this catchment are found to decrease and are not predicted to be acute.	0	0
10	No receivers would require consideration of mitigation as noise levels are within the allowance criteria and do not generate acute levels.	0	0

9.5 Operational Noise Mitigation Options

For all locations where noise mitigation would be required, guidance is taken from the RTA's *Environmental Noise Management Manual (ENMM)*, which was published to assist in interpretation of the Environmental Criteria for Road Traffic Noise and in particular, provides guidance on the selection of appropriate mitigation measures. The document states that community views should be fully taken into account in following the processes for evaluating and selecting noise treatments.

The Practice Note iv of the ENMM discusses the selection of “feasible and reasonable” mitigation options in accordance with that Practice Note. The barrier sensitivity analysis described in Practice Note iv(a) was considered. Figure 9-1 shows one analysis for the long barrier adjacent to NCA 7. The “target barrier”, the barrier option which resulted in the target noise levels being met at the most affected residences, was 5.5m.

Figure 9-1 Barrier Sensitivity Analysis, Main Bypass Barrier



Barriers from 3 to 8m in height, in 0.5m increments, were analysed. The analysis of indicated that noise barriers up to 5.5m in height would be necessary to mitigate noise. The RTA instructed that low noise pavement be considered as part of the noise mitigation strategy.

Noise barriers and low noise pavements are considered “at road” noise mitigations. For small groups of receivers, say less than three residences, at road noise mitigations are unlikely to be considered reasonable and feasible. If mitigation is required at isolated residences of small groups of residences, architectural treatment of residences might be considered. This could include provision of ventilation or air conditioning, or upgrading the glazing and doors of the

building. Appropriate architectural treatment is considered for each building individually. The level of noise mitigation achievable from these options is shown in Table 9-3.

Table 9-3 Noise Mitigation Options

Mitigation	Reduction of Traffic Noise Achievable	Comments
Noise Barriers	5-15dBA	According to the <i>ENMM</i> mitigations higher than 15dBA are difficult to achieve. A barrier that achieves less than 5dBA might not be considered reasonable and feasible.
Low Noise Pavement	2-6 dBA reduction over standard concrete pavement	Reduction depends on speed, traffic mix and type of pavement.
Architectural Treatment	More than 10dBA reduction indoors, depending on treatment. No reduction outdoors	Considered on a case by case basis. Houses with small exceedance of noise goals would typically only require provision of ventilation to allow windows to be kept closed.

In NCA 1, NCA 2 and NCA 8 isolated receivers where noise exceeds the criterion would be considered for architectural treatment.

In NCA 7 and NCA 8 there are significant numbers of houses grouped in a way that make consideration of at-road noise mitigations reasonable.

Indicative “at road” mitigation treatments are provided in Sections 9.5.1 and 9.5.2. The final treatment would be subject to detailed design.

9.5.1 Noise Mitigation Design for Bypass Noise at NCA 7

The bypass is found to generate exceedances at a considerable number of receivers in NCA 7. Three road mitigation options have been investigated and have shown to reduce noise levels to reach compliance at all NCA 7 receivers. Those options which use low noise pavement and noise barriers are as follows:

- Southbound barrier at a height of 5.5m and length of 1700m along the bypass between southbound chainages 114440-116140 as shown in Figure 9-2.
- Open graded asphalt (or low noise) pavement on both carriageways and on a 1700m long bypass section between southbound chainages 114440-116140 as shown in Figure 9-3.
- Combination of a southbound barrier at a height of 3.5m and length of 1700m along the bypass between southbound chainages 114440-116140 and open graded asphalt pavement on both carriageways along a 660m long road section between southbound chainages 114980-115640 as shown in Figure 9-4.

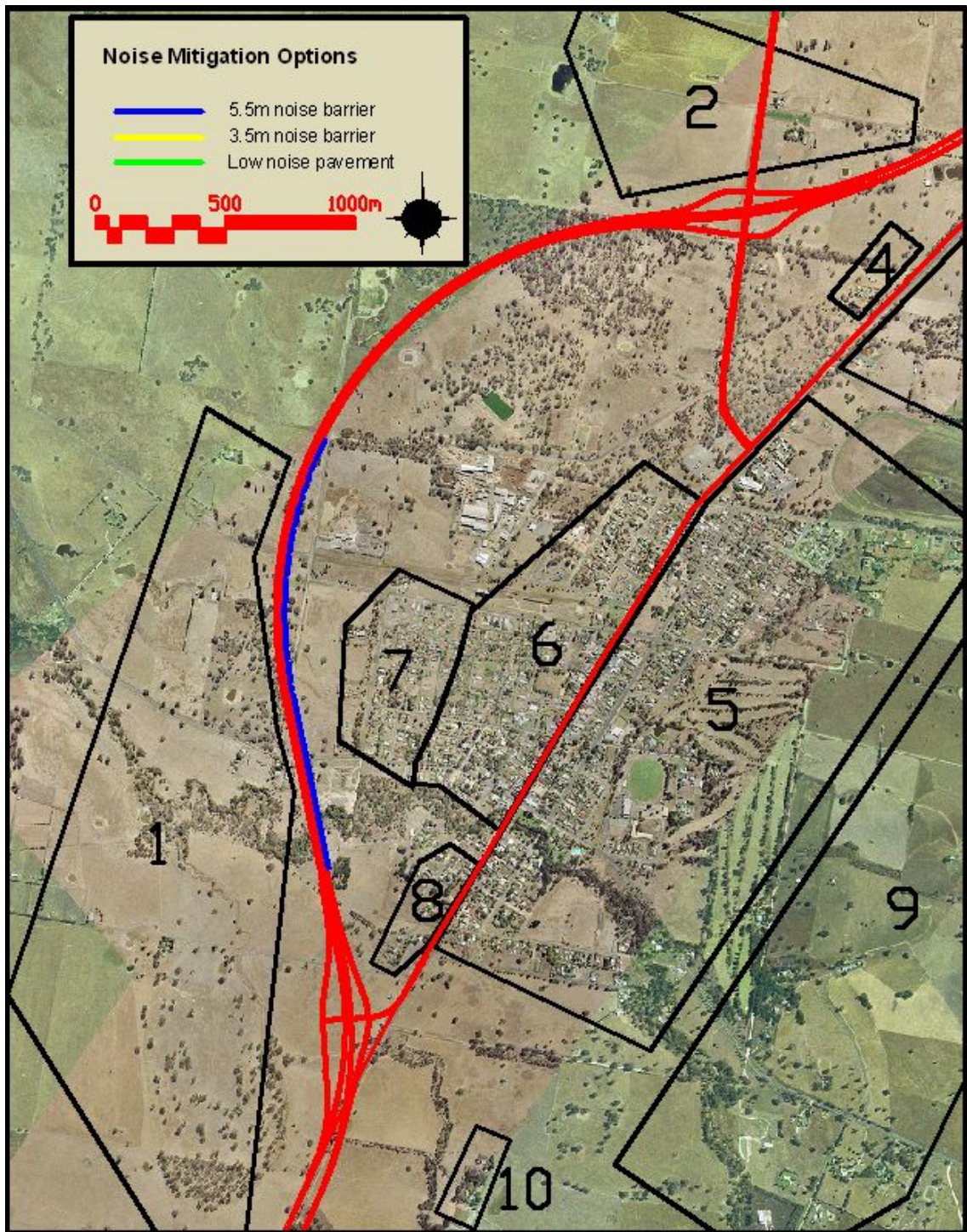
Figure 9-2 5.5m High Barrier (1700m Long)

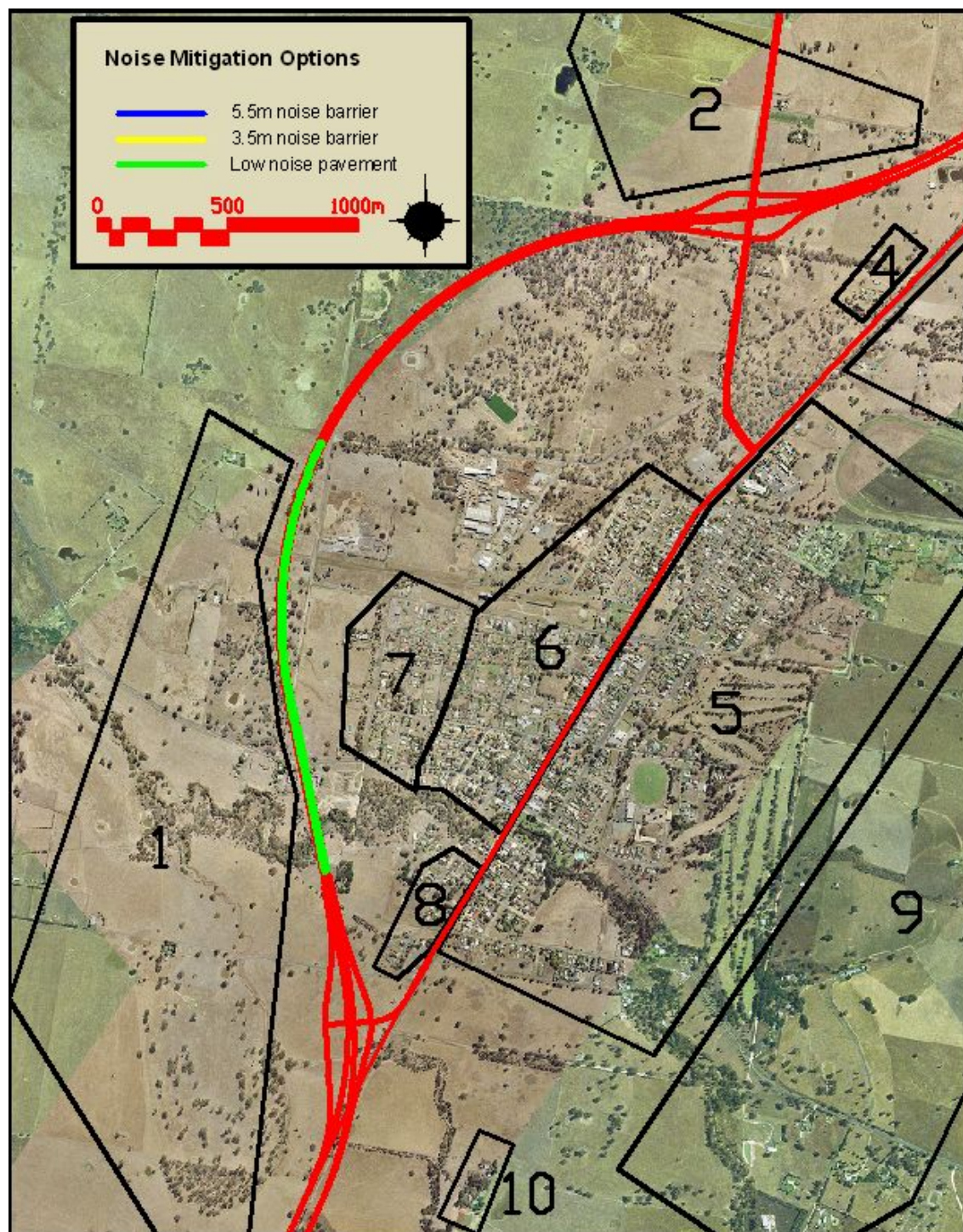
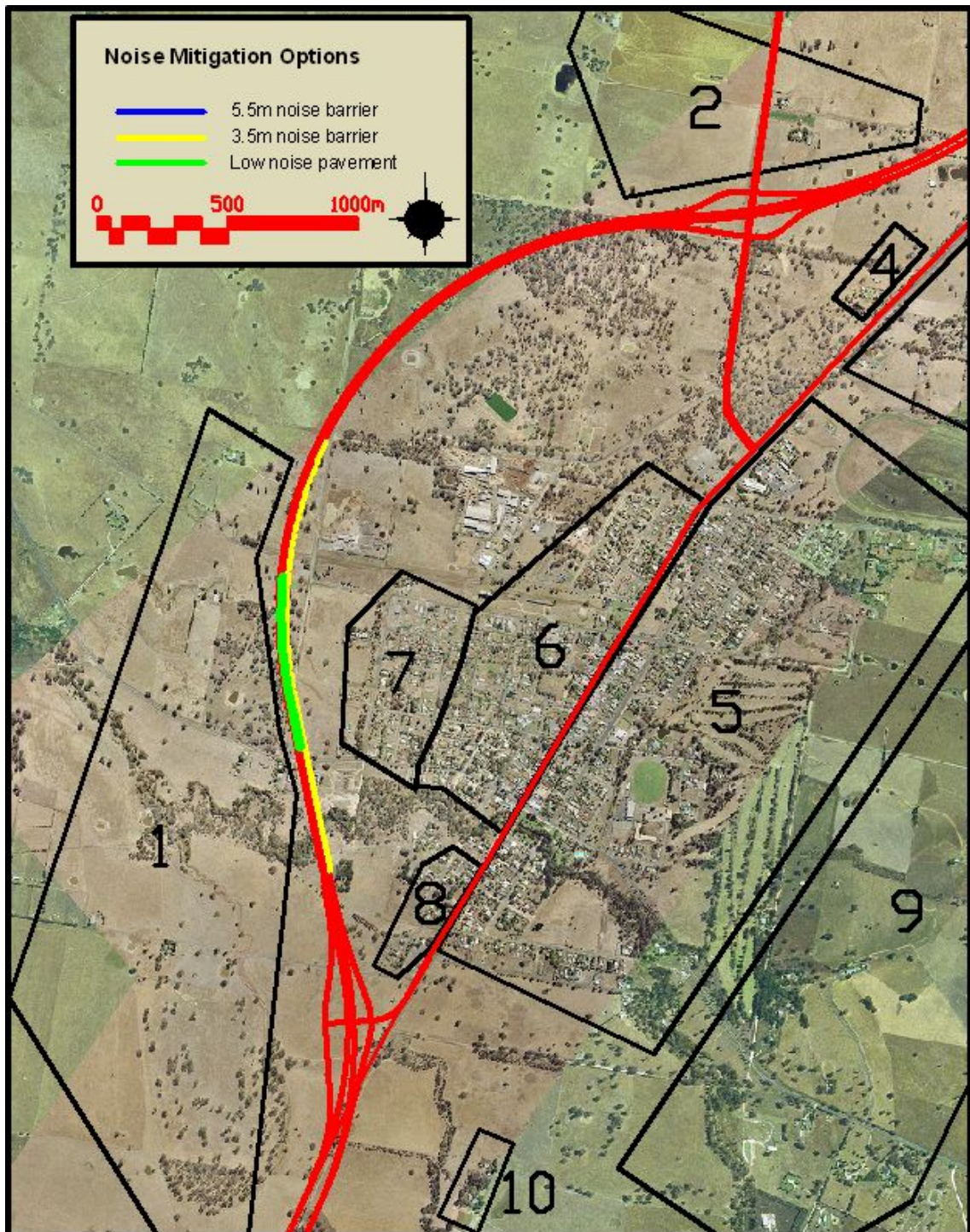
Figure 9-3 Low Noise Pavement (1700m Long)

Figure 9-4 3.5m High Barrier (1700m Long) with Low Noise Pavement (660m)



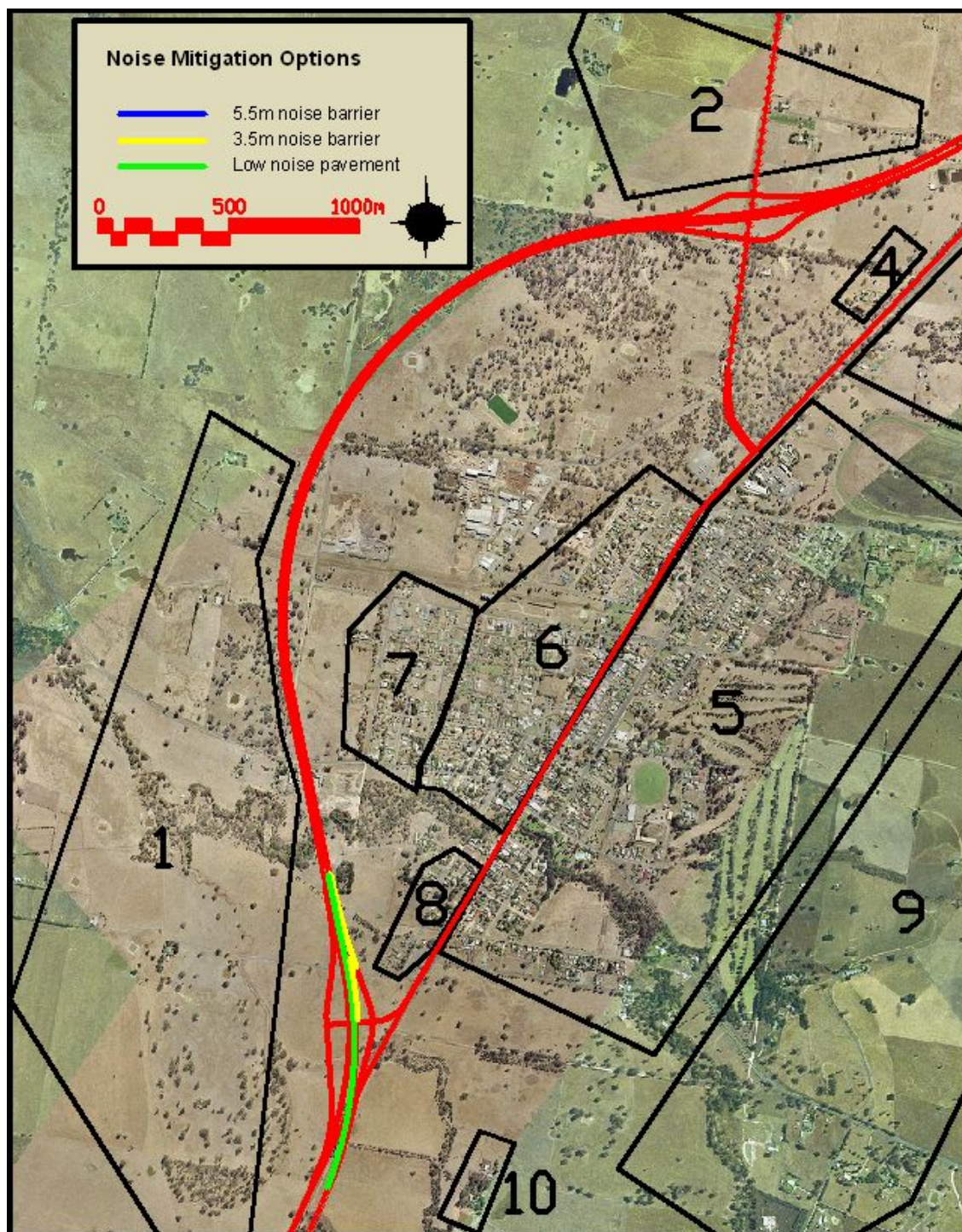
9.5.2 Noise Mitigation Design for Bypass Noise at NCA 8

A small cluster of 5 structures located in a caravan park in NCA 8 would also require noise mitigation. Those receivers are located near the southbound off-ramp which goes up an embankment above the main carriageway road level. Preliminary results have shown noise barriers in that section of the bypass would provide very little noise reduction since the ramp deviates from the main alignment.

It was found that in order to reach compliance, a combination of a 3.5m high split ramp barrier (running the entire ramp length, partly on the outside of the ramp and partly between the ramp and the main carriageways) and low noise pavement extending between southbound chainages 116140-117380 (1240m) would be necessary to reduce levels to compliance. These are shown on Figure 9-5.

It is important to consider that noise mitigation design at NCA 8 already assumes the use of low noise pavement near NCA 7 between southbound chainages 114440-116140. In the event the barrier options are opted for at NCA 7 (as opposed to low noise pavement), low noise pavement would need to extend further north.

It should also be noted that beside the 5 structures, the park is used by visitors travelling in caravans. The ENMM does not mention caravan sites, but they will be considered permanent residential locations for this assessment.

Figure 9-5 Noise Barrier for NCA 8

9.5.3 Noise Mitigation Design for Existing Hume Highway Noise

A number of receivers in Holbrook are expected to be exposed to acute noise levels near the existing Hume Highway. These receivers may be considered for mitigation as part of the RTA's Noise Abatement Program.

However, it is important to note that predicted 2022 noise levels will reduce when compared with the future existing (2012) noise levels without the Bypass. This is due to the fact that part of the traffic currently using the existing Hume Highway alignment would be deviated onto the bypass. Such noise reduction will benefit all receivers located within the township where the noise environment is dominated by traffic from the existing Hume Highway alignment.

The existing Hume Highway alignment which will become a service road for Holbrook is located far from any construction works associated with the Project and for this reason, it is considered unreasonable to mitigate those receivers in town.

9.6 Noise Contours

Night time noise contours have been produced for year 2022. Appendix E shows contours without noise mitigation. Appendix F shows contours with noise mitigation applied. The mitigation applied to NCA 7 is as shown in Figure 9-4 .

9.7 Summary of Operational Noise Mitigation Design

Table 9-4 outlines the noise modelling results and indicates the number of receivers that may require architectural treatments to meet *Environmental Criteria for Road Traffic Noise* criteria for each noise catchment area.

Table 9-4 Summary of Predicted 2022 Noise Impacts with Bypass and Noise Mitigation Design

NCA	Impact	Proposed Mitigation	Receiver Exposed to Acute Levels	Architectural Treatments
1	5 receivers would require consideration of mitigations.	Because of the isolated nature of houses, a noise barrier would not be considered appropriate. Architectural treatment is considered at the five receivers.	N/A	3, 4, 5, 6 & 7 (5 receivers)
2	3 receivers would require consideration of mitigations, one of which with acute noise levels.	Because of the isolated nature of the houses, a noise barrier would not be considered appropriate and architectural treatment is considered instead.	11	9, 10 & 11 (3 receivers)
3	Noise levels in this catchment are found to decrease and are not expected to be acute. Accordingly, no noise mitigation is recommended.	None	N/A	N/A
4	The 2 receivers located in this catchment are exposed to considerable noise from the Hume Highway and it is found additional noise from the bypass on the western façade of the houses are within the allowance criteria and do not generate acute levels. Accordingly, no noise mitigation is recommended.	None	N/A	N/A
5	13 receivers would be exposed to acute noise levels. It is important to note that those receivers are already exposed to acute levels and benefit from a noise reduction due to lower traffic volumes travelling on the Hume Highway.	None	411, 419, 420, 451, 452, 453, 458, 459, 460, 461, 462, 463 & 464 (13 receivers)	N/A

NCA	Impact	Proposed Mitigation	Receiver Exposed to Acute Levels	Architectural Treatments
6	16 receivers would be exposed to acute noise levels. Similarly to NCA 5, those receivers are impacted by traffic on the Hume Highway going through town. The receivers will benefit from a noise reduction and are considered too far from any works associated with the Proposal. Three receivers have minor exceedances on the western facades.	Noise at the three receivers with exceedances on the western façade (42, 43 and 99) will be mitigated by barriers proposed for NCA 7.	95, 96, 138, 139, 140, 141, 194, 195, 197, 198, 199, 200, 201, 202, 203 & 204 (16 receivers)	N/A
7	40 receivers would require consideration of mitigation.	The houses are grouped together and for this reason a noise barrier, low noise pavement or a combination of barriers and low noise pavement, would be considered appropriate. With any of the 3 road mitigation options discussed above, all NCA 7 receivers would comply with the base criteria.	N/A	N/A
8	9 caravan park receivers (cabins, not temporary spots) located near where the bypass rejoins the existing Hume Highway alignment would be exposed to exceedances associated with bypass traffic noise impinging on their western façades. As caravan parks are often used as permanent residences, they were considered as residential for this assessment.	With the road mitigation options as discussed for NCA 7, all NCA 8 receivers would comply with the base criteria.	64, 73 & 75 (3 receivers)	N/A
9	Noise levels in this catchment are found to decrease and are not expected to be acute. Accordingly, no noise mitigation is	None	N/A	N/A

NCA	Impact	Proposed Mitigation	Receiver Exposed to Acute Levels	Architectural Treatments
	recommended.			
10	The 2 receivers do not exceed the criteria for road redevelopment	None	N/A	N/A

10 NOISE TO NON-RESIDENTIAL RECEIVERS

Non-residential receivers have been located near the existing Hume Highway alignment and will therefore benefit from reduction in overall noise level due to lower traffic volumes going through town in 2022 when compared with 2012 ('do nothing' scenario). The following discussion presents noise impacts from the combined noise of the existing highway and the bypass.

Predicted noise levels at non-residential receivers are not given in the appendices as the criteria are all related to daytime noise.

10.1 Holbrook Public School

Outdoor levels in 2022 are predicted at up to 63dBA near the Hume Highway which exceeds the $L_{Aeq,15hr}$ 55dBA criterion for playgrounds.

The predicted 2012 $L_{Aeq,15hr}$ noise level at the Holbrook Public School buildings (Receiver 508) is 53-59dBA, reducing to 51-57dBA in 2022. Assuming a conservative 10dBA reduction between outside and inside the buildings (with windows open), the internal noise levels are predicted to range 41-47dBA depending on the location of the school buildings. Therefore, internal levels are expected to comply with the internal $L_{Aeq(1h)}$ 45dBA criterion at the school buildings furthest from the Hume Highway but are likely to exceed the criterion inside the buildings closest to the road. It should be noted that with windows closed, internal noise levels are anticipated to comply inside all school buildings.

10.2 St Patrick's School

Outdoor levels in 2022 are predicted to be up to 63dBA near the Hume Highway which exceeds the $L_{Aeq,15hr}$ 55dBA criterion for playgrounds.

The predicted 2012 $L_{Aeq,1hr}$ combined noise level at St Patrick's School building (Receiver 149) is 58-59dBA (without façade reflection correction) at the school buildings, reducing to 56-57dBA in 2022. Assuming a conservative 10dBA reduction between outside and inside the buildings (with windows open), the internal noise levels are predicted to range between 46-47dBA depending on the location of the school buildings. Therefore, internal levels are expected to exceed the internal $L_{Aeq(1h)}$ 45dBA criterion at all school buildings. With windows closed internal noise levels are anticipated to comply inside all school buildings.

10.3 Our Lady of Sorrows Church

Our Lady of Sorrows Church is Receiver 150. It is adjacent to St Patrick's School. External $L_{Aeq,1hr}$ noise levels are predicted to be 59dBA (without façade reflection correction) in 2022. Assuming a conservative 10dBA reduction between outside and inside the church (with main doors open), the internal noise levels are predicted to be 49dBA. This exceeds the internal $L_{Aeq(1h)}$ 40dBA criterion. This is a conservative calculation and it is likely that internal noise levels with all doors closed would comply with the relevant criterion most of the time.

It is important to note that $L_{Aeq,15hr}$ noise levels are generally lower than $L_{Aeq,1h}$ noise levels anticipated during the busiest hours.

10.4 Holbrook Hospital

Holbrook Hospital is Receiver 606.

External $L_{Aeq,1hr}$ noise levels in 2022 are predicted to range between 43-48dBA at the Hospital (without façade reflection correction). Assuming a conservative 10dBA reduction between outside and inside the hospital building (with windows open), the internal noise levels are predicted to range between 33-38dBA. With windows closed, internal noise levels are predicted to comply with the internal $L_{Aeq(1h)}$ 35dBA criterion inside the hospital.

10.5 Golf Course

The Golf Course is Receiver 605.

Predicted $L_{Aeq,15hr}$ noise levels in 2022 are predicted to range between 44-48dBA on the golf course. This complies with the criterion for active recreation areas.

10.6 Anglican Church in Young Street

The Anglican Church in Young Street is Receiver 255.

External $L_{Aeq,1hr}$ noise levels in 2022 are predicted to be 54dBA (without façade reflection correction). Assuming a conservative 10dBA reduction between outside and inside the church (with main doors open), the internal noise levels are predicted to be 44dBA. This exceeds the internal $L_{Aeq(1h)}$ 40dBA criterion. This is a conservative calculation and it is anticipated internal noise levels with all doors closed would comply with the relevant criterion even during the busiest hours.

10.7 Knox Uniting Church

The Knox Uniting Church is Receiver 607.

External $L_{Aeq,1hr}$ noise levels in 2022 are predicted to be 58dBA (without façade reflection correction). Assuming a conservative 10dBA reduction between outside and inside the church (with main doors open), the internal noise levels are predicted to be 48dBA. This exceeds the internal $L_{Aeq(1h)}$ 40dBA criterion. This is a conservative calculation and it is anticipated internal noise levels with all doors closed would generally comply with the relevant criterion.

10.8 Summary

Table 10-1 gives a summary of the noise assessment at non-residential receivers. Where it is noted that there is a possible exceedance at a building, it means that with windows open there may be an exceedance of the internal noise criterion. This could only be accurately established by inspection of the building and monitoring of noise. If exceedances occur, in most cases noise mitigation could be achieved by provision of suitable ventilation to allow the windows to remain closed.

Table 10-1 Predicted Noise Levels at Non-Residential Receivers

Receiver Number	NCA	Receiver Name	External Noise Levels, $L_{Aeq,1hr}$ dBA			Comments
			Hume Highway 2012	Combined Traffic Noise 2022 (Hume Highway and Bypass)	Criterion	
508	5	Holbrook Public School (buildings)	59	57	45 internal	Possible exceedance with windows open
605	5	Golf Course	50 (15hour)	48 (15 hour)	60 (15 hour external)	Complies
606	5	Hospital	50	48	35 internal	Possible exceedance with windows open
607	5	Knox Church	60	58	40 internal	Possible exceedance with windows open
149	6	St Patrick's School (buildings)	59	57	45 internal	Probable exceedance with windows open
150	6	Our Lady of Sorrows	61	59	40 internal	Possible exceedance with windows open
255	6	Anglican Church	54	54	40 internal	Possible exceedance with windows open

11 MAXIMUM NOISE LEVEL EVENTS

11.1 Guidelines

For road upgrades the *ECRTN* and *ENMM* provide guidance as to the likelihood of sleep disturbance. The *ECRTN* points out the following:

- There are no universally accepted criteria governing the likelihood of sleep disturbance. In other words, at the current level of understanding, it is not possible to establish absolute noise level goals that would correlate to levels of sleep disturbance (for all or even a majority of people).
- The *ECRTN* suggests that :
 - o Maximum internal noise levels below 50dBA to 55dBA are unlikely to cause awakening reactions.
 - o One or two events per night, with maximum internal noise levels of 65dBA to 70dBA, are not likely to affect health and well being significantly.
 - o At locations where road traffic is continuous rather than intermittent, the $L_{Aeq,9hour}$ target noise level should sufficiently account for sleep disturbance impacts.
 - o However, where the emergence of L_{Amax} noise levels over the L_{Aeq} noise level is greater than 15dBA, the $L_{Aeq,9hour}$ criteria may not sufficiently account for sleep disturbance impacts.

Thus, the *ECRTN* recommends that the assessment of sleep disturbance should include a consideration of the maximum noise level exceedances occurring during the night time period and the emergence of these exceedances above the ambient noise level.

The issue of sleep disturbance is addressed within the RTA's *ENMM* in a similar fashion.

- It is suggested that the assessment of sleep disturbance should include an examination of “maximum noise events”: A “maximum noise event” is defined as any single event where the L_{Amax} noise level exceeds 65dBA and the L_{Amax} noise level exceeds the $L_{Aeq,1hour}$ noise level by more than 15dBA.
- “Maximum noise event” characteristics to be assessed at nearest residential receivers include their occurrence throughout the 10.00pm to 7.00am night time period and their magnitudes.

Due to the absence of definitive qualitative correlation between sleep disturbance and noise level, the *ENMM* suggests that the above nominated noise levels and guidelines should not be taken to be criteria, but should be taken into consideration when determining noise mitigation measures to address general road traffic noise.

The quoted noise levels are not intended as specific noise criteria for the purpose of implementing mitigation measures but to highlight the potential for awakening reactions and the consideration of this in the design of noise mitigation, where this is considered to be necessary to reduce overall noise levels.

11.2 Maximum Noise Level Assessment

Table 11-1 shows estimated maximum levels from the existing Hume Highway. As the Hume Highway will continue to be used after the opening of the bypass, the analysis will change only by the number of vehicles using the highway. Heavy vehicles passing along the Hume Highway might still cause awakening events in 2022, but there will be many fewer such events than in 2012. This relative change is shown by the numbers in the last two columns of the table.

Table 11-1 Maximum Noise Level Events – Existing Hume Highway (50kph)

Location	Estimated External L_{Amax} Noise Level (dBA)	Estimated Internal L_{Amax} Noise Level with Window Open (dBA)	No. of Vehicle Movements per hour - 2012	No. of Vehicle Movements per hour - 2022
20m from Highway	67-72	57-62	100-120	40-60
50m from Highway	53-58	43-48	100-120	40-60
100m from Highway	49-54	39-44	100-120	40-60
500m from Highway	38-43	28-33	100-120	40-60

Predicted internal maximum levels at receivers beyond 50m from the road would be below 50dBA to 55dBA and are therefore unlikely to cause awakening reactions according to the *ECRTN*. For houses located closer to the road, awakening reactions may occur with open bedroom windows. However, awakening reactions are not expected with windows closed.

Table 11-2 shows the maximum noise levels for the bypass. In general, the maximum noise levels will be much less in Holbrook, but will increase for the isolated receivers in close proximity to the bypass.

Table 11-2 Maximum Noise Level Events – Bypass 2022 (110kph)

Location	Estimated External L_{Amax} Noise Level (dBA)	Estimated Internal L_{Amax} Noise Level with Window Open (dBA)	No. of Vehicle Movements per hour - 2022
50m from Highway	65-70	55-60	130-220
100m from Highway	62-67	52-57	130-220
200m from Highway	59-64	49-54	130-220

Location	Estimated External LA_{max} Noise Level (dBA)	Estimated Internal LA_{max} Noise Level with Window Open (dBA)	No. of Vehicle Movements per hour - 2022
300m from Highway	56-61	46-51	130-220
500m from Highway	46-51	36-41	130-220

Predicted internal maximum levels at receivers beyond 300m from the bypass would be below 50dBA to 55dBA and are therefore unlikely to cause awakening reactions according to the *ECRTN*. For houses located closer to the road, awakening reactions may occur with open bedroom windows. At the closest receivers (approximately 50m away), awakening reactions may occur even with windows closed.

12 CONSTRUCTION NOISE

12.1 Construction Noise Criteria for Receivers

Guidelines for the assessment of construction noise in New South Wales (NSW) are specified in the *Environmental Noise Control Manual (ENCM)*, Chapter 171 (NSW EPA, 1994).

The construction noise objectives presented in the *ENCM*, Chapter 171 are as follows:

- For periods of four weeks or less, the L_{A10} level should not exceed the background (L_{A90}) level by more than 20dBA;
- For periods greater than four weeks and less than 26 weeks, the L_{A10} level should not exceed the background (L_{A90}) level by more than 10dBA.

Although not clearly stated by the DECCW, it is considered that for construction periods longer than 26 weeks, as is the case with the Holbrook Bypass, the L_{A10} noise level should not exceed the background (L_{A90}) level by more than 5 dBA.

In addition, the DECCW suggests the following time restriction for the construction activities where the noise is audible at residential premises:

- Monday to Friday 7.00am - 6.00pm
- Saturday 8.00am - 1.00pm
- No construction work is to take place on Sundays or Public Holidays.

However, if night time construction is required for the project, it is recommended that the L_{A10} should not exceed the existing night background (L_{A90}) by more than 5dBA.

Additionally, peak noise levels have the potential to cause sleep disturbance. The DECCW's current sleep disturbance criterion is the $L_{A1, 1\text{minute}}$ should not exceed the background L_{A90} by more than 15dBA.

The DECCW also recommends generally that all possible steps should be taken to reduce noise levels of construction site equipment so as to minimise the impact of construction noise.

Blasting criteria are discussed in Section 16 "Blasting Assessment".

12.2 Proposed Working Hours

In accordance with the Environmental Noise Control Manual (ENCM) (EPA 1994), construction works are typically restricted to the hours of:

- Monday to Friday 7.00am - 6.00pm
- Saturday 8.00am - 1.00pm
- No construction work is to take place on Sundays or Public Holidays.

However, it is proposed that the construction hours for this project would be extended to maximise productivity and reduce the overall project delivery timeframe. Construction activities would take place from 6am to 7pm, Monday to Friday and 7am to 4pm Saturday (the daytime period), with no work on Sundays or public holidays.

By utilising available daylight and increasing the productivity of the working day, several positive benefits would be realised. Early completion of the project would deliver the project sooner and provide safer travel to road users in a shorter timeframe. Also, by shortening the total project duration, impacts on residents would be reduced proportionally, whilst resulting in minimal adverse impact on residents.

Also, certain activities would be required to take place during the evening and night periods due to:

- Technical considerations (such as the need to meet particular quality specifications for placement of concrete pavement).
- The climatic environment (cold winters and hot summers).
- An accelerated construction program.

12.2.1 Justification for Working Hours

Early 6.00am Starts

DECCW standard working hours commence at 7.00am. By commencing works for the project at 6am each weekday, an additional hour of work may be achieved for daytime activities.

The extra hour of work in the morning allows for a number of essential pre-start activities such as mechanical pre-start, minor maintenance and refuelling, equipment establishment and setup, and minor preparation works. These activities are generally of a quiet nature but would allow construction activities to commence at maximum efficiency immediately when sufficient daylight is available.

Concrete Paving

The RTA has specifications for placement of concrete pavement that relate to temperature and rainfall. For jointed concrete base, the specifications prohibit the placement of concrete during rain or when the ambient air temperature is below 5°C or above 32°C. As hot weather affects the quality of concrete pavement, in this climate paving in the early evening and into the night is preferred as it takes advantage of night temperatures. For cold weather concreting, early morning paving is recommended, to take advantage of daytime solar radiation and heat generation to promote concrete strength.

It is highly likely that concrete paving would need to be carried out during summer. Due to the climatic conditions experienced in the region during summer months, where day time ambient temperatures often exceed the maximum concrete placement temperature threshold of 32°C, concrete paving would need to occur during the day, evening and night-time periods.

Concrete Saw Cutting

The project would use plain concrete pavement (PCP), which is an un-reinforced pavement. To manage cracking associated with drying shrinkage, saw cutters are used to cut the pavement (usually in 4.2 metre sections). The timing of concrete cutting is governed by the hydration rate of the pavement, and may require cutting at any time within 4 and 24 hours after paving, with a 'cutting window' as short as 30 minutes. As the timing of cutting is critical to the quality of the pavement and acceptance of the finished product, concrete saw cutting may be needed at any time, including outside normal construction hours. Concrete saw cutting is a construction

activity that is transient in nature, and each 'saw cut' would be of a short duration.

As mentioned above, concrete paving is highly likely to be carried out during summer months. Following concrete paving, concrete saw cutting will take place within 4 and 24 hours, during the day, evening and night-time periods.

The project would also have sections of reinforced concrete where low noise pavement is used.

Concrete Batch Plant

Concrete batch plant(s) are proposed as part of the project. In addition to normal daytime operation for concrete products (drainage structures etc), the concrete batch plant(s) would need to operate in conjunction with concrete paving works during the evening and night-time periods.

The concrete batch plant(s) would also supply concrete to a number of other project components (eg pre-cast beams and parapet barriers (see below)), for which concrete may need to be supplied out of normal working hours.

To keep up with materials demand during these peak periods of concrete production, the batch plant would require materials deliveries outside of normal working hours. Due to the regional location of the project, the timing of deliveries may be determined by the pattern of supplier fleet movements (ie at night).

The number of deliveries would be dependent on the size of the batching plant and its storage capabilities; however, there is potential for up to three deliveries per night during peak periods.

The concrete batch plant would be operational for the entire construction period (approximately two years). Within that period, concrete batch plant deliveries may be undertaken during the evening and night-time periods during the following hours:

- 12.00am to 6.00am and 7.00pm to 12.00pm Monday to Friday; and
- At no time on Saturdays, Sundays or Public Holidays.

Concreting Activities Relating to Bridge

The concreting construction works relating to bridge works would potentially fall within the summer months, which are likely to have high ambient daytime temperatures which would need to be avoided. This would require these concreting activities to be carried out during the evening and night-time periods.

12.3 Project Specific Construction Noise Criteria

The construction noise criteria specific to this project are shown in Table 12-1, based on the measured RBLs (Section 6). For the village, the criteria are based on the levels measured in Holbrook (Location 2). The early morning criteria (6.00am to 7.00am) are higher than the daytime criteria due to the increased traffic flow on the Hume Highway in this hour.

For isolated properties, criteria have been based on the lowest levels measured at any property (Location 3).

For this project daytime construction hours are 6.00am to 7.00pm. As the hour from 6.00am to 7.00am is normally considered night time, it has been considered separately and denoted "early morning". The hour from 6.00pm to 7.00pm is normally considered evening, but as the RBLs

for this period were similar to the RBLs for daytime, it was included in the assessed daytime period.

Table 12-1 L_{A10} Construction Noise Criteria

	L _{A10} Construction Noise Criteria (dBA)				Sleep Disturbance L _{A1} , dBA	
	Early	Daytime	Evening	Night	Early	Night
	Morning (6am-7am)	(7am- 7pm) *	(7pm- 10pm)	(10pm- 6am)	Morning (6am-7am)	(10pm- 6am)
Village	44	43	46	37	54	47
Isolated Receivers	45	43	39	38	55	48

* including DECCW Early Evening (6.00pm to 7.00pm)

12.4 Construction Stages

The construction stages proposed by the Hume Highway Woomargama Alliance are shown in Table 12-2.

Table 12-2 Construction Stages

Construction Phase	Activities	Plant and Equipment
Environmental Management System (EMS)	- EMS development - Environmental management plans - Statutory approvals and licensing	-
Early works	- Land acquisition - Relocation of farm dams/fencing - Survey of construction site - Notify residents of commencement of work - Site establishment - Site compounds - Fencing of site boundaries and areas to be used for stockpile sites - Fencing of sensitive environmental and heritage areas - Installation of erosion and sediment control (ERSED) outside identified environmental constraint areas - Establishment of access	- Fences - Sheds - Fuel storage tanks - Graders, rollers and water carts - Excavators - Generators - Concrete batch plants - Water tanks

Construction Phase	Activities	Plant and Equipment
	tracks where required to allow construction of earthworks ▪ Other activities determined by the Environmental Representative to have minimal environmental impact	
Service relocations	▪ Service relocations	▪ Trucks, cranes and excavators ▪ Elevated platform vehicle ▪ Backhoes ▪ Trenchers ▪ Under boring machines ▪ Bulldozers ▪ Small equipment (eg hand tools, compactors)
Site preparation	▪ Clearing and grubbing of vegetation ▪ Mulching ▪ Stripping and stockpiling of topsoil ▪ Establishment of access tracks ▪ Establishment of temporary and permanent crossovers	▪ Fences ▪ Sheds ▪ Fuel storage tanks ▪ Graders, rollers and water carts ▪ Excavators ▪ Generators ▪ Concrete batch plants ▪ Water tanks
Earthworks	▪ Excavation of cuttings ▪ Fill embankments ▪ Rock blasting (if required) ▪ Quarrying ▪ Rock crushing (if required) ▪ Placement of select materials ▪ Batter treatments	▪ Mulching plant and chipper ▪ Chainsaw ▪ Rock breaker ▪ Rock crusher ▪ Excavators ▪ Bulldozers ▪ Trucks ▪ Scrapers ▪ Graders ▪ Water carts ▪ Street sweepers ▪ Compactors ▪ Vibratory rollers ▪ Drilling and blasting equipment for hard rock cuttings ▪ Bitumen sprayers ▪ Rubber-tyred rollers
Bridges and drainage	▪ Bridges ▪ Culvert	▪ Piling rigs ▪ Concrete pumps

Construction Phase	Activities	Plant and Equipment
Interchanges	- Catch drains - Drainage blankets - Permanent water quality control basins	- Cranes - Overhead gantry crane - Excavators - Trucks - Scaffolding - Small equipment (eg hand tools, concrete vibrators, curing equipment)
	On-load/off-load ramps	
Pavement	- Concrete paving (rigid pavements) - Gravel base/sub-base layers and asphalt paving (flexible pavement)	- Trucks - Concrete paver - Profiler - Concrete curing equipment - Concrete saws - Asphalt paver - Concrete pumps - Concrete trucks - Concrete batch plant - Stabiliser - Water carts - Vibratory rollers - Rubber-tyred rollers
Other works	- Property access - Local roads - Tie-ins	- Graders - Backhoes - Excavators - Trucks - Water carts - Vibratory compactors - Bitumen sprayers - Vibratory rollers - Rubber-tyred rollers
Finishing works	- Noise barrier(s) (if required) - Safety barrier(s) - Lighting - Line marking - Signposting - Signage - Landscaping - Site clean up	- Trucks, cranes and excavators - Elevated platform vehicle - Backhoes - Trenchers - Under boring machines - Bulldozers - Small equipment (eg hand tools, compactors)

The construction period for the project is expected to be approximately two years.

12.5 Mobile Plant Source Noise Levels

Sound levels of typical equipment are listed in Table 12-3. The Table gives both Sound Power

Level (SWL) and Sound Pressure Level (SPL) at 7 metres for the equipment. SWL is independent of measurement position. Verification of plant noise is typically done by measuring the SPL at 7 metres.

Table 12-3 Typical Construction Plant Sound Levels

Plant	Sound Power Level (dBA)	Sound Pressure Level at 7m (dBA)
Front End Loader	111	86
Grader	107	82
Smooth Drum Roller	107	82
Spoil, Materials or Concrete Truck	109	84
Tower Crane or Mobile Crane	105	80
Truck-mounted Shotcrete Pump	106	81
Excavator or Bobcat	107	82
Concrete Pump	105	80
Concrete Vibrator	103	78
Concrete Cutter	109	84
Large Bored Drilling Rig	112	87
Small Bored Drilling Rig	108	83
Powered Hand Tools	109	84
30t Excavator operating with hydraulic hammer	122	97
Rock Saw	116	91
Water Cart	110	85
Kerbing Machine	99	74
Chainsaw	106	81
Forklift	106	81
Mulcher	106	81
Articulated Dump Truck	113	88
Handheld Jackhammer	113	88
Air Compressor (Power Tools)	98	73
Asphalt Paving Plant	114	89

Based on the above, noise from some example activities has been predicted. While noise has not been predicted from every activity shown in Table 12-4, the stages are considered representative of the majority of activities.

Table 12-4 Calculation of Total Sound Power Level (SWL)

Activity	Typical Equipment Used	Total LA10,15min Sound Power Level (SWL) used for Calculations
Milling and repaving	Road Trucks, Compactor, multi tyred and vibratory Rollers, Asphalt paving plant, Backhoe, Profiler, Sweeper, Compressors, Generators	113
Site establishment	Excavators, Chainsaws, Mulching plant and Chipper, Cranes, Generators	111
Removal of corridor vegetation	25t Excavator, Mulcher, Chainsaw, Trucks, Grader, Combination Backhoe FEL	111
Earthworks	Road Trucks, Compactor, Grader, Steel, multi tyred and Vibratory Rollers, Concrete pour, including Trucks and Concrete Vibrator, Asphalt paving plant, Backhoe, Sweeper, Compressors, Generators, (Excavator with hammer)	114 (120)
Piling	Bored or driven piling rigs	115 (bored) – 120 (driven)
Bridge works	Piling rigs, cranes	115 – 120 (possible when piling)
Paving	Road Trucks, Compactor, (Jackhammers), Steel, multi tyred and vibratory Rollers, Concrete Pour, including Trucks & Concrete Vibrator, Asphalt paving plant, Backhoe, (Concrete saw), Profiler, Sweeper, Compressors, Generators	113 (116)
Landscaping of exposed areas	Excavator/Bobcat, Powered Hand Tools, Air Compressor, Spoil, Material or Concrete truck, Jackhammer (for concrete embedded parts)	111

Note: The Table shows the typical maximum sound power level predicted for each activity. The figures in brackets are for the occasional use of rock breakers, jackhammers and concrete saws.

12.6 Works Schedule and Proposed Working Hours

Table 12-5 shows the duration of construction activities, and an estimate of how long each activity would potentially cause noise impacts at any group of receivers.

Table 12-5 Predicted Duration of Noise Impact of Construction Activities

Activity	Expected Duration of Impact at any Receiver
Site preparation	2 months
Bulk earthworks	8 months
Cross Drainage	2 months
Bridges	16 months
Paving	11 months

The proposed working hours are between 6am to 7pm Monday to Friday and 7am to 4pm Saturday. Some work may be required in the evening and night-time. Table 12-6 identifies the typical activities that would be done during evening and night-time. The table includes descriptions of necessary night works. As it is proposed to commence work at 6am, the hour from 6.00am to 7.00am would be assessed as night time noise.

Table 12-6 Work Activities and Time

Day	Time	Activity
Monday to Friday	Daytime (6am to 7pm)	▪ Compound operation
		▪ Earthworks
		▪ Structures
		▪ Drainage
		▪ Ancillary/finishing work
		▪ Paving
		▪ Concrete saw cutting
		▪ Concrete batch plant operation
		▪ Maintenance activities
		▪ Blasting activities (would only occur between 9am and 5pm and be limited to two blasts per day)
	Evening (7pm to 10pm)/ Night-time (10pm to 6am)	▪ Compound operation
		▪ Paving
		▪ Concrete saw cutting
		▪ Concrete batch plant deliveries
		▪ Concrete batch plant operation
		▪ Other concreting works that are temperature dependent

Day	Time	Activity
Saturday	Daytime (7am to 4pm)	▪ Compound operation
		▪ Deliveries
		▪ Earthworks
		▪ Structures
		▪ Drainage
		▪ Ancillary/finishing works
		▪ Paving
		▪ Concrete saw cutting
		▪ Concrete batch plant deliveries
		▪ Batch plant operation
		▪ Maintenance activities
Sunday and Public Holiday	No scheduled work	

Construction activities not identified in Table 12-6 would be undertaken during the daytime. Exceptions to this would be limited to:

- Works that do not cause construction noise to be audible at any sensitive receiver; or
- Delivery of materials is required by the Police or other authorities for safety reasons; or
- Work is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or
- A case-by-case or activity specific basis, which would be subject to consultation with the DECCW and affected sensitive receivers.

12.7 Predicted Noise Levels at Receivers

The noise level experienced at any receiver along the route will depend upon many factors, such as distance to the construction site, shielding between the site and the receiver, and the activity occurring at the construction site. There would typically be a 20dBA range of noise levels depending on the construction activity taking place: the quietest activities include site preparation, and the noisiest activity would be earthworks using rock breakers. Further, noise levels would be quieter whenever the construction takes place in cut compared with that undertaken on fill. The construction site is also long – over 9km including the sections of the existing Hume Highway to be duplicated. As activities move along the corridor, noise will change at any receiver.

As the construction site moves, receivers are typically not exposed to line of sight view of paving equipment for an extended period of time (i.e. more than a few days or a week). Noise impact at some receivers is therefore restricted to a limited time period.

Table 12-7 presents a range of predicted construction noise levels to be expected from each activity at various indicative distances. The number of residence in the “distance” column is the number of residences between that distance and the previous distance from the project. For example there are 193 residences within 200m of the project in the Holbrook Village NCAs. The

number for 300m is 133: this means that there are 133 between 200m and 300m from the project, and their noise levels would be in the range between the 200m row and the 300m row.

The table gives a maximum level based on construction at the nearest point to the receiver. The “typical” level in the table is an estimated noise level that would be audible for a significant time. Owing to the length of the project there will be times when construction activities will be inaudible. The analysis is repeated in Table 12-8 for evening, and Table 12-9 for night time activities.

The application of the predicted levels to specific situations is discussed in Section 12.8. Noise levels at the closest residence in any NCA are predicted, and these are given in Table 12-10, Table 12-11 and Table 12-12 for daytime, evening and night time activities respectively. See the contour maps in the appendices for locations of specific residences. The noise levels for structural works and piling were estimated from the approximate locations of structures and piling work, not from the bypass.

Receiver	Dist (closer than)	Number of Receivers	Receivers
Village	200m	193	NCA 7, NCA 8
	300m	133	NCA7, NCA 8
	500m	146	NCA7, NCA 6 (south west corner)
	1km	52	NCA 5, NCA 6
	2km	126	NCA 5, NCA 6
Isolated Receivers	50m	0	-
	100m	3	NCA 1(4,5), NCA 2(10)
	200m	6	NCA 1(1), NCA 2(9), NCA 3(291, 508), NCA 4(256, 257)
	300m	1	NCA 3(292)
	500m	7	NCA 1(6), NCA 2(11), NCA 3(294, 295, 296, 460, 587)
	1km	6	NCA 1(2, 7), NCA 2(8), NCA 3(583), NCA 10 (289, 290)
	2km	11	NCA 9 (448, 584, 586, 588, 589, 594, 596, 597, 598, 599, 600)

Table 12-7 Predicted Construction Noise Levels - Daytime

Receiver	Dist.	No. Recs	Criterion, L _{A10} dBA		Noise Levels, L _{A10} dBA															
			6am- 7am	7am - 7pm	Site Prep.		Earth- works		Earth- works with Rock- hammer		Bridge Structure		Bridge Structure with Piling		Paving & Concreting		Saw Cutting		Land- scaping	
					Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max
Village	200m	193	44	43	48	54	51	57	57	63	52	58	57	63	50	56	53	59	48	54
	300m	133	44	43	43	49	46	52	52	58	47	53	52	58	45	51	48	54	43	49
	500m	146	44	43	38	44	41	47	47	53	42	48	47	53	40	46	43	49	38	44
	1km	52	44	43	27	33	30	36	36	42	31	37	36	42	29	35	32	38	27	33
	2km	126	44	43	16	22	19	25	25	31	20	26	25	31	18	24	21	27	16	22
Isolated Receivers	50m	0	45	43	62	68	65	71	71	77	66	72	71	77	64	70	67	73	62	68
	100m	3	45	43	55	61	58	64	64	70	59	65	64	70	57	63	60	66	55	61
	200m	6	45	43	48	54	51	57	57	63	52	58	57	63	50	56	53	59	48	54
	300m	1	45	43	43	49	46	52	52	58	47	53	52	58	45	51	48	54	43	49
	500m	7	45	43	38	44	41	47	47	53	42	48	47	53	40	46	43	49	38	44
	1km	6	45	43	27	33	30	36	36	42	31	37	36	42	29	35	32	38	27	33
	2km	11	45	43	16	22	19	25	25	31	20	26	25	31	18	24	21	27	16	22

Table 12-8 Predicted Construction Noise Levels – Evening and Night Time

Receiver	Dist.	No. Recs	Criterion, L _{A10}		Noise Levels, L _{A10}			
			dBA		dBA			
			7pm-10pm	10pm-6am	Paving and Concreting		Saw Cutting	
					Typical	Max	Typical	Max
Village	200m	193	46	37	50	56	53	59
	300m	133	46	37	45	51	48	54
	500m	146	46	37	40	46	43	49
	1km	52	46	37	29	35	32	38
	2km	126	46	37	18	24	21	27
Isolated Receivers	50m	0	39	38	64	70	67	73
	100m	3	39	38	57	63	60	66
	200m	6	39	38	50	56	53	59
	300m	1	39	38	45	51	48	54
	500m	7	39	38	40	46	43	49
	1km	6	39	38	29	35	32	38
	2km	11	39	38	18	24	21	27

Table 12-9 Predicted Construction Noise Levels – Sleep Disturbance

Receiver	Dist.	No. Recs	Criterion, L _{A1}		Noise Levels, L _{A1}			
			dBA		dBA			
			10pm-6am	6am-7am	Paving and Concreting		Saw Cutting	
					Typical	Max	Typical	Max
Village	200m	193	47	54	53	59	56	62
	300m	133	47	54	48	54	51	57
	500m	146	47	54	43	49	46	52
	1km	52	47	54	32	38	35	41
	2km	126	47	54	21	27	24	30
Isolated Receivers	50m	0	48	55	67	73	70	76
	100m	3	48	55	60	66	63	69
	200m	6	48	55	53	59	56	62
	300m	1	48	55	48	54	51	57
	500m	7	48	55	43	49	46	52
	1km	6	48	55	32	38	35	41
	2km	11	48	55	21	27	24	30

Table 12-10 Predicted Daytime Construction Noise at NCAs

NCA	Nearest Receiver	Criterion, $L_{A10,15min}$ dBA		Noise Levels, $L_{A10, 15min}$ dBA									
		6am-7am	7am-7pm	Site Preparation		Earthworks		Piling		Bridge Structure		Paving	
				Typical	Max	Typical	Max	Typical	Max	Typical	Max	Typical	Max
1	4	45	43	53	69	56	72	43	49	38	44	55	71
2	10	45	43	53	71	56	74	41	47	36	42	55	73
3	291	45	43	37	41	40	44	38	44	33	39	39	43
4	257	45	43	49	53	52	56	50	53	45	48	51	55
5	577	44	43	47	54	50	57	19	25	14	20	49	56
6	42	44	43	48	57	51	60	55	57	50	52	50	59
7	15	44	43	57	79	60	82	63	64	58	59	59	81
8	64	44	43	57	71	60	74	50	52	45	47	59	73
9	448	45	43	30	31	33	34	53	54	48	49	32	33
10	289	45	43	45	49	48	52	53	54	48	49	47	51

Note: Bold text presents an exceedance of the criteria.

Table 12-11 Predicted Evening Construction Noise Levels at NCAs

NCA	Nearest Receiver	Criterion, $L_{A10,15min}$ dBA	Noise Levels - $L_{A10,15min}$ Intrusiveness Assessment			
			Paving and Concreting		Sawcutting	
			Typical	Max	Typical	Max
1	4	39	55	71	58	74
2	10	39	55	73	58	76
3	291	39	49	53	52	56
4	257	39	51	55	54	58
5	577	46	56	63	59	66
6	42	46	50	59	53	62
7	15	46	54	76	57	79
8	64	46	49	63	52	66
9	448	39	39	40	42	43
10	289	39	37	41	40	44

Note: Bold text presents an exceedance of the criteria.

Table 12-12 Predicted Night Time Construction at NCAs

NCA	Nearest Receiver	Sound Levels							
		Intrusiveness of Construction Noise, $L_{A10,15min}$ dBA					Sleep Disturbance Levels, $L_{A1,1min}$ dBA		
		Criterion 10pm-70am	Noise Level, Paving		Noise Level, Sawcutting		Criterion 10pm-6am	Criterion 6am-7am	Noise Level, Maximum Event
			Typical	Max	Typical	Max			Typical Max
1	4	38	55	71	58	74	48	55	60 76
2	10	38	55	73	58	76	48	55	60 78
3	291	38	49	53	52	56	48	55	54 58
4	257	38	51	55	54	58	48	55	56 60
5	577	37	56	63	59	66	47	54	61 68
6	42	37	50	59	53	62	47	54	55 64
7	15	37	54	76	57	79	47	54	59 81
8	64	37	49	63	52	66	47	54	54 68
9	448	38	39	40	42	43	48	55	44 45
10	289	38	37	41	40	44	48	55	42 46

Note: Bold text presents an exceedance of the criteria.

12.8 Discussion

Most daytime road work noise will satisfy the construction noise criterion at all village receivers beyond approximately 500m. The two westernmost rows of houses in NCA 7 (Receivers 15 to 45) and the caravan park in NCA 8 (Receivers 50 to 63) would be subject to construction noise impact. Exceedances would typically be up to 15dBA, but higher when the work is at the closest point to the residence. Typically, as the site moves, the higher exceedances are temporary.

With noisier works involving piling and rock-hammering, there would be potential exceedances at receivers located within 1km of the bypass. This includes all NCA 7 and NCA 8 receivers and the houses located to the southern end of NCA 6 (Recs 42, 43, 77 to 106). Noise at many receivers beyond approximately 600m would be shielded to some extent by other houses, and impact would be reduced.

With regards to isolated receivers, most daytime road work noise is expected to impact houses within 500m of the bypass. Exceedances are anticipated in NCA 1 (Rec 1, 4, 5, 6 & 7), NCA 2 (Rec 9, 10 & 11) and NCA 4 (Rec 256 & 257).

Evening road work noise will satisfy the criterion at all village receivers beyond approximately 500m. The two westernmost rows of houses in NCA 7 (Receivers 15 to 45) and the caravan park in NCA 8 (Rec 50-63) would be subject to construction noise impact. Exceedances are anticipated to range up to 10dBA over the criteria, depending on work location and activity. At night the village is likely to be exposed to exceedances if works take place within 1km. This includes all receivers located in NCA 6, 7 and 8 as well as all NCA 5 receivers located to the south of Young Street (Rec 42, 43, 81-84, 147). The closest receivers would be exposed to exceedances ranging 20dBA over the relevant night criterion.

Evening and night time works isolated receivers are likely to be exposed to exceedances if works take place within 1km. This would include all receivers in NCA 2, 3, 4 and 10 as well as most of the receivers in NCA 1 (Rec 1, 4, 5, 6 & 7). The closest receivers would be exposed to exceedances ranging 35dBA over the relevant night criterion.

At the village, the early morning sleep disturbance criterion is predicted to be exceeded within 300m of the bypass. Considering this, the two westernmost rows of houses in NCA 7 (Rec 14-46) and the caravan park in NCA 8 (Rec 50-63) would be subject to potential sleep disturbance. At night, the village is likely to be exposed to exceedances if works take place within 500m. This includes most receivers located in NCA 7 and 8. The closest receivers would be exposed to exceedances up to approximately 20dBA over the relevant sleep disturbance criterion.

With regards to isolated receivers, the early morning sleep disturbance criterion is likely to be exceeded within 300m of the bypass. Exceedances are anticipated in NCA 1 (Rec 1, 4, 5, 6 & 7) and NCA 2 (Rec 9 & 11). At night, isolated receivers are likely to be exposed to exceedances if works take place within 500m. This includes most houses in NCA 1 (Rec 1, 4, 5, 6 & 7) and NCA 2 (Rec 9, 10 & 11) as well as all NCA 4 receivers. One house located in NCA 3 (Rec 291) would also be subject to potential sleep disturbance. The closest receivers would be exposed to exceedances approximately 13dBA over the relevant sleep disturbance criterion.

13 ASSESSMENT OF NOISE FROM CONCRETE BATCHING PLANT AND COMPOUNDS

Site compounds and one or more concrete batching plants would be required during the construction of the Project. No specific locations for compounds and concrete batching are proposed at this stage. Siting of these facilities will be considered at the detailed design stage and will be determined based on noise exclusion zones and other environmental constraints.

13.1 Batching Plants Source Noise Levels

The dominant noise sources of typical batching plants are described in Table 13-1.

Table 13-1 Dominant Noise Sources of Batching Plant

Noise Source	Description
Aggregate loading	A front end loader (FEL) is used to load aggregate and sand from the stockpiles into the hoppers (Two were used on Hume Highway Southern Alliance project).
Aggregate hopper gates	The aggregate is loaded onto the conveyors via gates which are controlled by compressed-air power rams. There is a significant air release each time gates are opened.
Aggregate conveyor	The aggregate is loaded to the mixing drum via a conveyor. The conveyor is driven by an electric motor and runs on rollers, which squeal if not properly lubricated.
Dust extraction fan	The dust extractor fan is externally mounted.
Vibratory aggregate hopper cleaner	This cleaner is activated in each batch to ensure all product has been loaded and emits a mid-frequency hum.
Mixing drum	Rotation powered by an electric motor and tilts into the waiting truck.
Truck movements	Truck movements as in above table.
Compressor	Used to operate aggregate hopper gates, externally mounted
Generator	A diesel generator is required at both batching plants. Emergency use only if connected to the grid.
Cement loading	Cement is pneumatically loaded to the silo using a blower on the silo.
Reverse beepers	Trucks at the Coolac site were required to reverse into the loading bay. However, beepers were not a dominant noise source.
Light vehicles	Regular movements for worker transport and various site activities. Did not contribute significantly to overall plant noise.

The total noise level of the plant is the combined noise of the plant (SWL 110dBA), two front end loaders (SWL 111dBA each), and two concrete trucks (SWL 109dBA each). The combined $L_{A10,15min}$ sound power level is 117dBA which is similar to the levels measured by Wilkinson Murray at similar facilities.

For after hours deliveries, the estimated source level is $L_{A10,15min}$ 115dBA – equivalent to one truck and one front end loader.

For sleep disturbance assessment a maximum level of L_{A1} 120 dBA is assumed.

13.2 Batching Plant Noise to Receivers

As the final batching plant and compound site locations are not yet fixed, a range of levels has been given based on the areas of disturbance (Holbrook or isolated areas) and distance separating the receiver and the site. These levels are based on there being a direct line of sight from the houses to the sites. It is the final locations recommended that be chosen to take advantage of local shielding by topography where possible.

Predicted noise levels from the batching plants are given in Table 13-2.

Table 13-2 Predicted Noise Levels from Batching Plants

Receiver	Distance to Plant	$L_{A10,15min}$ Criterion (dBA)				Predicted $L_{A10,15min}$ Levels (dBA)	
		Early Morning (6am-7am)	Daytime (7am-7pm)	Evening (7pm-10pm)	Night Time (10pm-6am)	Normal Hours	After Hours Deliveries
Holbrook	100m	44	43	46	37	68	66
	200m	44	43	46	37	61	59
	500m	44	43	46	37	52	50
	1km	44	43	46	37	44	42
	2km	44	43	46	37	33	31
Isolated Receivers	100m	45	43	39	38	68	66
	200m	45	43	39	38	61	59
	500m	45	43	39	38	52	50
	1km	45	43	39	38	44	42
	2km	45	43	39	38	33	31

In Holbrook, exceedances of the daytime and evening criteria are generally predicted within 1km of the site. At night, compliance can generally be expected beyond 1.5km.

At isolated receivers, exceedances of the daytime criterion are generally predicted within 1km of the site. In the evening and during night time, compliance can generally be expected beyond 1.5km.

Table 13-3 shows the predicted maximum noise levels. They are assessed against the sleep disturbance criteria for night time (10.00pm to 6.00am), and the early morning period (6.00am to 7.00am).

Table 13-3 Predicted Construction Noise Levels – Sleep Disturbance - Batching Plants

Receiver	Distance to Plant	L _{A1} Sleep Disturbance Criterion (dBA)		Predicted L _{A10,15min} Levels (dBA)	
		Night Time (10pm-6am)	Early Morning (6am-7am)	Normal Hours	After Hours Deliveries
Holbrook	100m	47	54	71	71
	200m	47	54	64	64
	500m	47	54	55	55
	1km	47	54	47	47
	2km	47	54	36	36
Isolated Receivers	100m	48	55	71	71
	200m	48	55	64	64
	500m	48	55	55	55
	1km	48	55	47	47
	2km	48	55	36	36

13.3 Compound Source Noise Levels

The noise generation associated with compounds is predominantly due to movement of vehicles. A sound power level of L_{A10,15min} 112dBA was assumed to account for the possibility of heavy vehicles accessing the compounds. Levels at least 10dBA quieter than this would be expected during busy times if the compound was used for light vehicles only.

For sleep disturbance assessment a maximum level of L_{A1} 115 dBA is assumed. If only light vehicles use the compound, the level would be approximately L_{A1} 95 dBA. The L_{A1} for light vehicles is due to engines starting, doors closing, and vehicles accelerating.

Predicted noise levels are given in Table 13-4 for L_{A10}, and Table 13-5 for sleep disturbance. The table predicts exceedances if heavy vehicles access the compounds within 100-200m of residences. Minor exceedances would be predicted if only light vehicles were used.

Table 13-4 Predicted Noise Levels from Compounds (Heavy Vehicles)

Receiver	Distance to Plant	L _{A10,15min} Criterion (dBA)				Predicted L _{A10,15min} Levels (dBA)	
		Early Morning (6am-7am)	Daytime (7am-7pm)	Evening (7pm-10pm)	Night Time (10pm-6am)	Normal Hours	After Hours Deliveries
Holbrook	100m	44	43	46	37	63	61
	200m	44	43	46	37	56	54
	500m	44	43	46	37	47	45
	1km	44	43	46	37	39	37
	2km	44	43	46	37	28	26
Isolated Receivers	100m	45	43	39	38	63	61
	200m	45	43	39	38	56	54
	500m	45	43	39	38	47	45
	1km	45	43	39	38	39	37
	2km	45	43	39	38	28	26

Table 13-5 Predicted Construction Noise Levels – Sleep Disturbance – Heavy vehicle compound

Receiver	Distance to Plant	L _{A1} Sleep Disturbance Criterion (dBA)		Predicted L _{A10,15min} Levels (dBA)	
		Night Time (10pm-6am)	Early Morning (6am-7am)	Normal Hours	After Hours Deliveries
Holbrook	100m	47	54	66	66
	200m	47	54	59	59
	500m	47	54	50	50
	1km	47	54	42	42
	2km	47	54	31	31
Isolated Receivers	100m	48	55	66	66
	200m	48	55	59	59
	500m	48	55	50	50
	1km	48	55	42	42
	2km	48	55	31	31

13.4 Summary for Batching Plants and Compounds

13.4.1 Batching Plants

In Holbrook, exceedances of the night time criteria are generally predicted within 1km of the site. In the early morning, compliance can generally be expected if the site is located beyond 1.5km of the village.

At isolated receivers, exceedances of the night time criterion are generally predicted within 1km of the site. In the evening, compliance can generally be expected beyond 1.5km.

Mitigation measures are available to reduce noise impacts. These would be site specific, and would include measures such as temporary shielding on access roads, and use of quieter equipment. Siting of the plants behind hills or industrial buildings would provide mitigation.

13.4.2 Compounds

Exceedances would occur if heavy vehicles access the compounds within 100-200m of residences. Minor exceedances (<3dBA) would be predicted if only light vehicles were used in a compound 100m from a residence.

14 MITIGATION OF CONSTRUCTION NOISE

Reduction of construction noise for night time road works is often impractical. For example if temporary screens are proposed a significant part of the shift might be used in setting up and taking down noise control, thereby extending the duration of the project. Often it is appropriate to mitigate impacts in consultation with residents most affected by the noise.

Best practice mitigation and management measures will be used to minimise construction noise and vibration at noise sensitive receivers and will be described in a construction noise management plan.

The plan would include the following:

- Development of notification and negotiation procedure for receivers where noise impact cannot be mitigated to meet the criteria;
- Procedure assessing audibility at any sensitive receiver outside normal construction hours and developing a negotiated agreement if necessary (as defined under the *Industrial Noise Policy* (EPA, 2000)) is in place;
- A procedure for dealing with and responding to complaints; and
- Development of noise monitoring and auditing procedures to verify compliance with the predicted noise impacts.

In general, management of noise and vibration requires attention to the following:

- Construction hours.
- Noise and vibration monitoring on site and at sensitive receivers.
- Training and awareness.
- Communication.
- Incident and emergency response.
- Non-conformance, preventative and corrective action.

Where appropriate the specific noise mitigation measures could include:

- Mitigation of specific noise sources may be possible by using portable temporary screens.
- For extended periods of driven piling and use of rock breakers, respite periods could be considered.
- Maximising the offset distance between noisy plant items and sensitive receivers.
- Construction timetabling, in particular for works outside standard hours, to minimise noise impacts. This may include time and duration restrictions and respite periods.
- Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.

- Orienting equipment away from sensitive receivers.
- Carrying out loading and unloading away from sensitive receivers.
- Using dampened tips on rock breakers.
- Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks.
- Selecting plant and equipment based on noise emission levels.
- Using alternative construction methods.
- Providing alternative arrangements with affected residents such as temporary relocation.
- Selecting site access points and roads as far as possible away from sensitive receivers.
- Using spotters, closed circuit television monitors, “smart” reversing alarms, or “squawker” type reversing alarms in place of traditional reversing alarms.

Education and training of site staff is necessary for satisfactory implementation of noise mitigation measures. Education and training strategies should focus on:

- Site awareness training / environmental inductions that include a section on noise mitigation techniques / measures to be implemented throughout the project.
- Ensuring work occurs within approved hours.
- Locating noisy equipment away from sensitive receivers.
- Using noise screens for mobile plant and equipment.
- Ensuring plant and equipment is well maintained and not making excessive noise.
- Turning off machinery when not in use.

The potential noise mitigations that can be achieved by noise mitigation measures are shown in Table 14-1.

Table 14-1 Noise Mitigation Measures

Management Measure	Anticipated Noise Reduction, dBA
Administrative Controls	
Operate during approved hours	N/A
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers	N/A
Appropriate training of onsite staff	N/A

Management Measure	Anticipated Noise Reduction, dBA
Undertake community consultation and respond to complains in accordance with established project procedures	N/A
Turning off machinery when not in use	0-5
Respite periods for pile drivers and rock breakers	N/A
Engineering Controls	
Portable temporary screens	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers.	3-6
Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.	2-3
Orienting equipment away from sensitive receivers.	3-5
Carrying out loading and unloading away from sensitive receivers.	3-5
Using dampened tips on rock breakers.	3-6
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting site access points and roads as far as possible away from sensitive receivers	3-6
Using spotters, closed circuit television monitors, "smart" reversing alarms, or "squawker" type reversing alarms in place of traditional reversing alarms	2-5
Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers	5-10

15 ASSESSMENT OF CONSTRUCTION VIBRATION (EXCLUDING BLASTING)

15.1 Criteria

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building damage objectives.

15.1.1 Human Comfort

The DECCW's *Assessing Vibration: A Technical Guideline* provides acceptable values for continuous and impulsive vibration in the range 1-80Hz. Both preferred and maximum vibration limits are defined for various locations and are shown in Table 15-1.

Table 15-1 Preferred and Maximum Peak Particle Velocity (PPV) Values for Continuous and Impulsive Vibration

Location	Assessment Period ⁽¹⁾	Preferred Values	Maximum Values
Continuous Vibration			
Critical areas ⁽²⁾	Day or night time	0.14	0.28
Receivers	Daytime	0.28	0.56
	Night time	0.20	0.40
Offices, schools, educational institutions and places of worship	Day or night time	0.56	1.1
Workshops	Day or night time	1.1	2.2
Impulsive Vibration			
Critical areas ⁽²⁾	Day or night time	0.14	0.28
Receivers	Daytime	8.6	17.0
	Night time	2.8	5.6
Offices, schools, educational institutions and places of worship	Day or night time	18.0	36.0
Workshops	Day or night time	18.0	36.0

Notes: 1) Daytime is 7.00am to 10.00pm and night time is 10.00pm to 7.00am.

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 BS 6472-1992.

These limits relate to a long-term (16 hours for daytime), continuous exposure to vibration sources. Where vibration is intermittent, a vibration dose is calculated and acceptable values are shown in Table 15-2.

Table 15-2 Acceptable Vibration Dose Values for Intermittent Vibration ($\text{m/s}^{1.75}$)

Location	Daytime ⁽¹⁾		Night Time ⁽¹⁾	
	Preferred Value	Maximum Values	Preferred Value	Maximum Value
Critical areas ⁽²⁾	0.10	0.20	0.10	0.20
Receivers	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

Notes: 1) Daytime is 7.00am to 10.00pm and night time is 10.00pm to 7.00am.
 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 BS 6472-1992.

15.1.2 Building Damage

In regard to potential building damage, German Standard DIN 4150 (Table 1) shows guideline values for short term vibration for commercial buildings, houses and heritage buildings which are dependent on the frequency of vibration. The recommended vibration level for sensitive heritage buildings ranges from 3 to 10mm/s, and 5 to 20mm/s for dwellings.

15.2 Source Levels of Vibration

Table 15-3 provides some estimated vibration levels at a range of distances from the various construction activities.

Table 15-3 Typical Vibration Emission Levels from Construction Plant

Activity	PPV Vibration Level (mm/s) at Distance		
	10m	20m	30m
Concrete Sawing	0.5	0.3	0.2
4-Tonne Vibratory Roller (High)	2.0-2.4	0.4-1.2	0.2-0.8
Hydraulic Hammer (30t)	3	1.5	1.0

15.3 Vibration Levels at Residential Receivers

The vibration levels of this project will not result in levels that cause damage to buildings. It is possible that at some receivers close to the bypass route that there will be vibration levels exceeding the criteria for human comfort, particularly when the hydraulic hammer is used within 30m of any receiver. Some impact could also be expected during use of the vibratory roller within approximately 30-40m of any receiver. The impacts are expected to be temporary as the construction site moves away from the residential areas.

As the minimum distance from any house to the construction site is more than 65m, no vibration impact is predicted.

15.4 Vibration Levels at Heritage Buildings

Three heritage structures have been identified near the proposal. The criterion for building damage depends on frequency of vibration, but overall levels less than 3mm/s would generally comply. Higher levels would indicate a requirement for a more detailed study of the building and its relationship to the works. The buildings, and the assessment of vibration, is summarised in Table 15-4.

Table 15-4 Construction Vibration at Heritage Buildings

Building	Approximate Distance to Work Site	Vibration Level of Hydraulic Breaker	Complies?
Montpellier Shearer's Quarters	220	<1mm/s	Yes
Hereford Stud Homestead	40-50	0.8-1mm/s	Yes
Hereford Stud Dairy and Well	250	<1mm/s	Yes

15.5 Summary of vibration Assessment

The vibration levels of this project will not result in levels that cause damage to buildings, with the possible exception of Hereford Stud Homestead. A precondition survey should be carried out at this location. Depending on the building relation to the final design, vibration monitoring would be recommended.

The criteria for human comfort are not predicted to be exceeded at any residence.

16 BLASTING ASSESSMENT

16.1 Blasting Requirements

Blasting may be required in one area at the northern end of the Project to a cut depth of approximately 10m. As geotechnical studies are incomplete, the need for blasting is not known.

If needed, blasting would be undertaken between 9am and 5pm – Monday to Friday. Up to two blasts per day would be undertaken. Generally the process for blasting would be:

- Drilling of holes into rock;
- Placement of explosives;
- Placement of stemmings in drill holes;
- Clearance of area before blast;
- Explosion; and
- Removal of blasted rock to crushing and processing areas.

16.2 Blasting Assessment Criteria

16.2.1 Annoyance & Discomfort

For assessment of annoyance due to blasting, the DECCW (and most similar authorities in Australia) has adopted guidelines produced by the Australian and New Zealand Environment and Conservation Council (ANZECC). The fundamental criteria are that at any receiver or other sensitive location:

- The maximum overpressure due to blasting should not exceed 115dB for more than 5% of blasts in any year, and should not exceed 120dB for any blast; and
- The maximum peak particle ground velocity should not exceed 5mm/sec for more than 5% of blasts in any year, and should not exceed 10mm/sec for any blast.

16.2.2 Structural Damage

At sufficiently high levels, blast overpressure may in itself cause structural damage to some building elements such as windows. However, this occurs at peak overpressure levels of about 133dB and above, well in excess of criteria for annoyance.

For assessment of damage due to ground vibration, Australian Standard *AS2187.2-1993 Explosives – Storage, Transport and Use* contains an appendix specifying recommended levels for peak particle vibration velocity to protect typical buildings from damage.

These are:

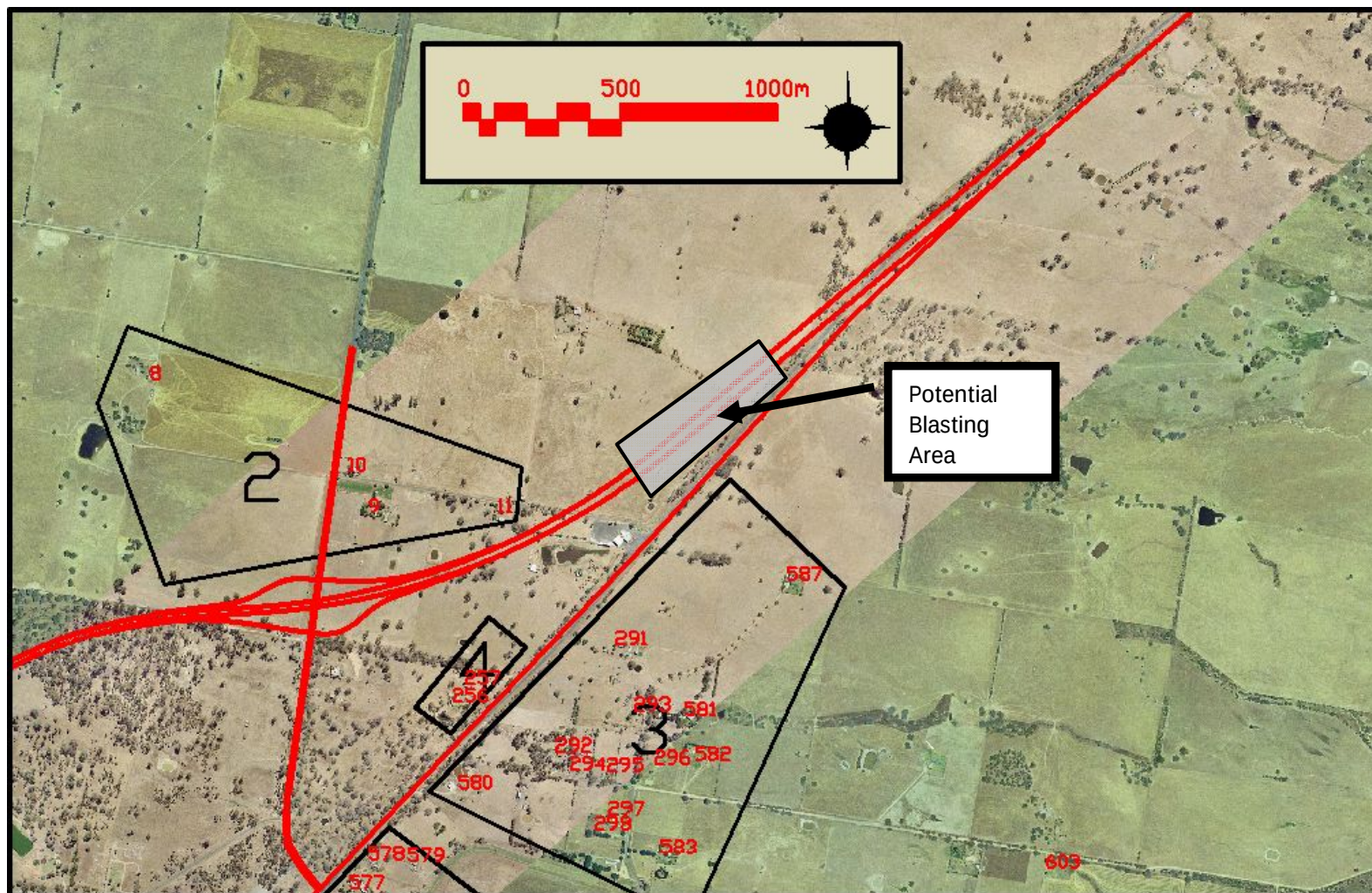
- “Structures that may be particularly susceptible to ground vibration” – 5mm/sec;

- “Houses and low-rise residential buildings; commercial buildings not included below” – 10mm/sec; and
- “Commercial and industrial buildings or structures of reinforced concrete or steel construction” – 25mm/sec.

16.3 Locations of Blasting

Blasting would potentially be required at one location marked on Figure 16-1.

The closest receiver locations are located in NCAs 2, 3 and 4 which will be addressed in this blasting assessment.

Figure 16-1 Location of Potential Blasting Area

16.4 Definition of “Scaled Distance”

Airblast overpressure and ground vibration levels from blasting are related to the “scaled distance” from the blast, which is defined as

Scaled distance = $D/W^{(1/3)}$ for airblast overpressure, and
 Scaled distance = $D/W^{(1/2)}$ for ground vibration,

where D is the distance from the blast in metres and W is the maximum instantaneous charge (MIC) of explosive, in kg Ammonium Nitrate Fuel Oil (ANFO) equivalent.

16.5 Prediction of Overpressure

Peak overpressure levels are predicted as

$$L = A - B \log(D/W^{1/3})$$

where B depends on the site characteristics and A depends on both site characteristics and blasting practice.

Wilkinson Murray has analysed blast monitoring from Prospect Quarry and Bayswater No 3 Mine in order to validate this procedure. The data from that analysis shows the “best fit” line has values of $B = 22.4$ and $A = 158$ in the above equation. However, to ensure that 95% of blasts are within a criterion, a value of $A = 171$ is required. While mine blasts are typically much larger than those expected on the Holbrook Bypass, the study showed that the overpressure values predicted by the “best fit” line can be achieved if best practice blasting procedures are adopted.

16.6 Prediction of Vibration Levels

The “scaled distance” from the a blast, which is defined as

$$\text{Scaled distance} = D/W^{(1/2)} \text{ for ground vibration.}$$

Peak particle velocity is predicted as

$$\text{PPV} = K (D/W^{1/2}) - a$$

where a depends on the ground characteristics and K depends on both site characteristics and blasting practice.

Australian Standard 2187.2 gives recommended values K and for cases where site data are not available, the relevant values being:

Blasting to a free face, hard rock: $K = 500$, $a = 1.6$

Blasting to a free face, average rock: $K = 1140$, $a = 1.6$

16.7 Recommendations for Blasting

Table 16-1 summarises the predicted results for the allowable MIC to meet the overpressure ANZECC guidelines at the closest residential dwelling to each blast site. The predictions assume no shielding from local topography.

Table 16-1 Allowable MICs to meet overpressure goals

Receiver Number	Approximate Distance to closest blast *	Maximum Instantaneous Charge (kg)	
		For any Blasts	For more than 5% of Blasts in any Year
NCA 2			
8	1,600	605.3	129.5
9	940	122.8	26.3
10	900	107.7	23.1
11	430	11.8	2.5
NCA 3			
291	530	22.0	4.7
292	940	122.8	26.3
293	720	55.2	11.8
294	950	126.7	27.1
295	920	115.1	24.6
296	900	107.7	23.1
297	1,080	186.2	39.8
298	1,130	213.2	45.6
580	1,130	213.2	45.6
581	760	64.9	13.9
582	900	107.7	23.1
583	1,200	255.4	54.6
587	560	26.0	5.6
NCA 4			
256	890	104.2	22.3
257	830	84.5	18.1

* Note: Distance to closest receiver is measured from the closest point of the proposed blasting area to the receiver in question

Table 16-2 summarises the predicted results for the allowable MIC to meet the ground vibration ANZECC guidelines at the closest residential dwelling to each blast site.

Table 16-2 Allowable MICs to meet ground vibration goals

Receiver Number	Approximate Distance to closest blast *	Maximum Instantaneous Charge (kg)	
		For any Blasts	For more than 5 % of Blasts in any Year
NCA 2			
8	1,600	1,086.6	456.9
9	940	428.4	180.1
10	900	397.0	166.9
11	430	109.0	45.8
NCA 3			
291	530	157.2	66.1
292	940	428.4	180.1
293	720	268.7	113.0
294	950	436.4	183.5
295	920	412.6	173.5
296	900	397.0	166.9
297	1,080	546.2	229.7
298	1,130	591.2	248.6
580	1,130	591.2	248.6
581	760	295.3	124.2
582	900	397.0	166.9
583	1,200	656.8	276.2
587	560	173.1	72.8
NCA 4			
256	890	389.3	163.7
257	830	344.6	144.9

* Note: Distance to closest receiver is measured from the closest point of the proposed blasting area to the receiver in question

Site tests would be necessary to establish the characteristics of the rock and allow more accurate determination of the MIC values shown in the table.

16.8 Mitigation of Blasting Impacts

Test blasts should be conducted to determine appropriate values for A and B, as given in the equations in Section 16.5. Once these are established the appropriate MIC values can be determined for each blast.

The criteria can be achieved using the MIC in the above tables (or as modified for the site) using well controlled blasting practices, including:

- All blasts should be monitored at the closest residences.
- Only qualified technicians should be used.

- Pre and post condition surveys may be required.

If the MIC is determined by the overpressure criterion, a higher MIC may be used if residents are moved during the blast. This condition will be site specific and depends on the distance to the blast and the blast design.

16.9 Summary of Blasting Assessment

Criteria for overpressure and vibration can be achieved using correct blast design and an MIC not exceeding those given in the tables. Test blasts could show site specific characteristics that allow higher values for the MIC.

Mitigation of impacts includes monitoring of blasts, building surveys, and test blasts.

17 CONCLUSION

Noise from the proposed Holbrook Bypass has been assessed. The following aspects were considered:

- Operational Noise;
- Construction Noise and Vibration; and
- Blasting Overpressure and Vibration.

17.1 Noise Monitoring

Noise monitoring was undertaken at four locations. The noise monitoring determined background noise and existing traffic noise.

17.2 Noise Modelling and Validation

Noise from both the existing highway and the proposed bypass was modelled. The model was validated using predicted noise from the highway and comparing it to noise measured while traffic was counted. Good correlation was found between predicted and measured values.

17.3 Recommendations for Operational Noise

A total of eight houses would require consideration for architectural treatment. All of those houses are located in NCA 1 and NCA 2.

17.3.1 Noise Mitigation Design for Bypass Noise at NCA 7

The bypass is found to generate exceedances at a considerable number of receivers in NCA 7. Three road mitigation options have been investigated and have shown to reduce noise levels to reach compliance at all NCA 7 receivers. Those options which use low noise pavement and noise barriers are as follows:

- Southbound barrier at a height of 5.5m and length of 1700m along the bypass between southbound chainages 114440-116140.
- Open graded asphalt (or low noise) pavement on both carriageways and on a 1700m long bypass section between southbound chainages 114440-116140.
- Combination of a southbound barrier at a height of 3.5m and length of 1700m along the bypass between southbound chainages 114440-116140 and open graded asphalt pavement on both carriageways and on a 660m long road section between southbound chainages 114980-115640.

17.3.2 Noise Mitigation Design for Bypass Noise at NCA 8

A small cluster of 5 structures and caravan sites located in a caravan park in NCA 8 would also require noise mitigation. Those receivers are located near the southbound off-ramp which goes up an embankment above the main carriageway road level. Preliminary results have shown noise barriers in that section of the bypass would provide very little noise reduction since the ramp deviates from the main alignment. It was found that in order to reach compliance, a combination of a 3.5m high split ramp barrier (running the entire ramp length, partly on the outside of the ramp and partly between the ramp and the main carriageways) and low noise pavement extending between southbound chainages 116140-117380 (1240m) would be necessary to reduce levels to compliance.

It is important to consider that noise mitigation design at NCA 8 already assumes the use of low noise pavement near NCA 7 between southbound chainages 114440-116140. In the event the barrier options are chosen at NCA 7 (as opposed to low noise pavement), low noise pavement would need to extend further north.

17.4 Acute Noise Levels

A number of receivers in Holbrook are expected to be exposed to acute noise levels near the existing Hume Highway. These receivers may be considered for mitigation under the RTA's Noise Abatement Program.

However, it is important to note that predicted 2022 noise levels will reduce when compared with the future existing (2012) noise levels without the Bypass. This is due to the fact that part of the traffic currently using the existing Hume Highway alignment would be deviated onto the bypass. Such noise reduction will benefit all receivers located within the township where the noise environment is dominated by traffic from the existing Hume Highway alignment.

The existing Hume Highway alignment is located far from any construction works associated with the Project and for this reason, it is considered unreasonable to mitigate those receivers in town.

17.5 Construction Noise Assessment

Noise from construction will cause impact at some receivers. The main areas of noise impact are expected in NCA 1, NCA 2 and NCA 4 when dealing with isolated receivers and NCA 7 and 8 when looking at Holbrook.

17.6 Construction Vibration Assessment

The vibration levels of this project will not result in levels that cause damage to buildings, with the possible exception of Hereford Stud Homestead. A precondition survey should be carried out at this location. Depending on the relationship of the building to the final design, vibration monitoring would be recommended.

The criteria for human comfort are not predicted to be exceeded at any residence.

17.7 Blasting Assessment

Criteria for overpressure and vibration can be achieved using correct blast design and an MIC not exceeding those given in the tables. Test blasts could show site specific characteristics that allow higher values for the MIC.

Mitigation of impacts includes monitoring of blasts, building surveys, and test blasts.

Note

All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

Quality Assurance

We are committed to and have implemented AS/NZS ISO 9001:2000 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC

This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Version	Status	Date	Prepared by	Checked by
A	Draft	14 August 2009	Roman Haverkamp	George Jenner
B	Draft	20 August 2009	Roman Haverkamp	George Jenner
C	Draft	26 August 2009	George Jenner	-
D	Draft	2 September 2009	George Jenner	-
D	Final	7 October 2009	George Jenner	-
E	Final	4 November 2009	George Jenner	-

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

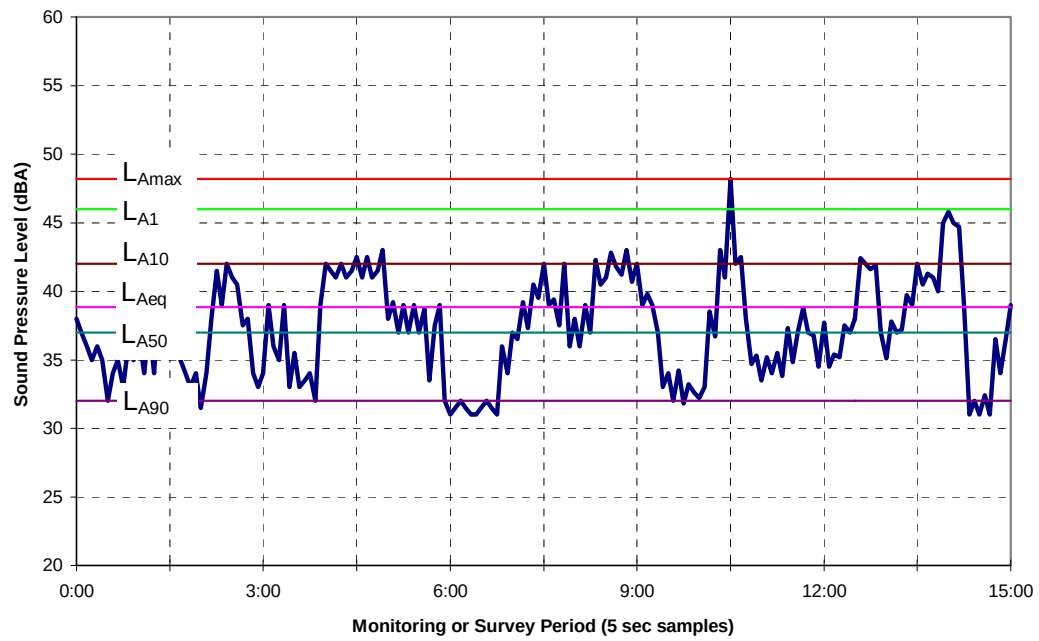
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.



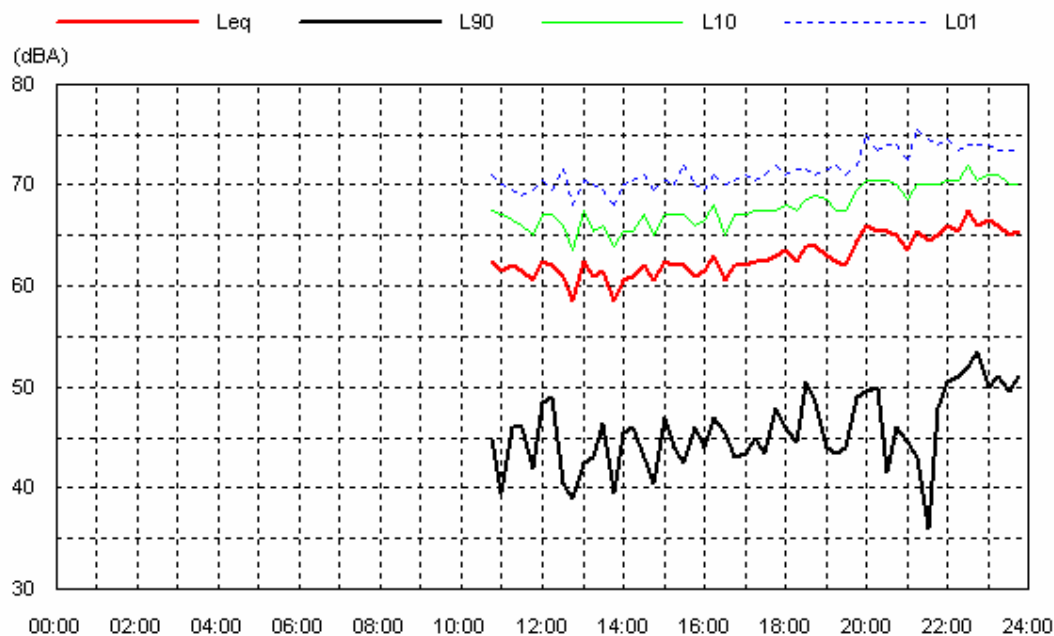
APPENDIX B

NOISE MEASUREMENT RESULTS

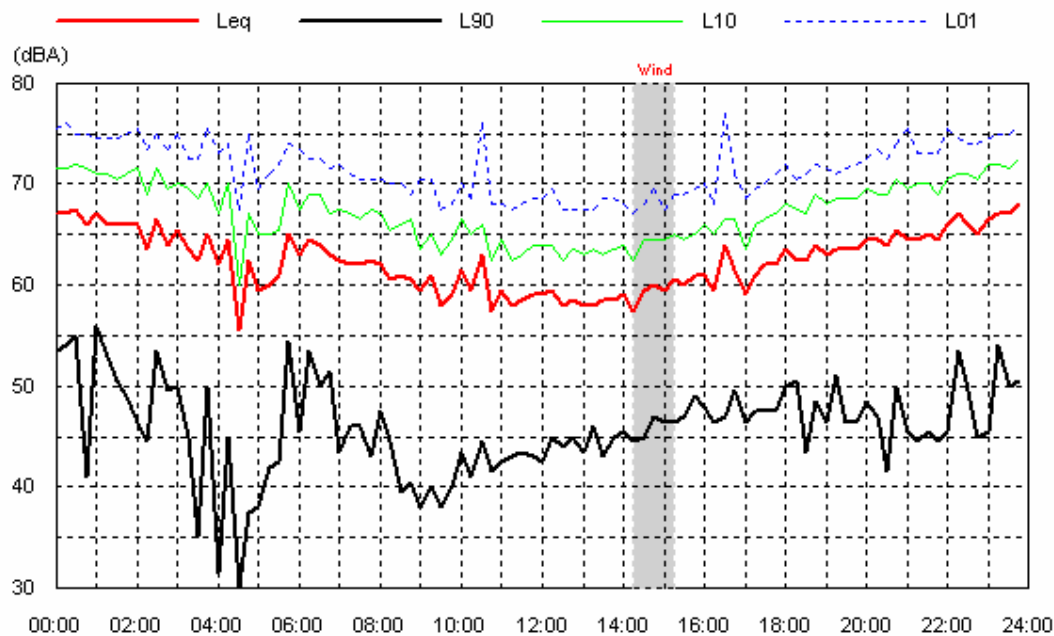
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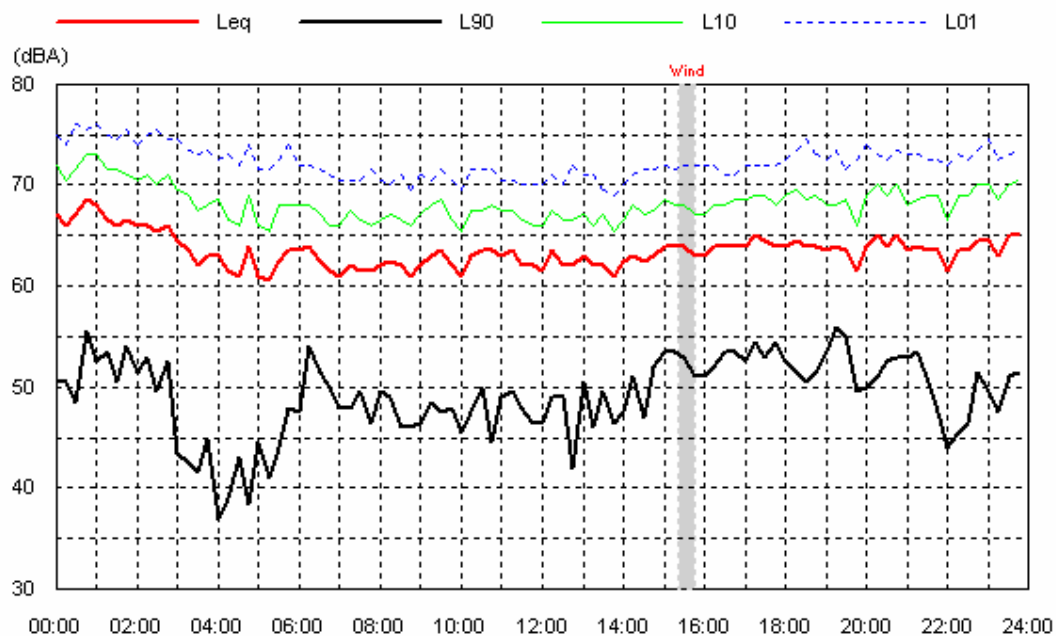
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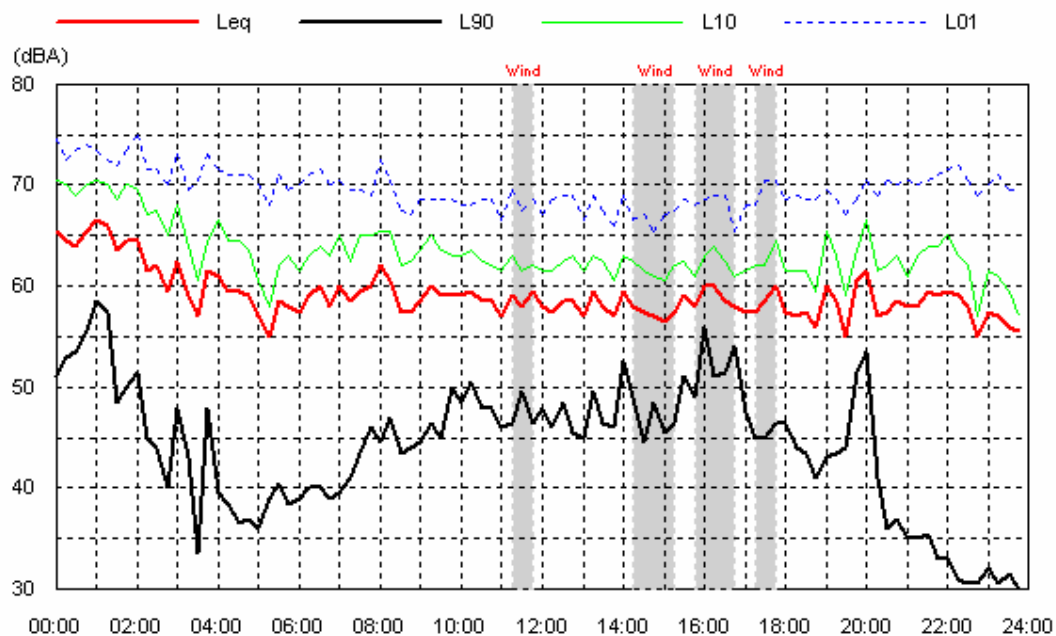
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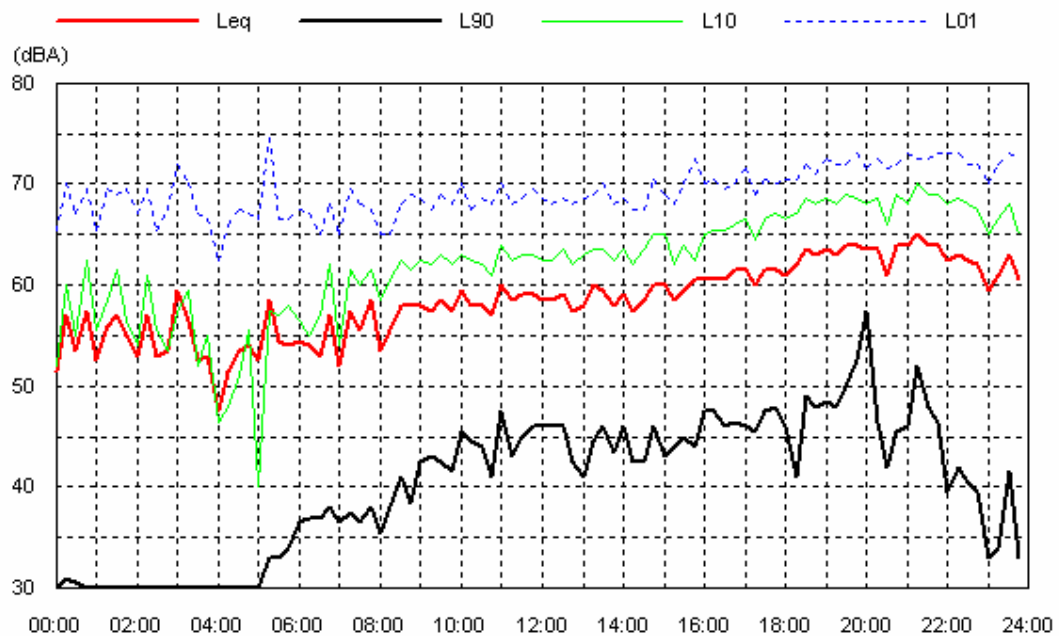
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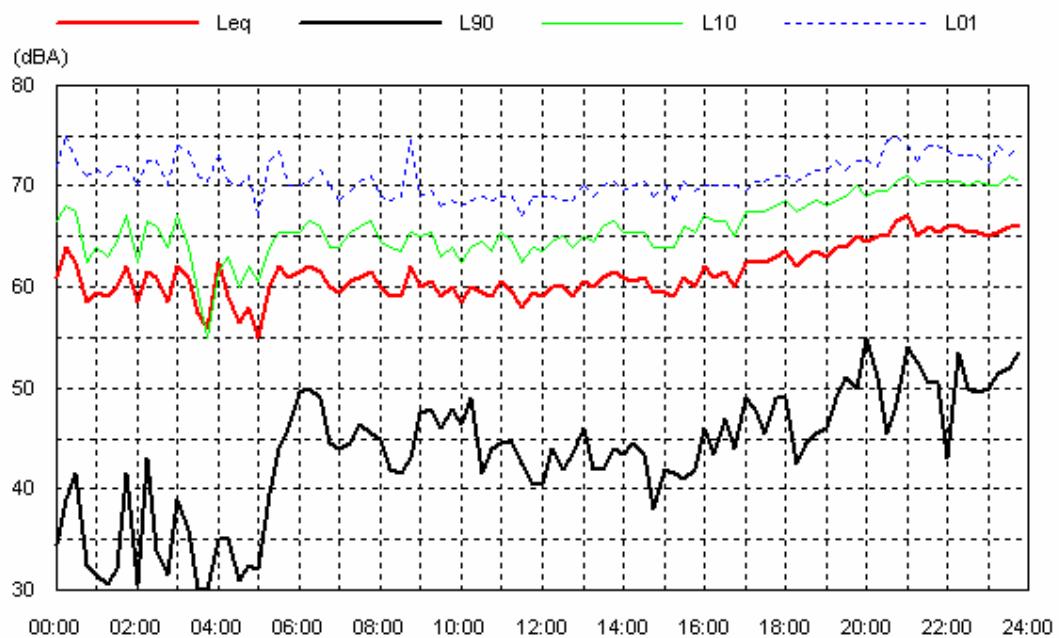
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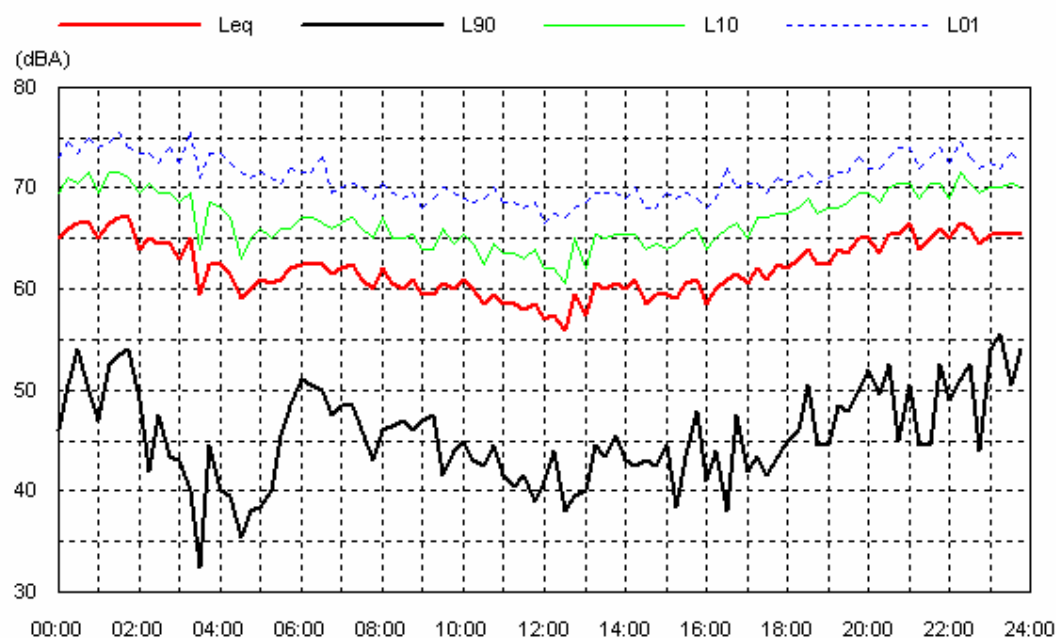
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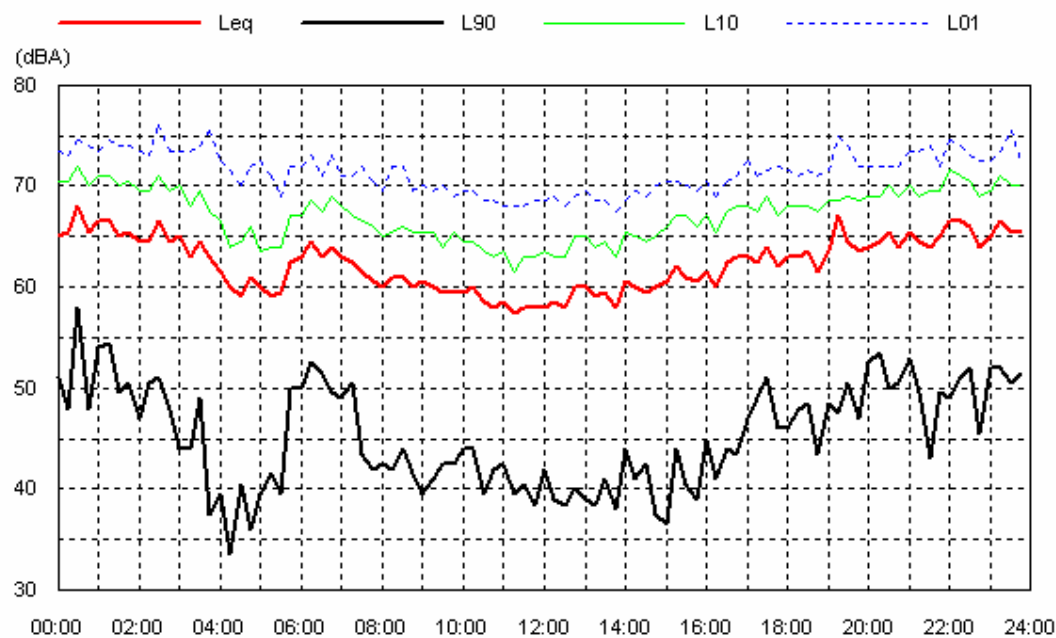
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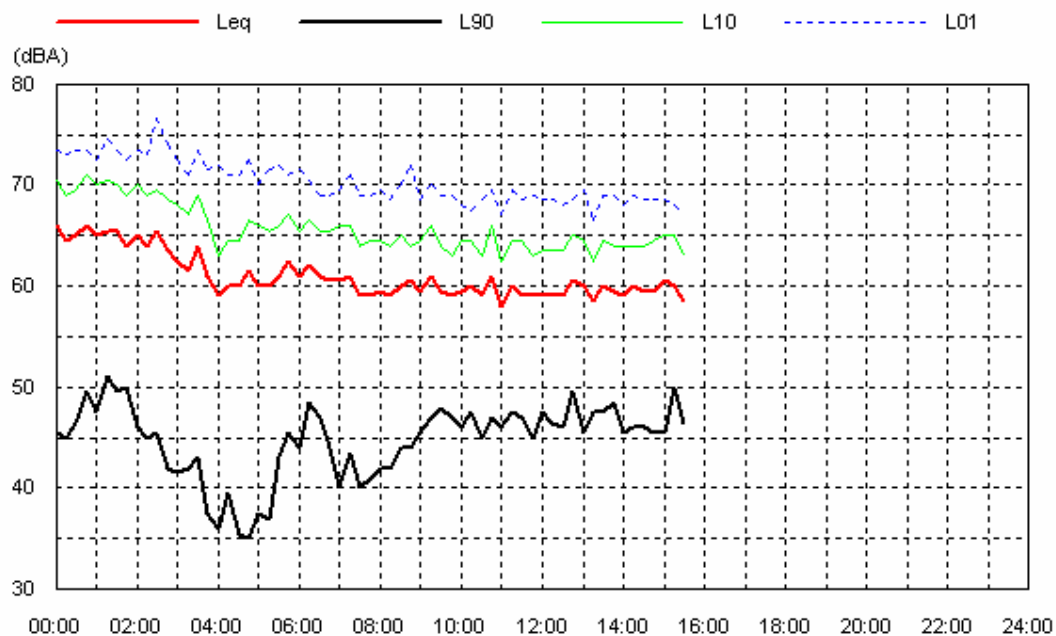
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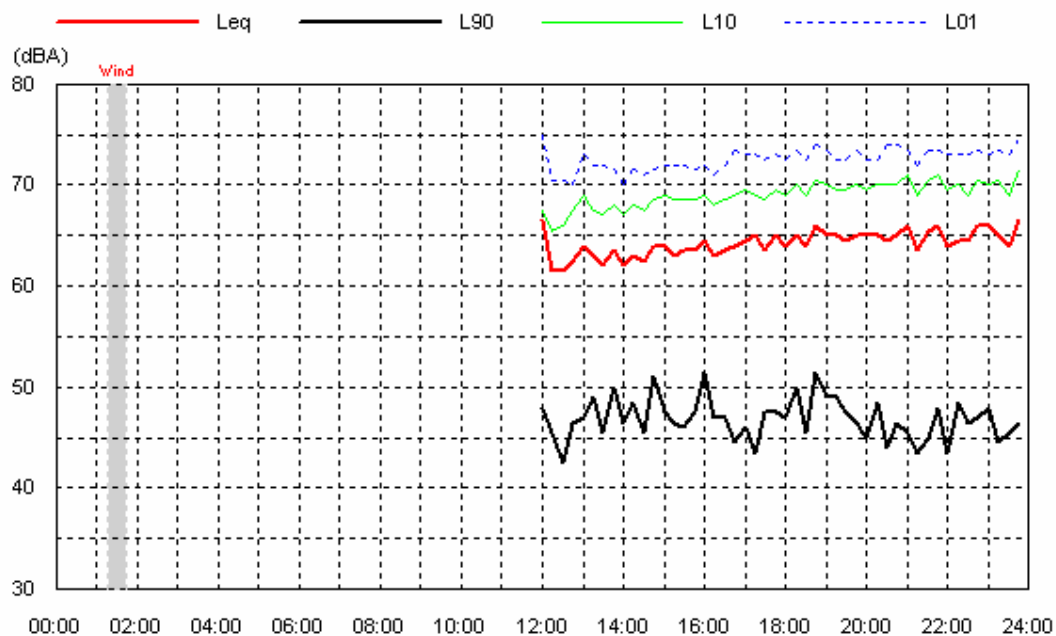
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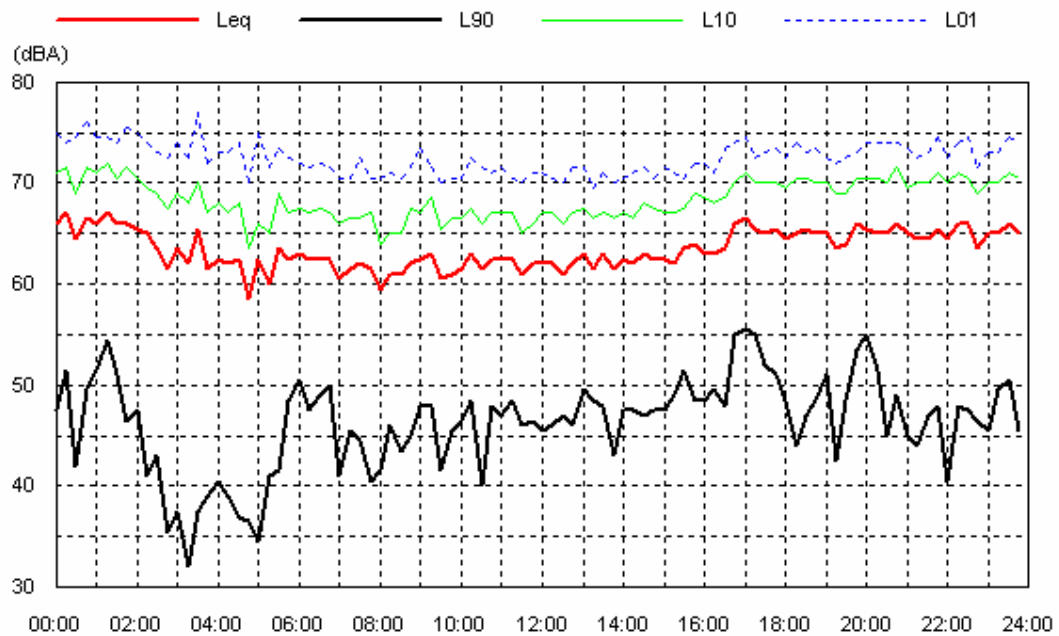
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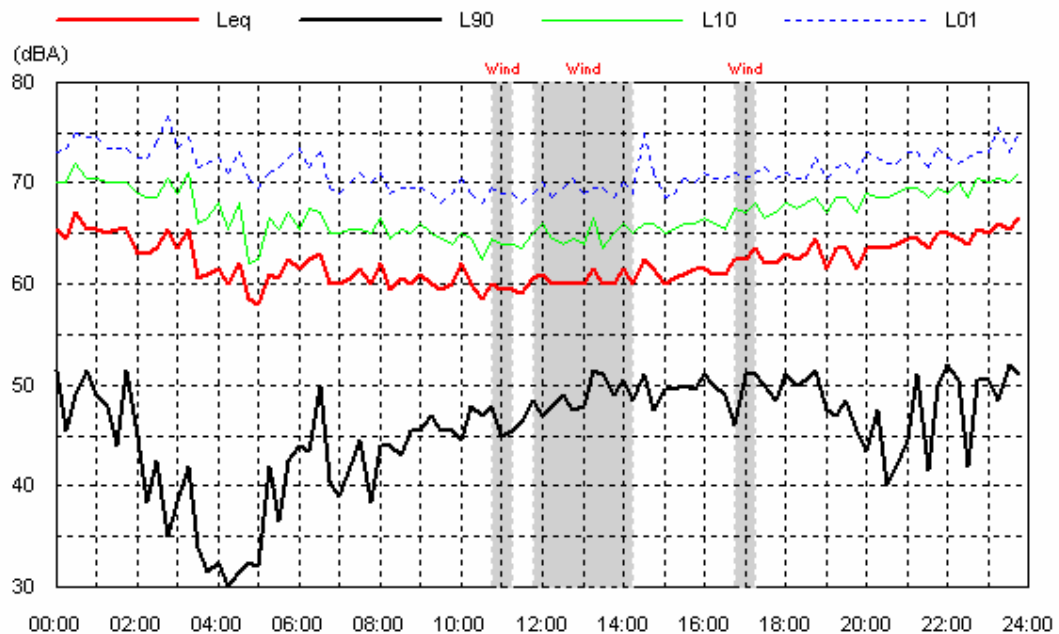
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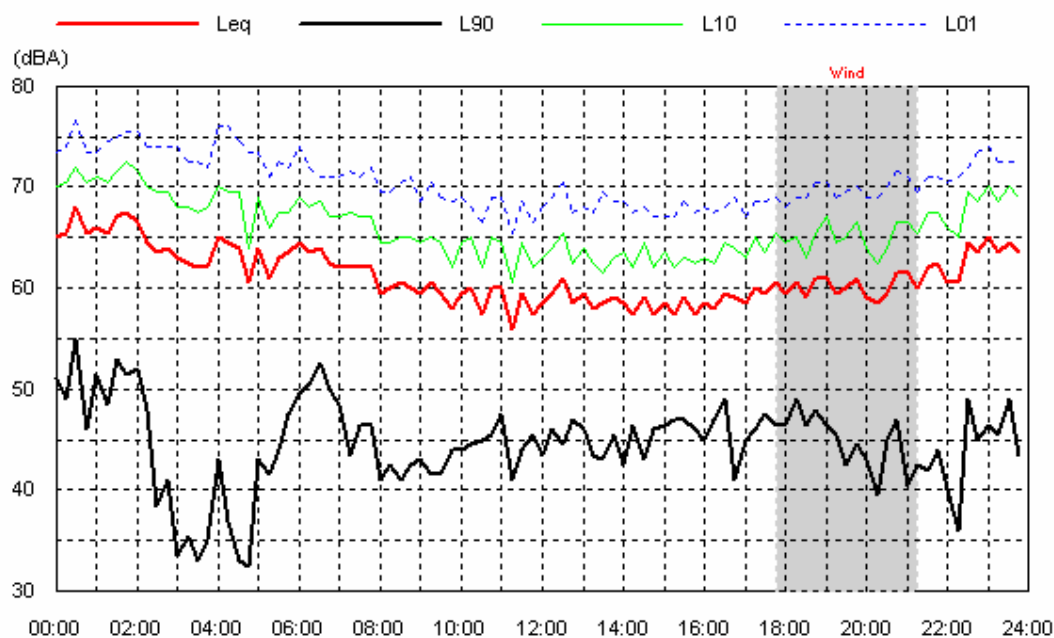
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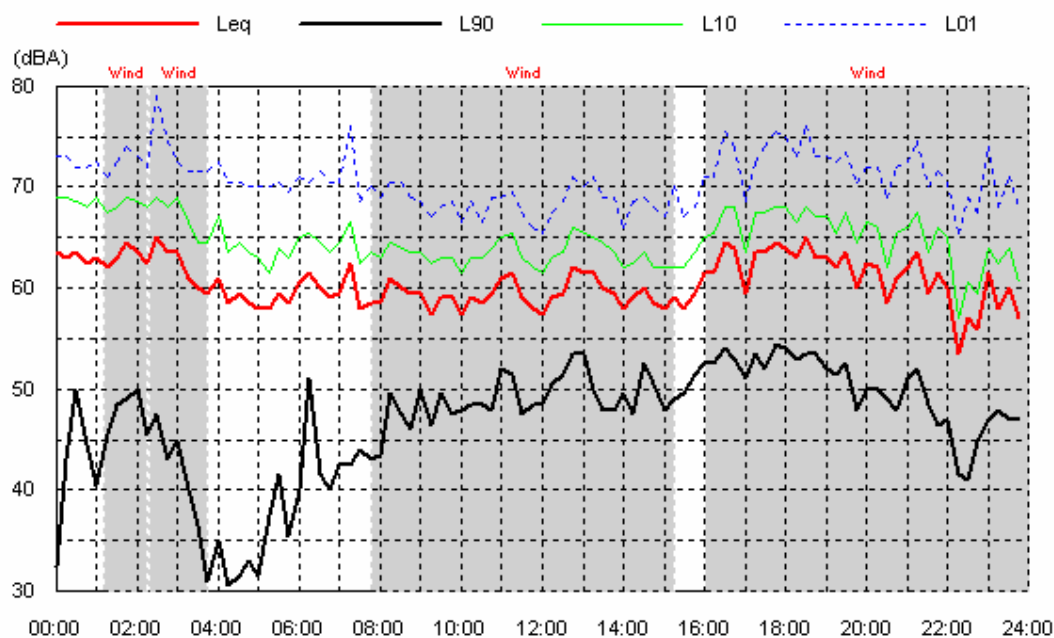
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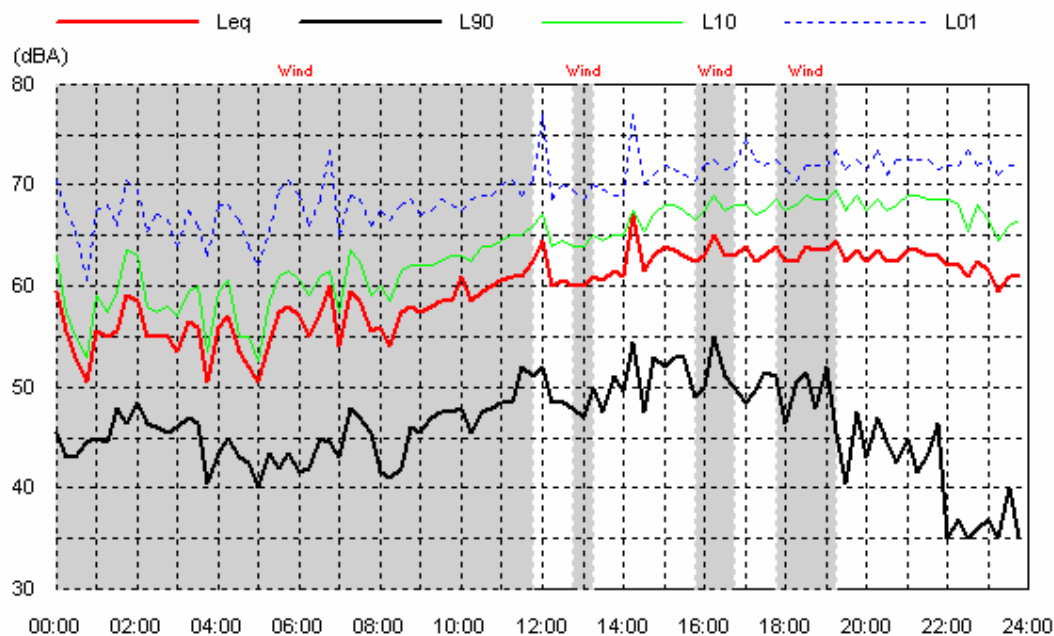
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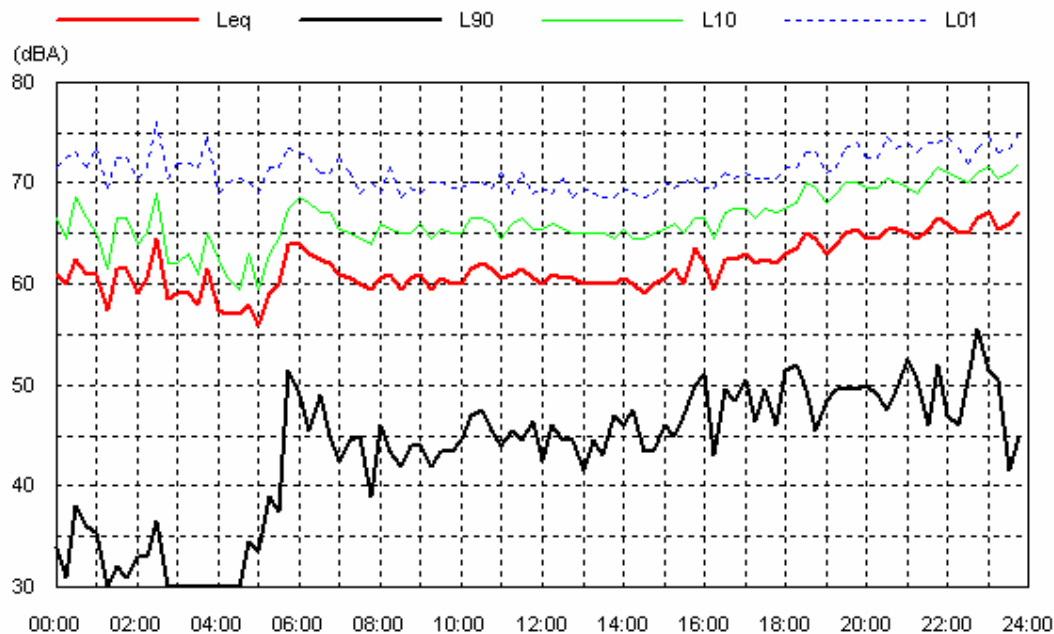
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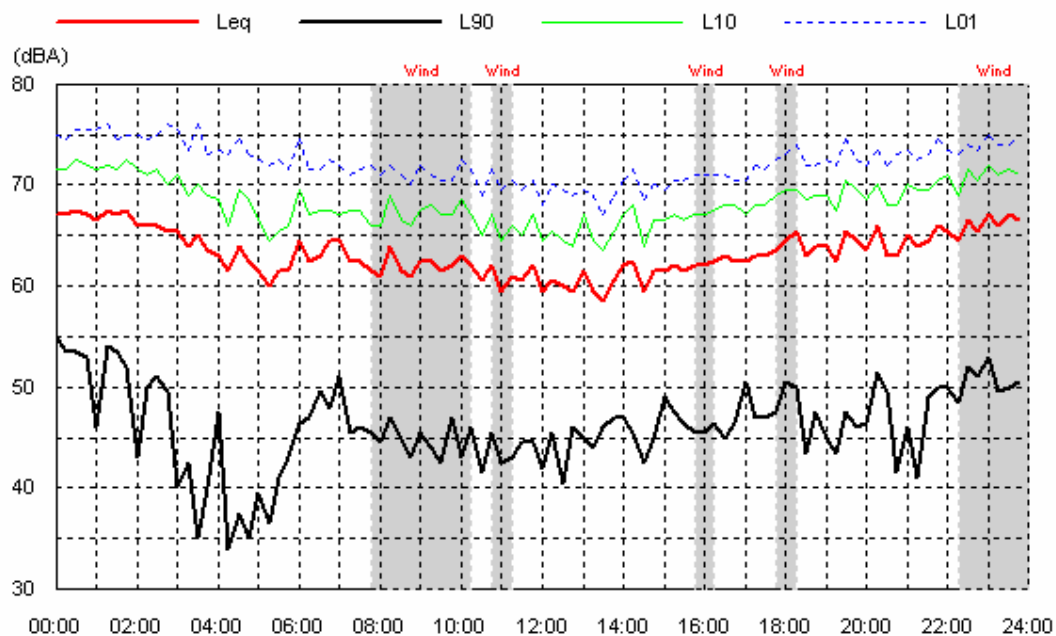
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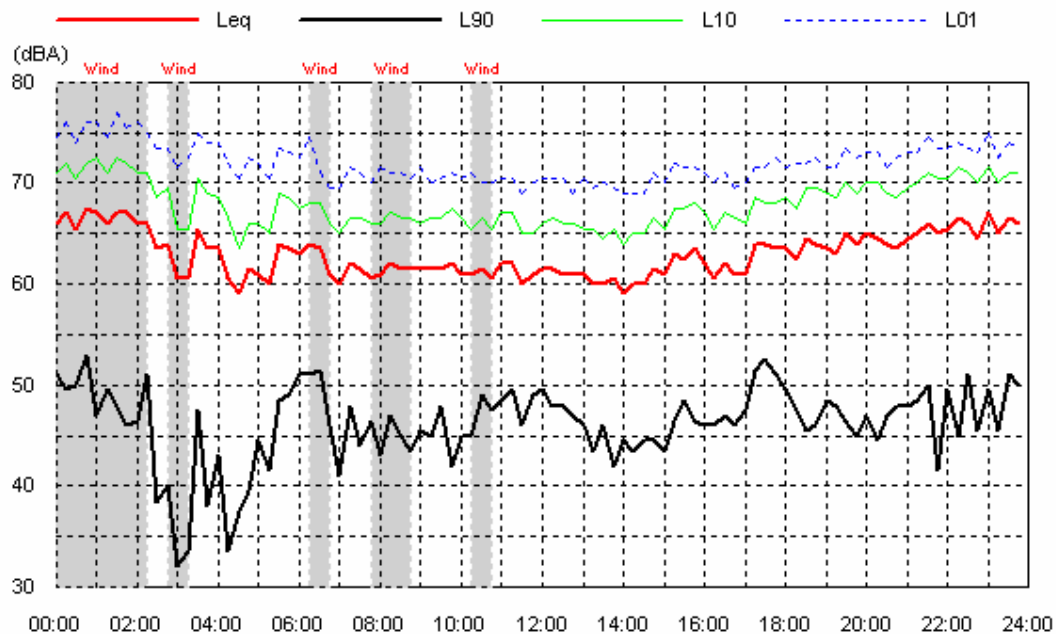
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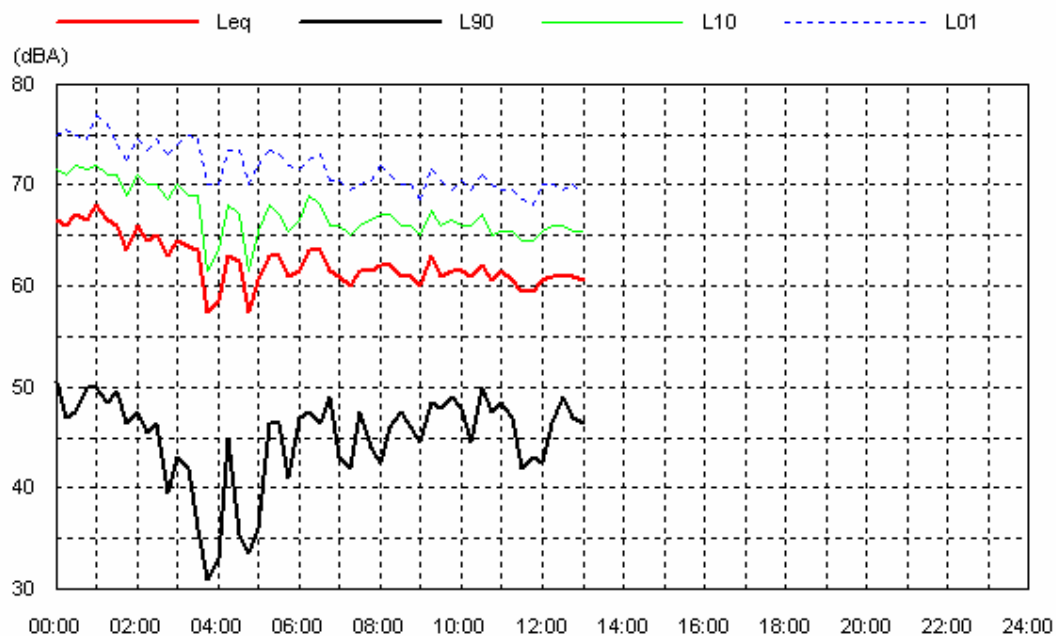
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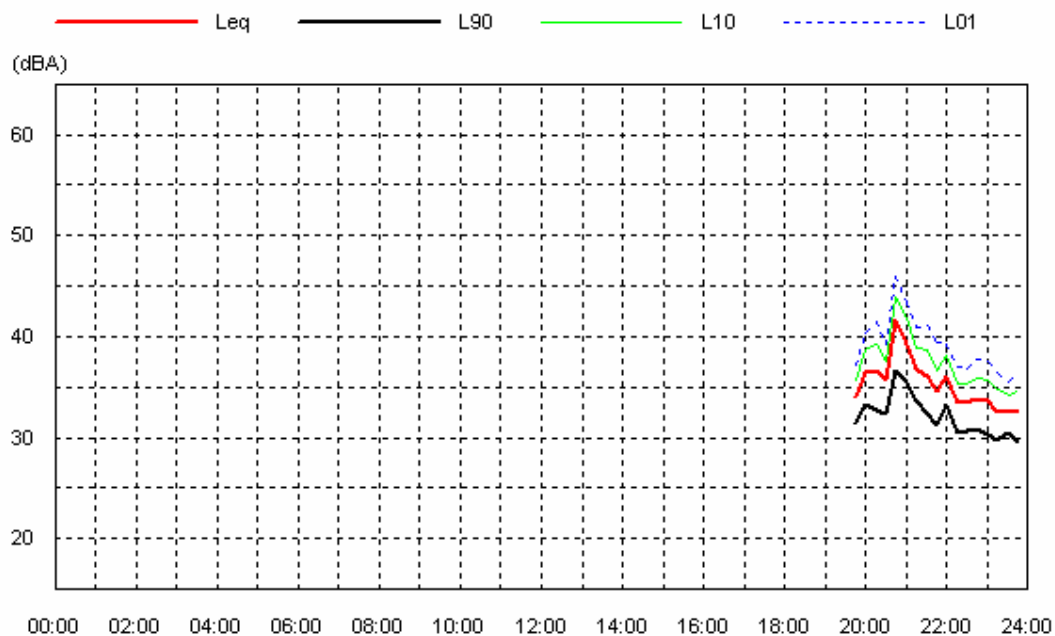
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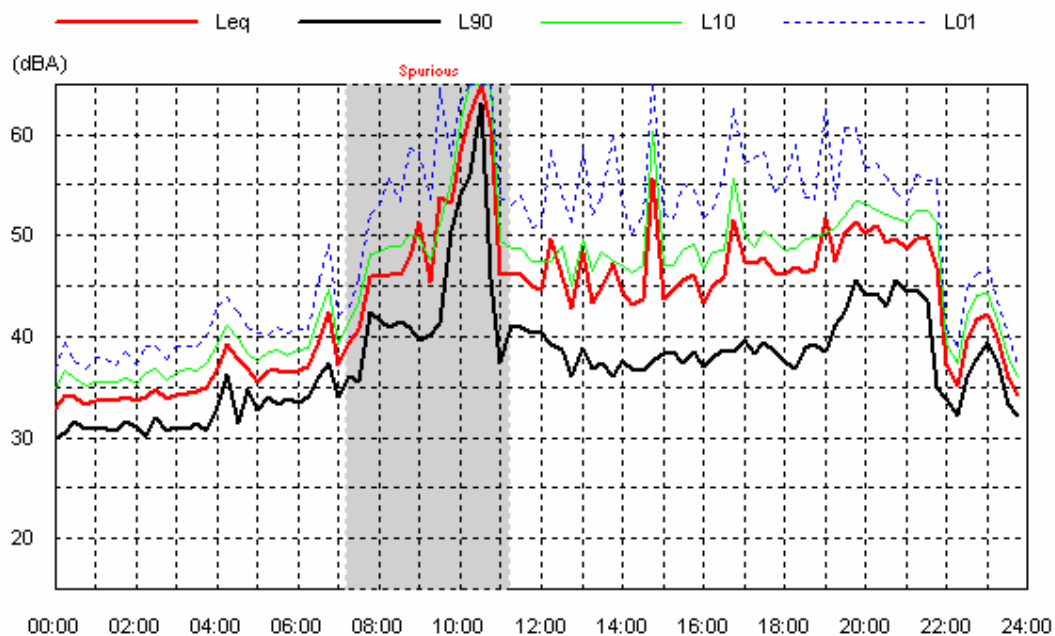
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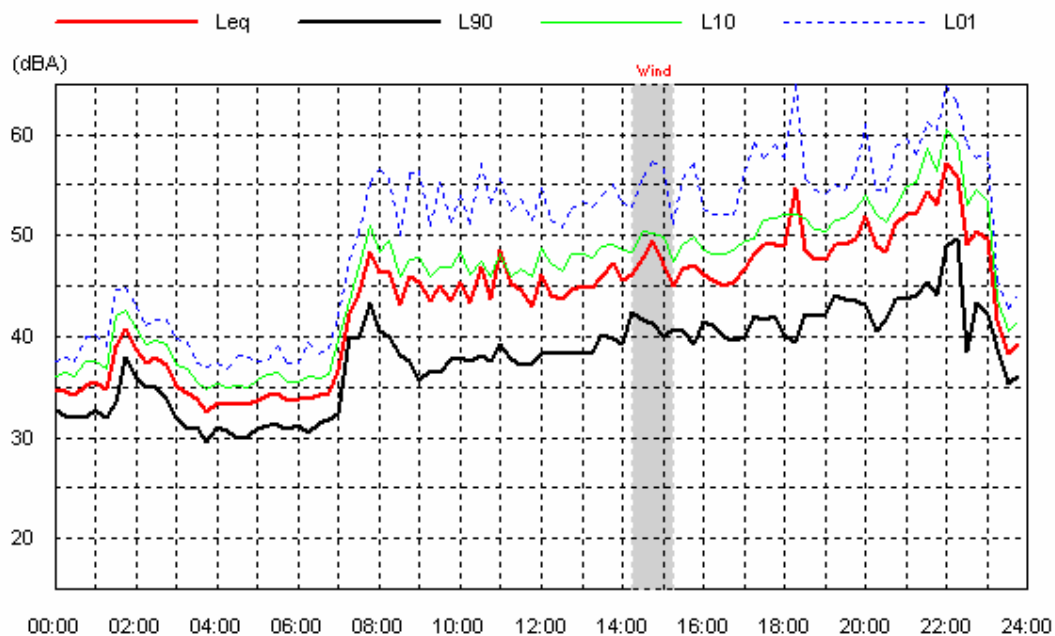
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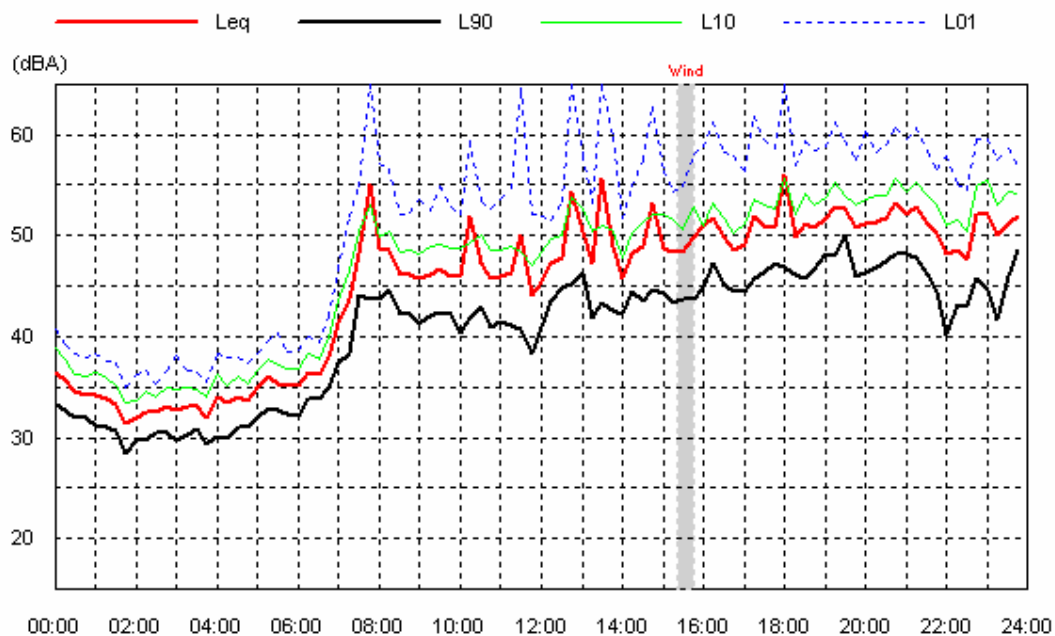
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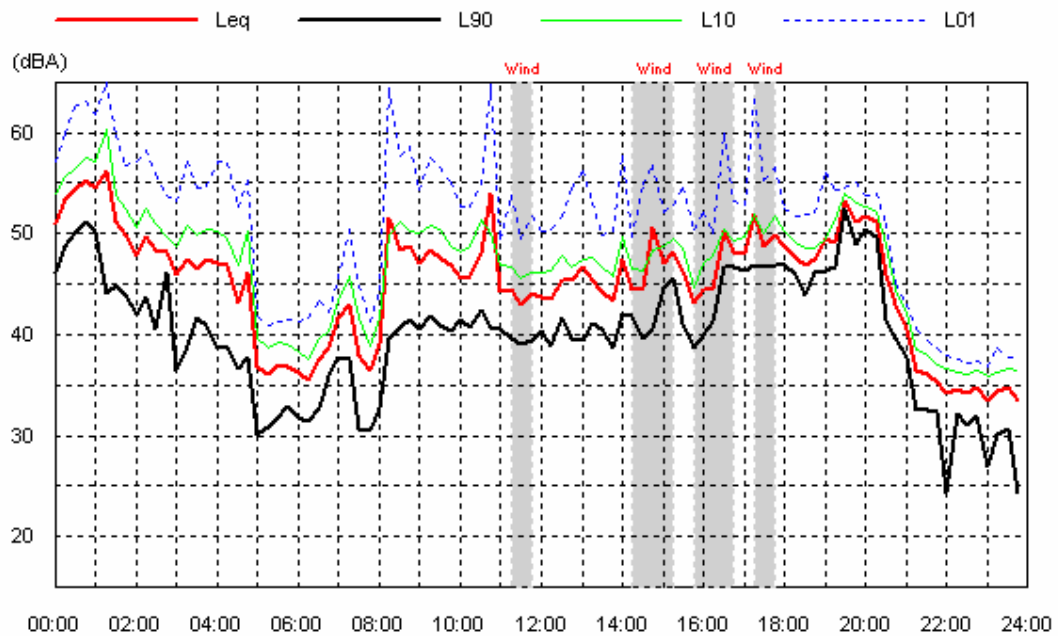
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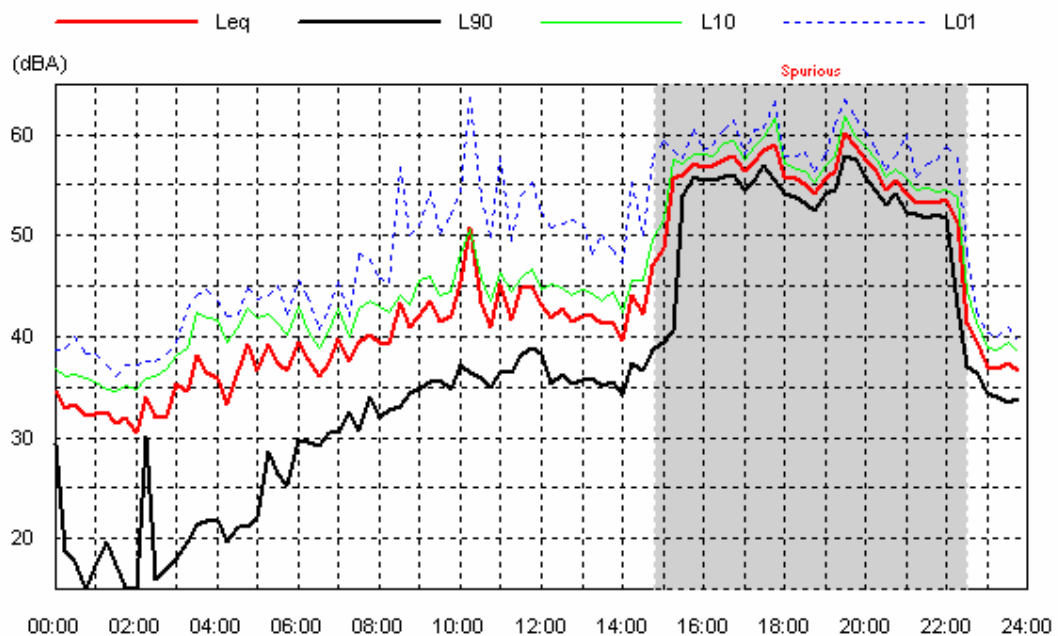
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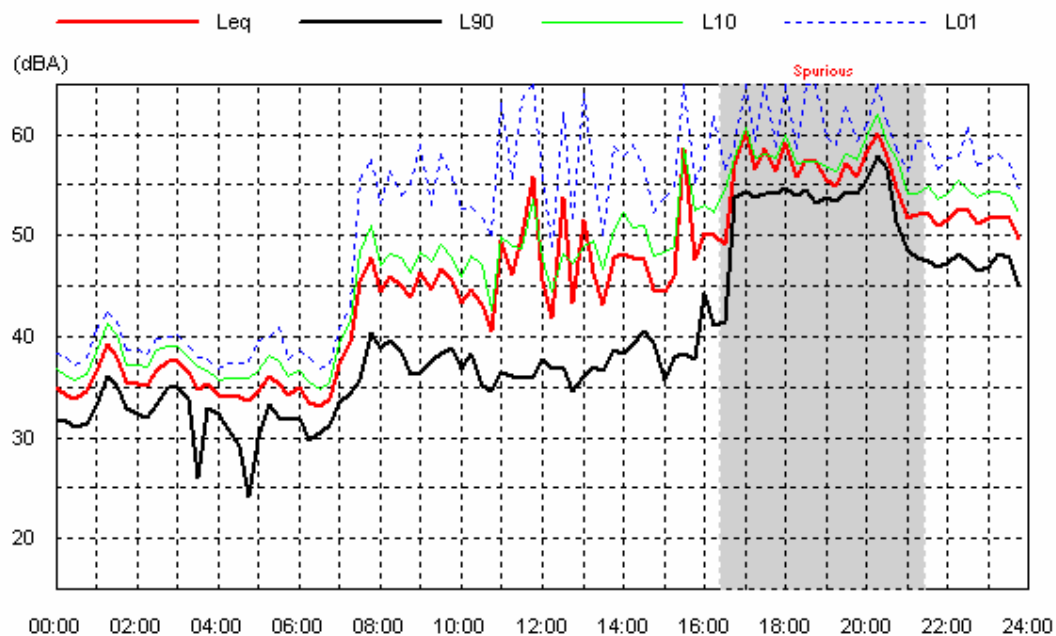
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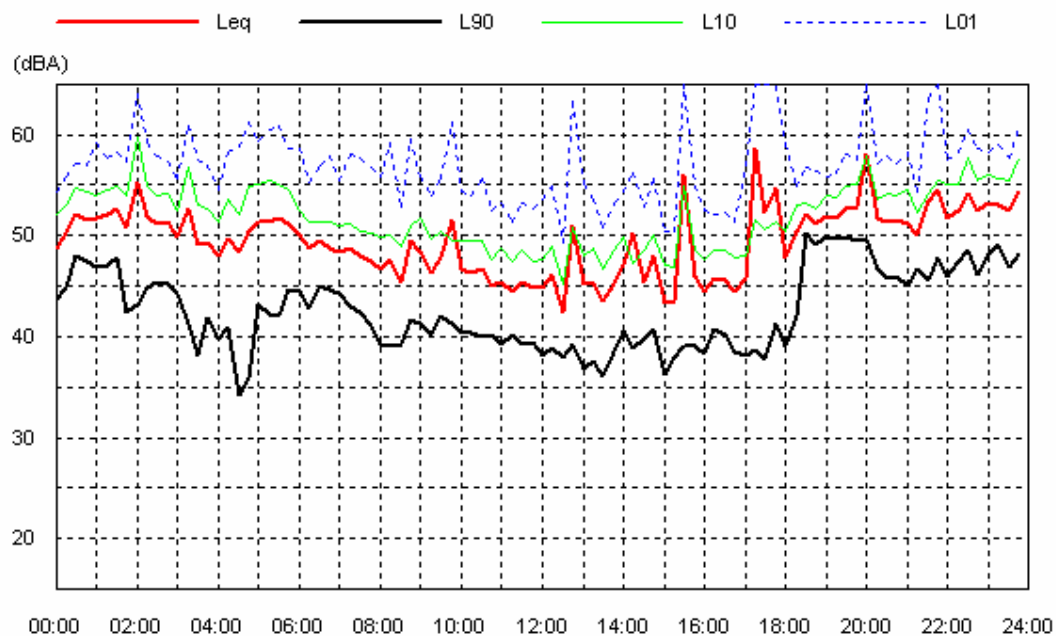
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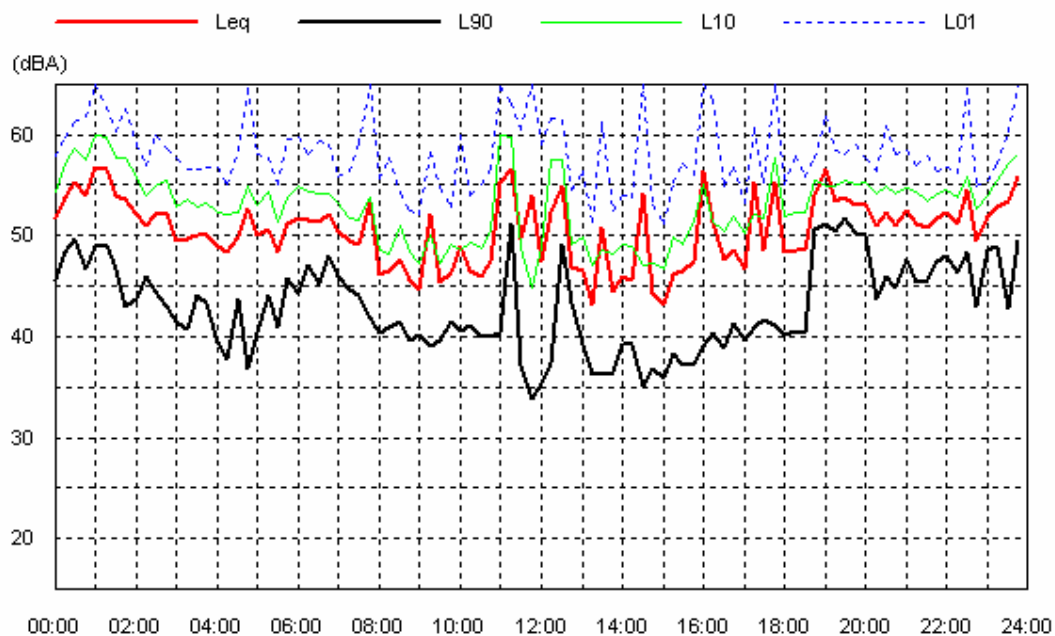
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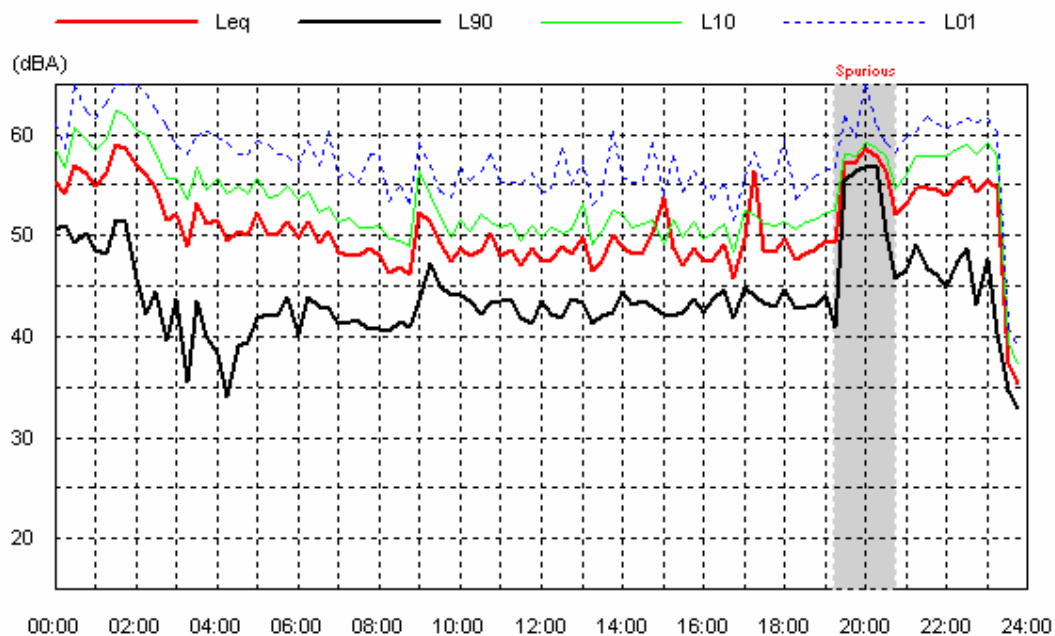
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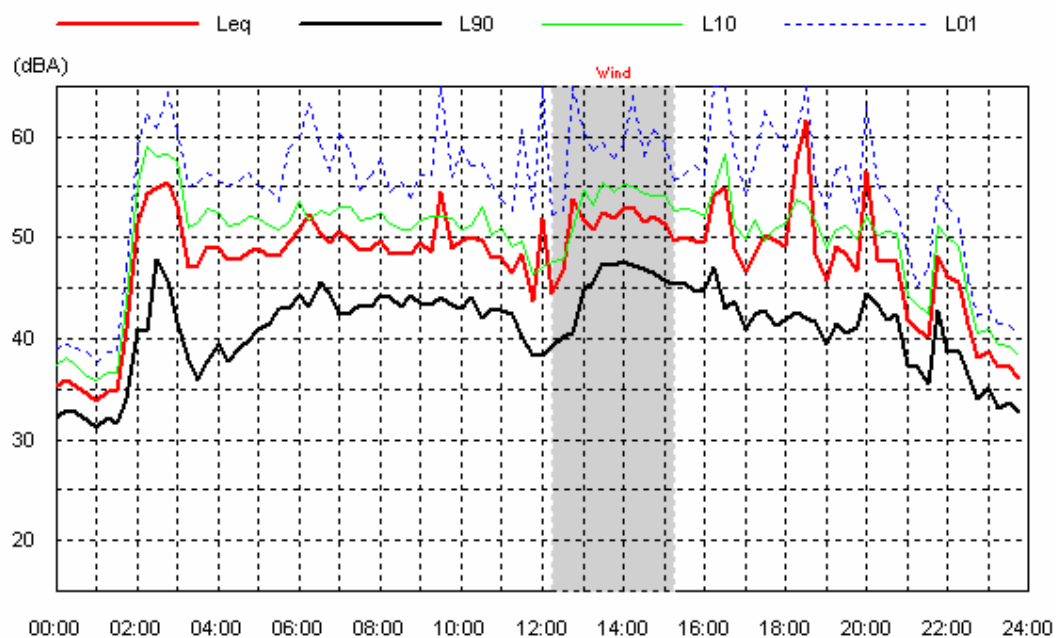
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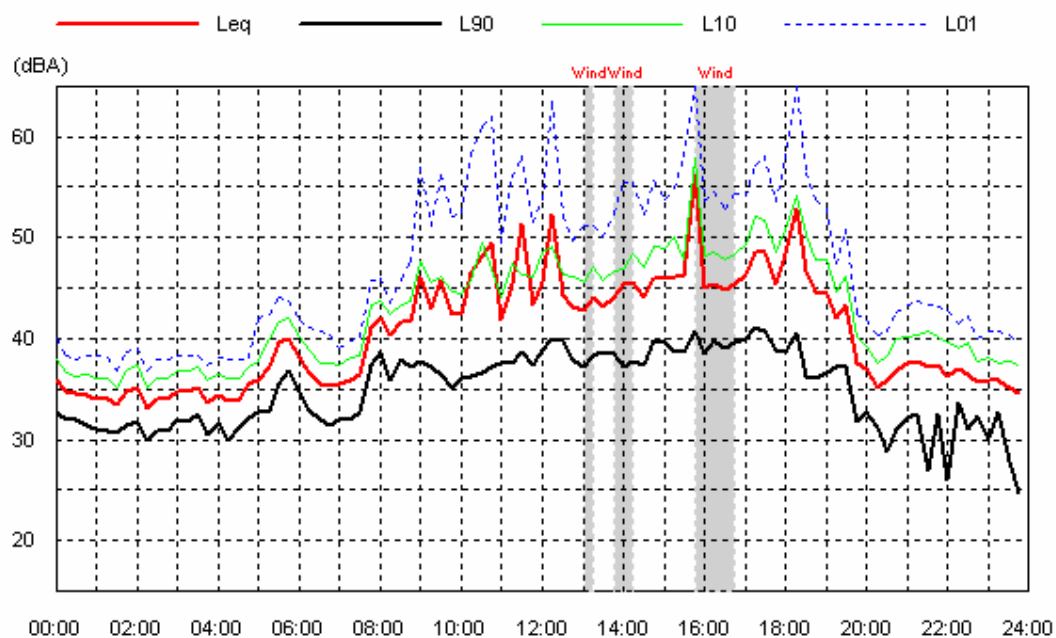
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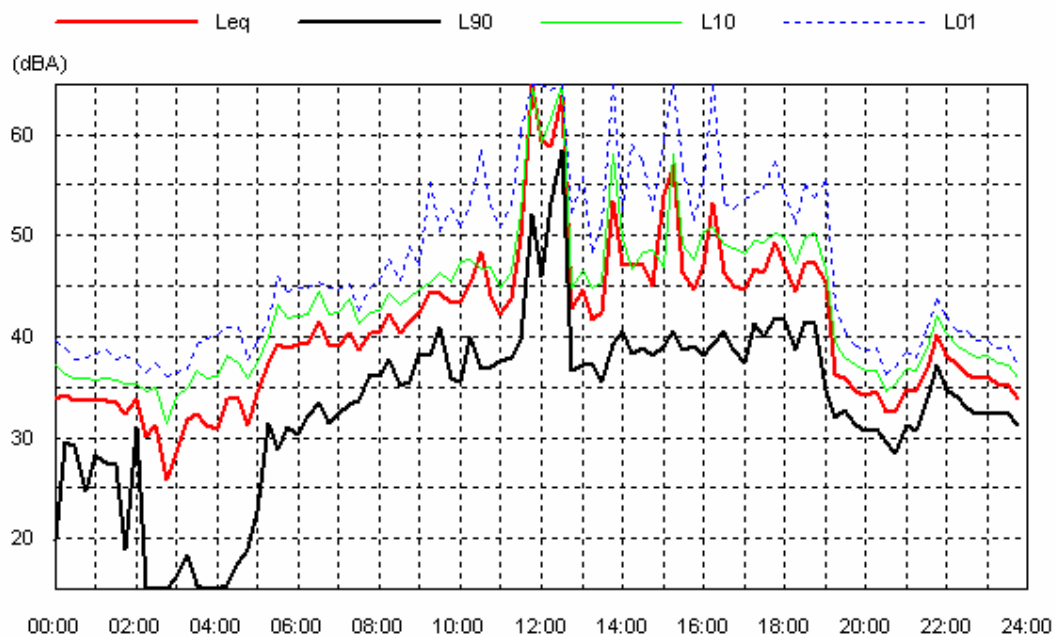
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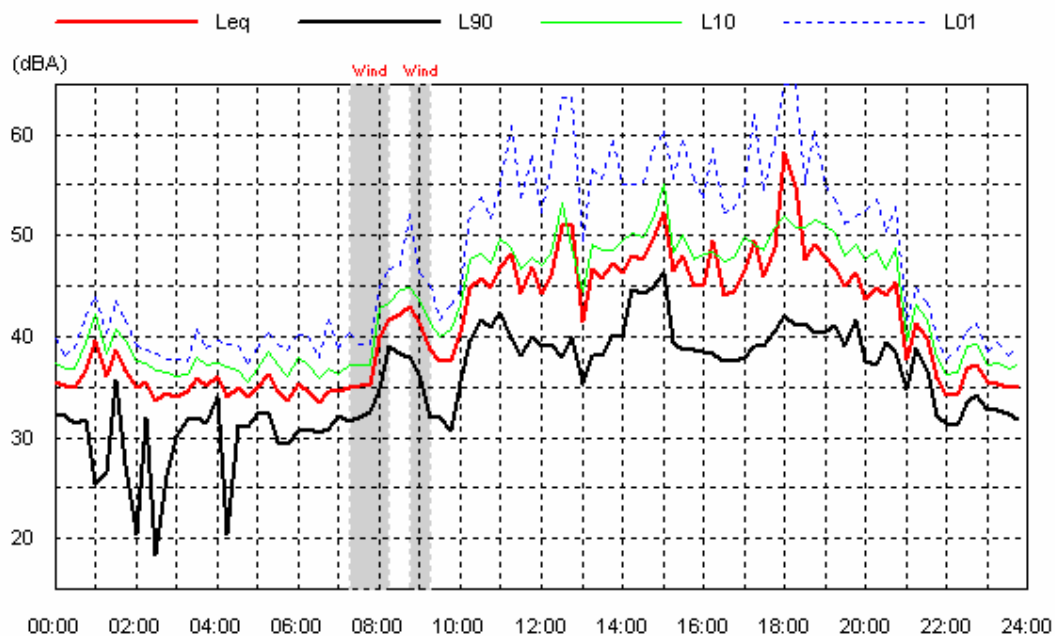
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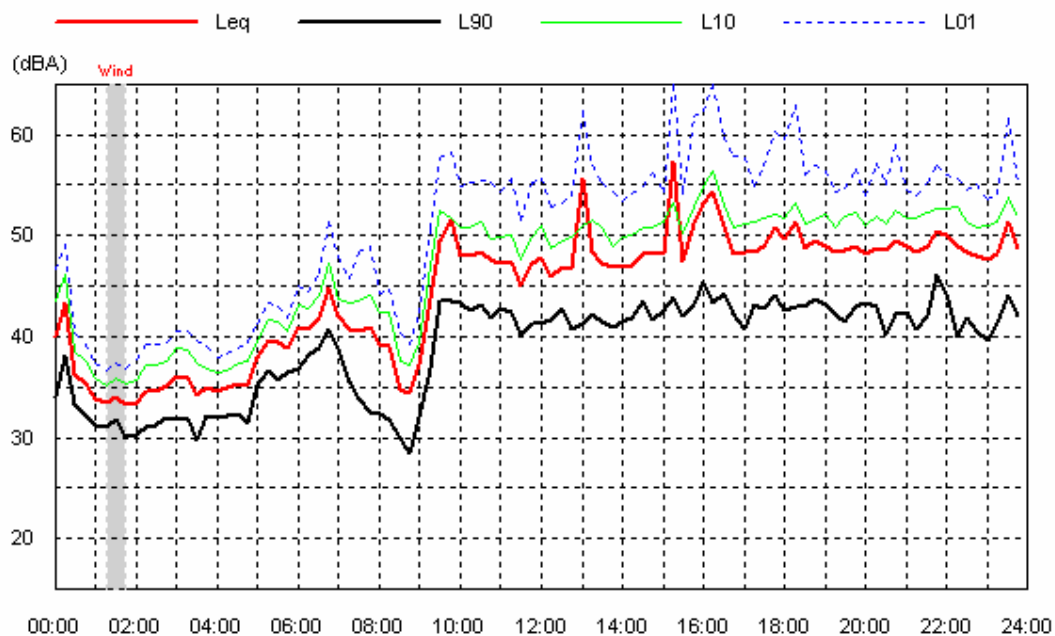
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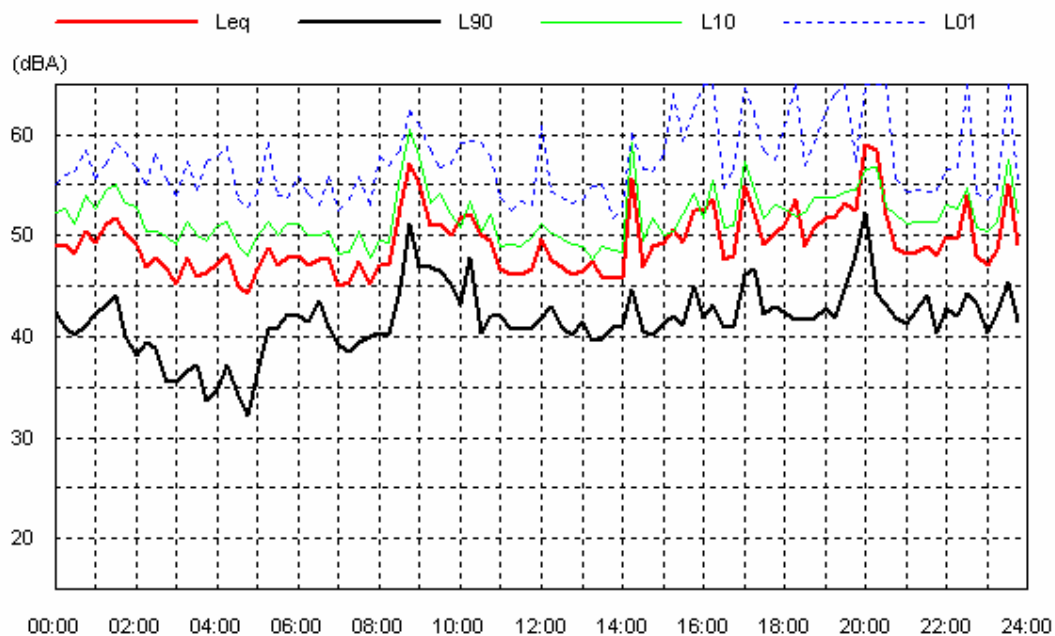
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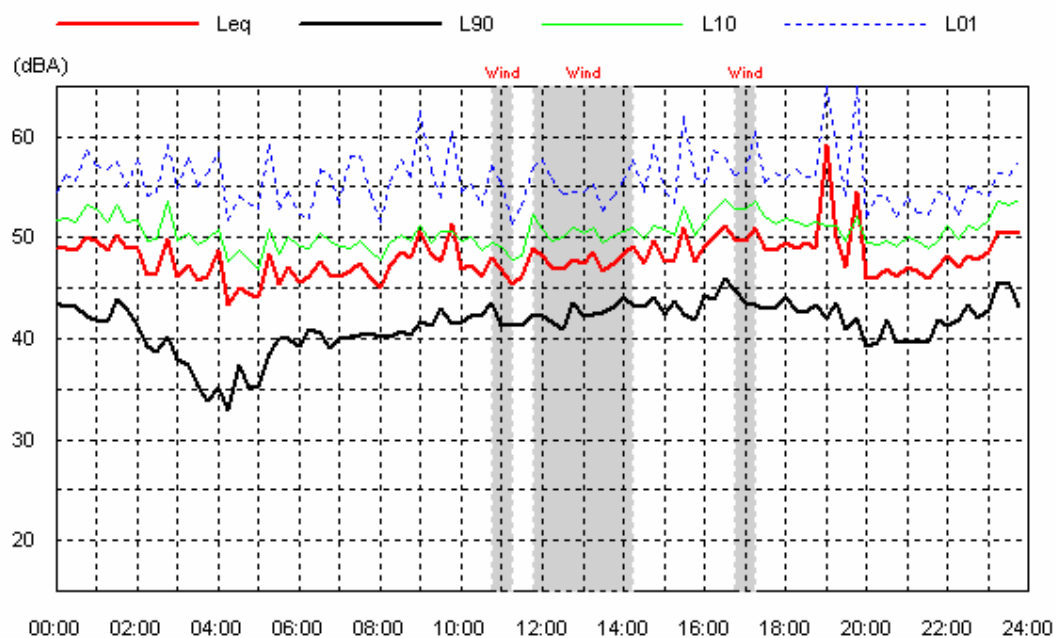
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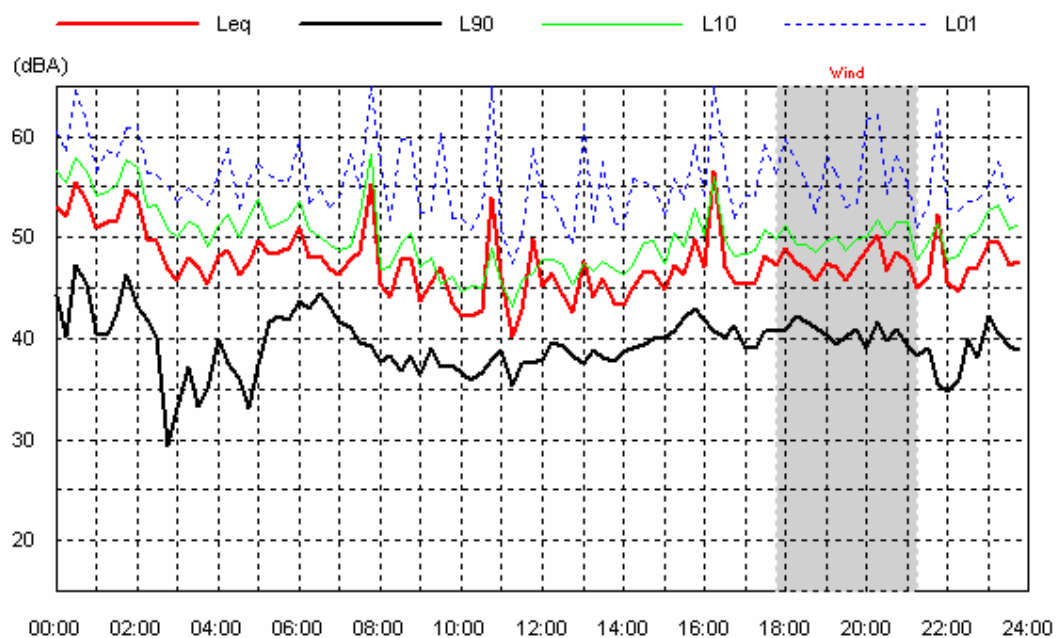
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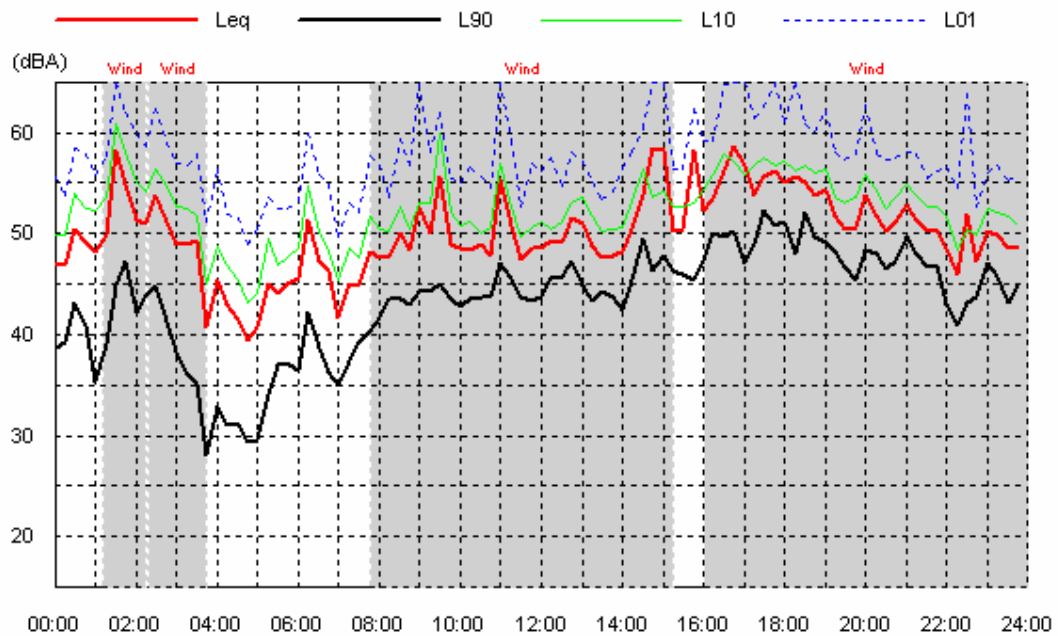
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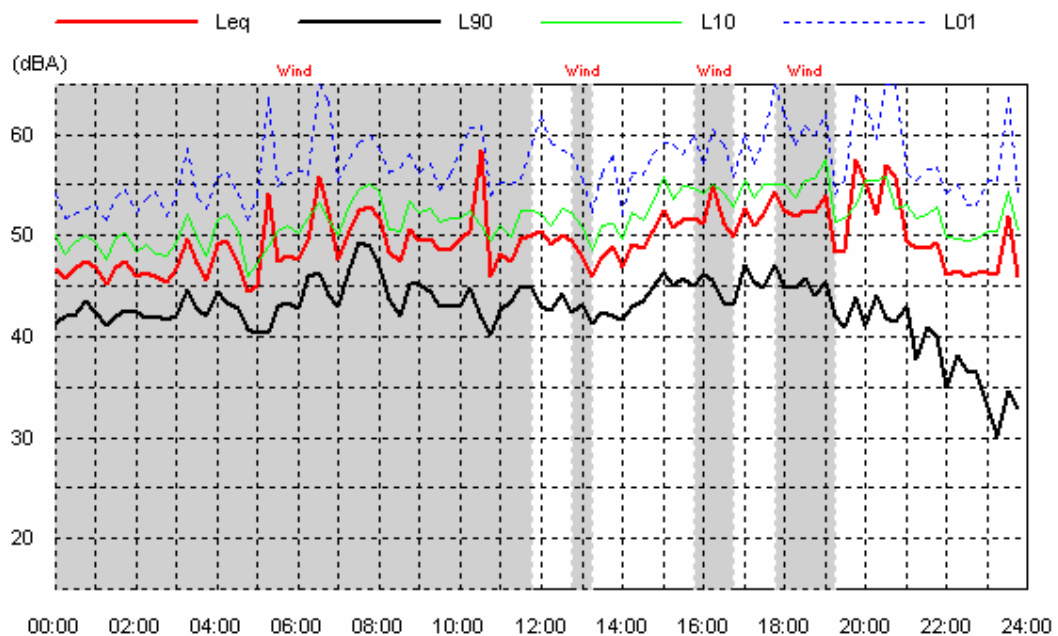
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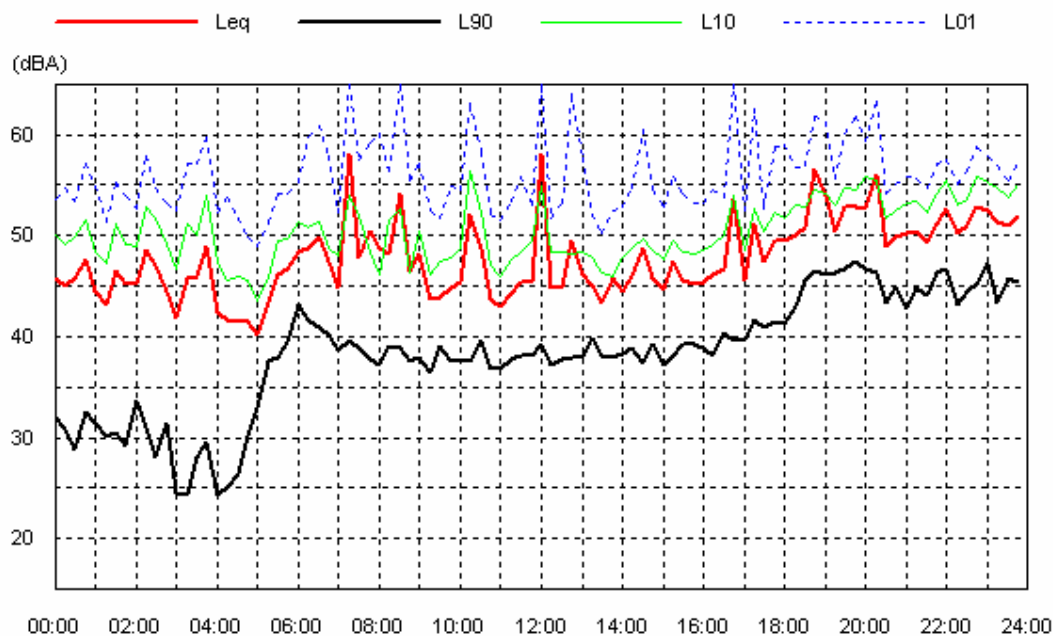
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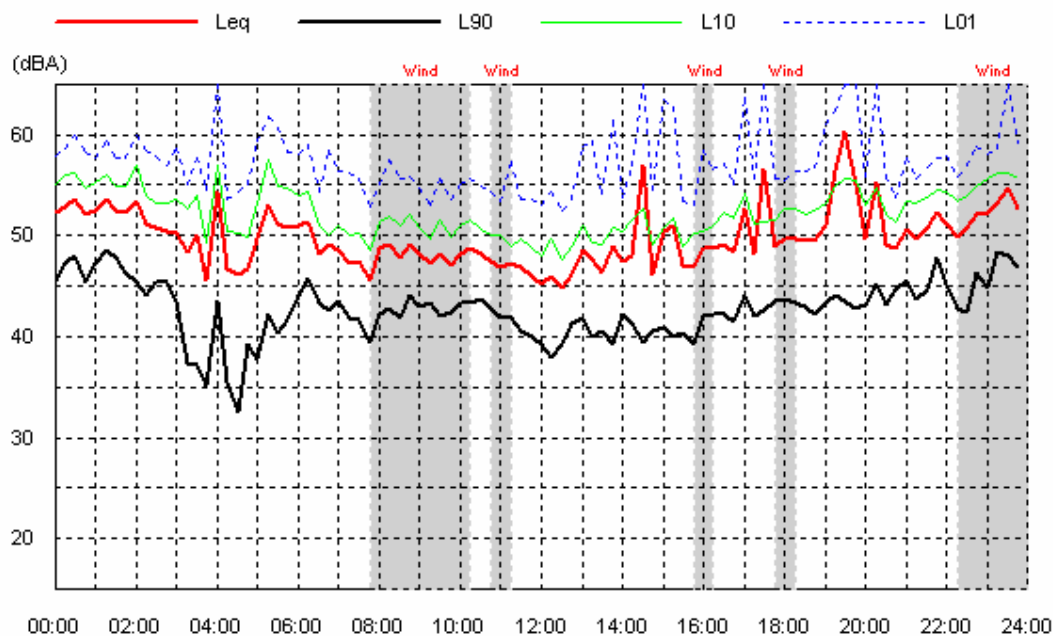
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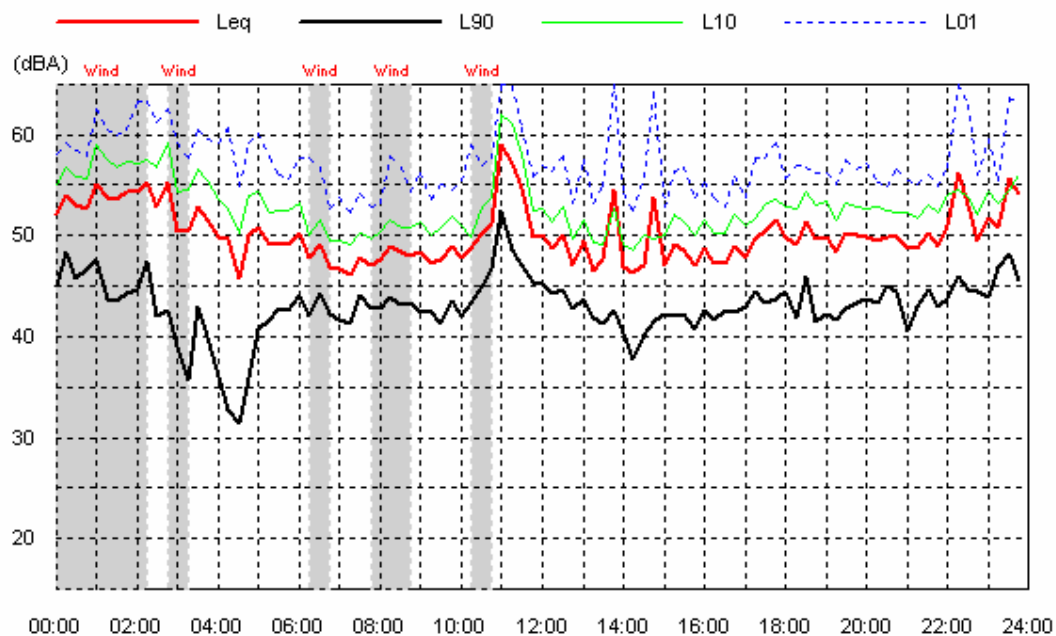
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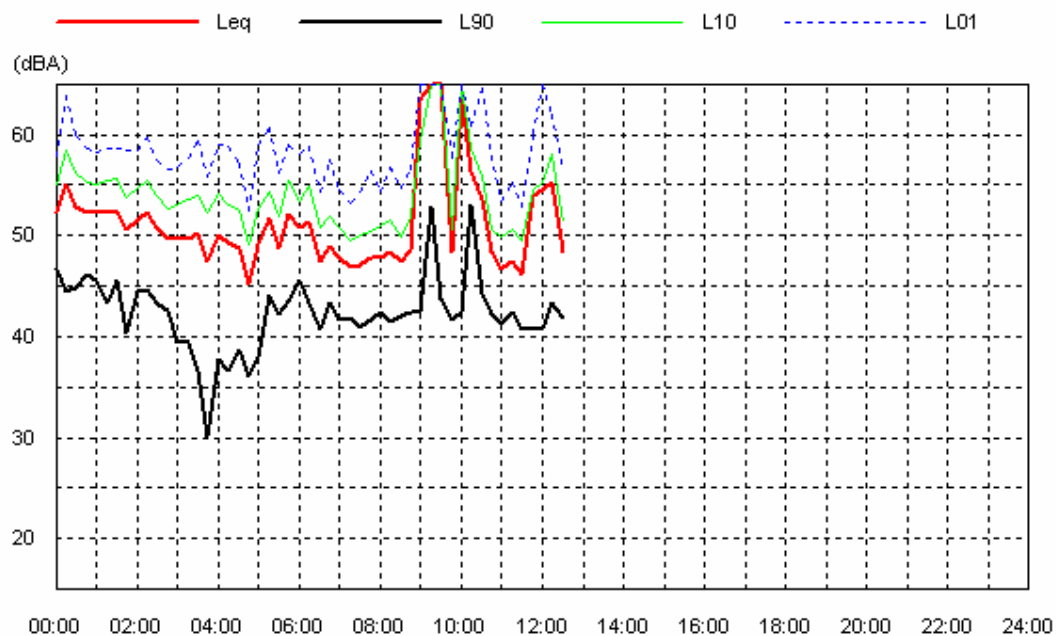
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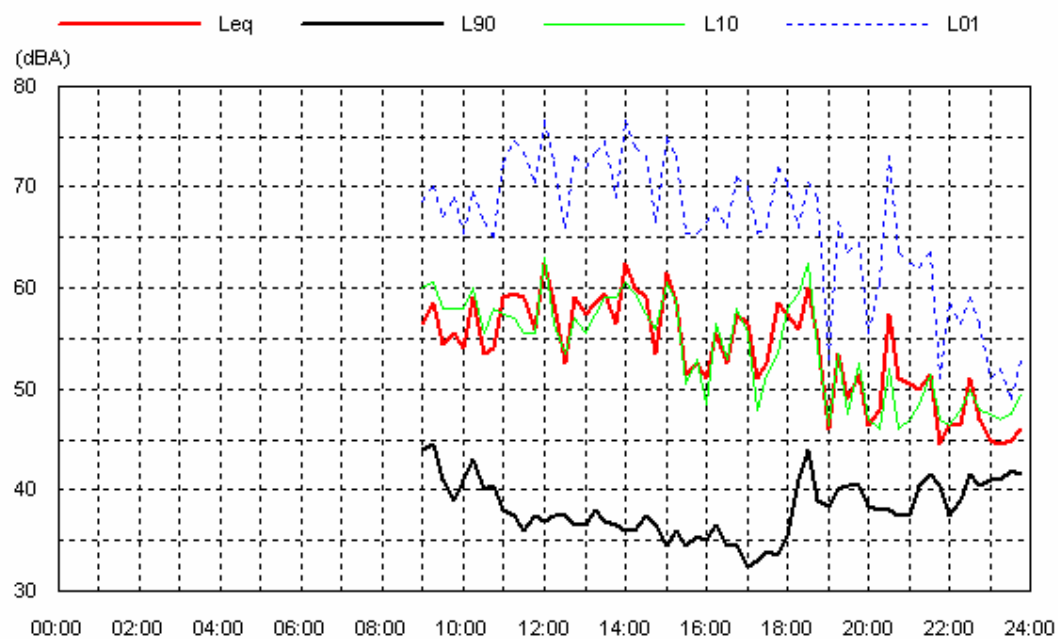


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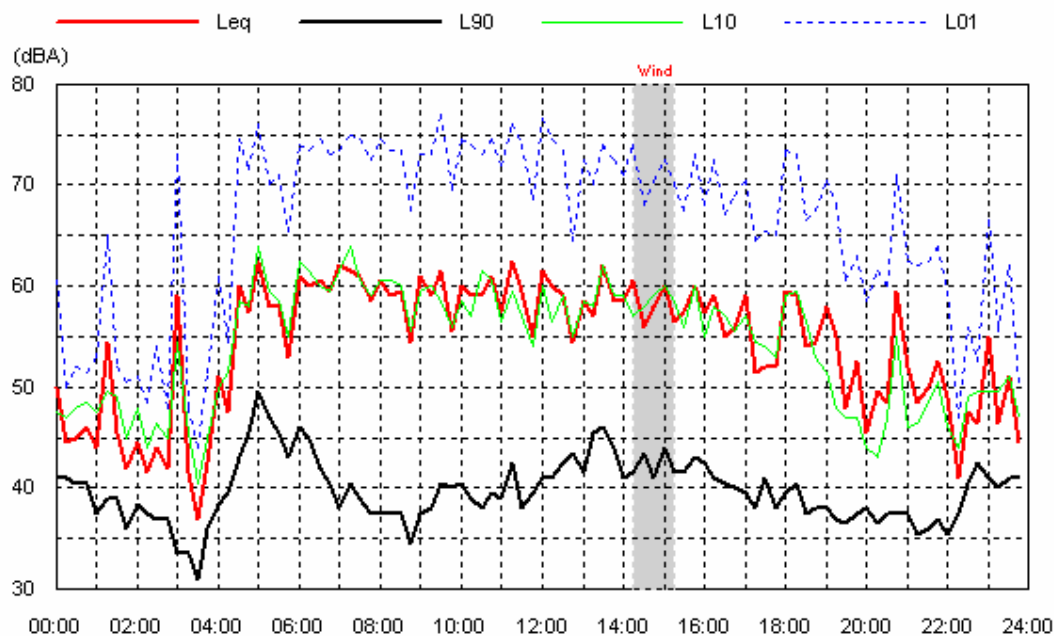
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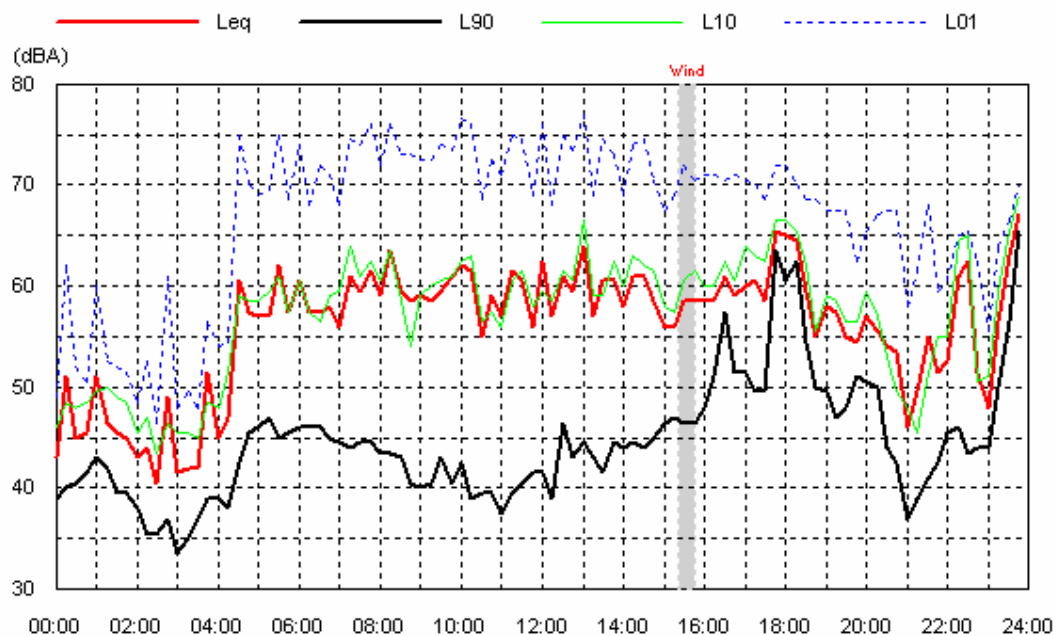
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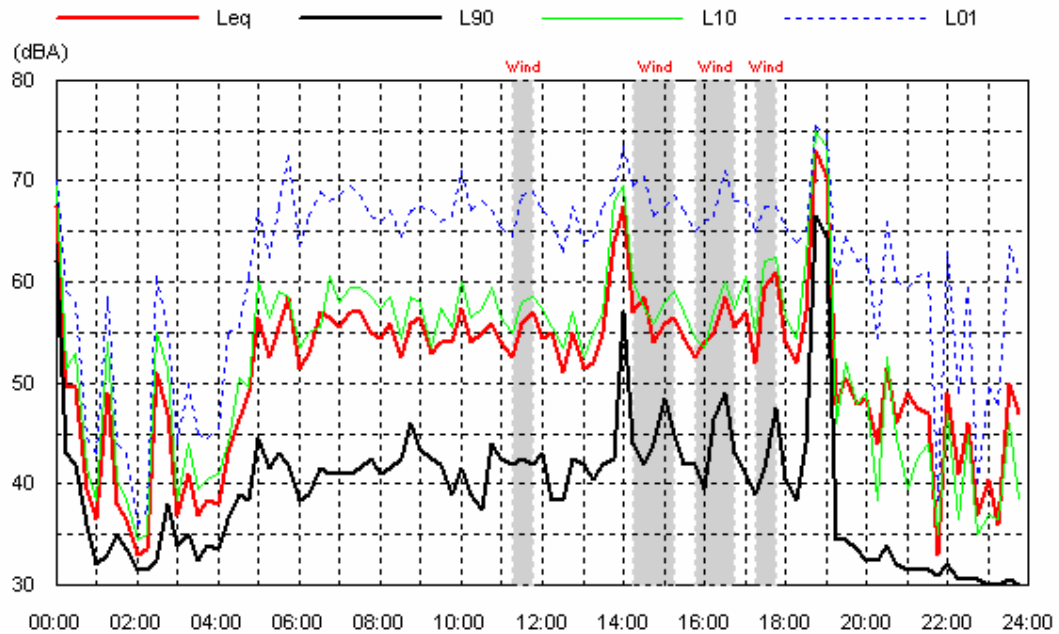
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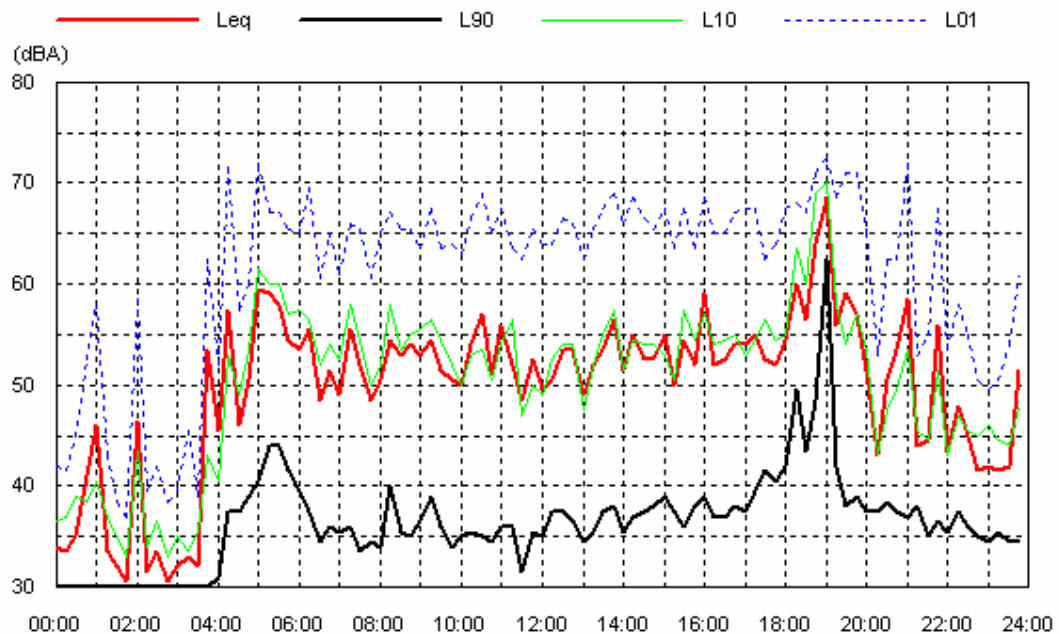
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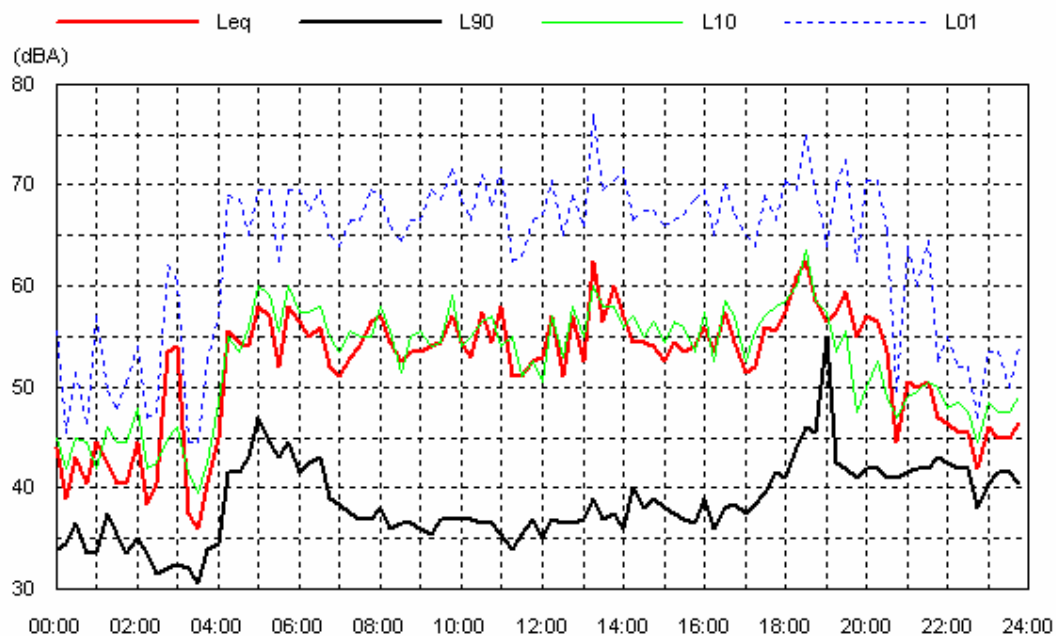
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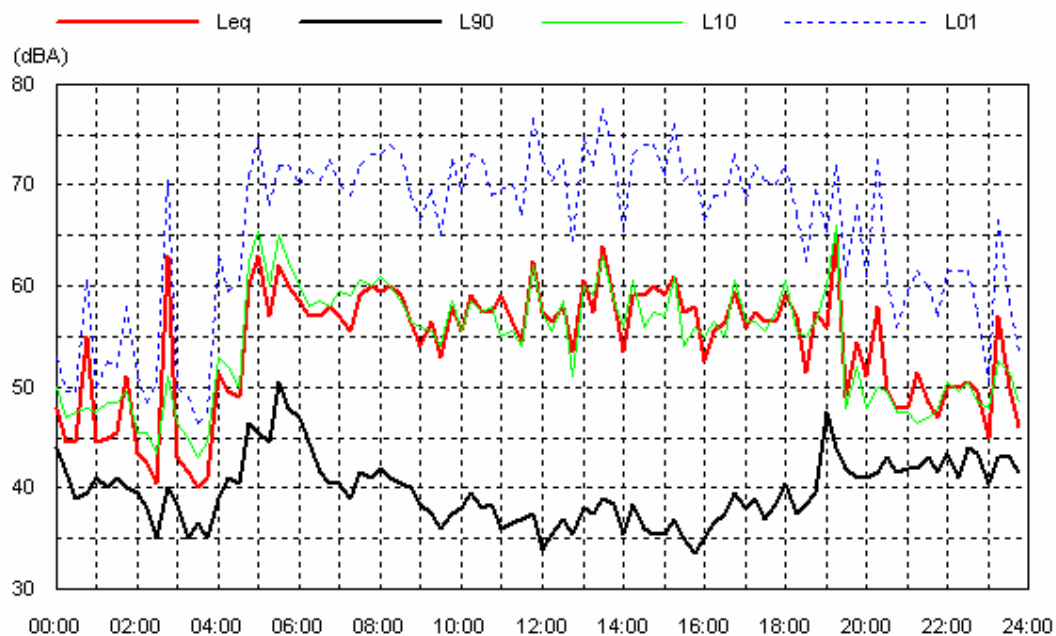
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Data shaded: Downloading Data; Wind

Mon 10 Nov 08



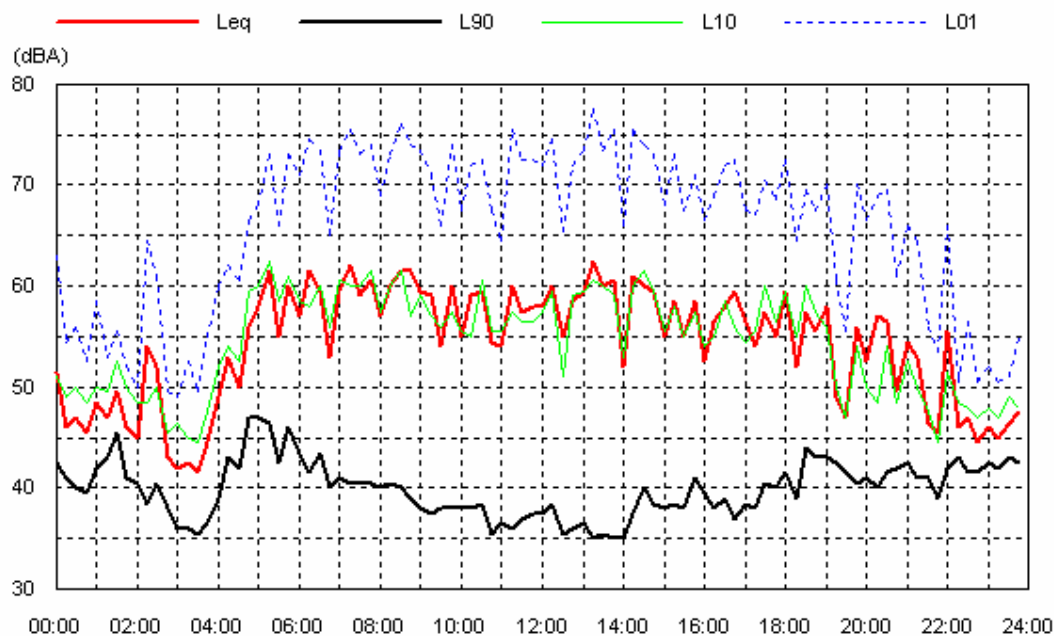
Tue 11 Nov 08



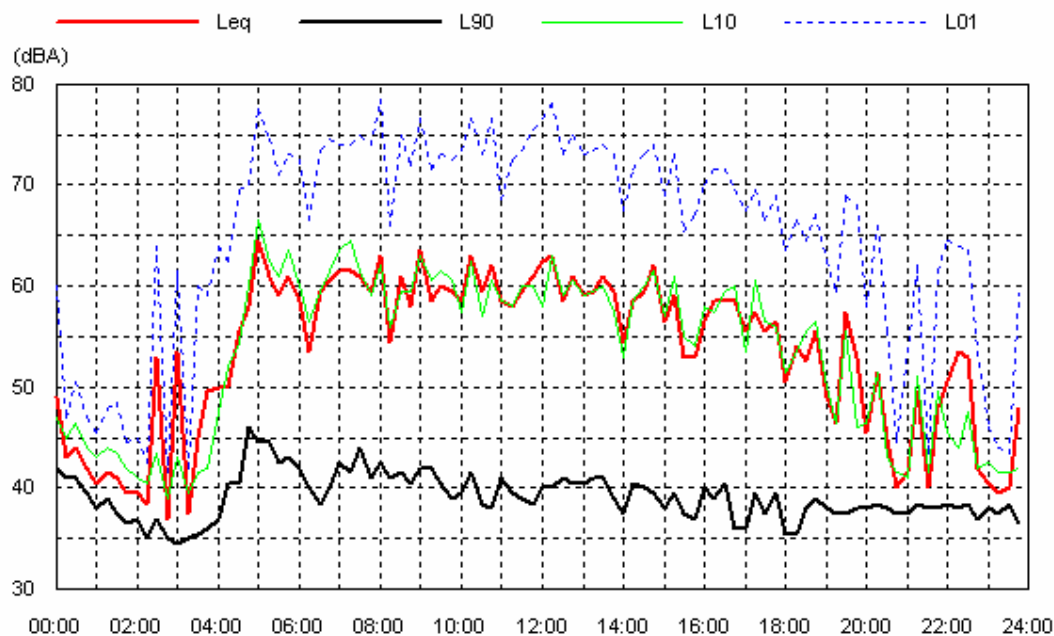
Location C: Burra Hereford Stud, Culcairn Road, Holbrook (DP5540)

Data shaded: Downloading Data; Wind

Wed 12 Nov 08



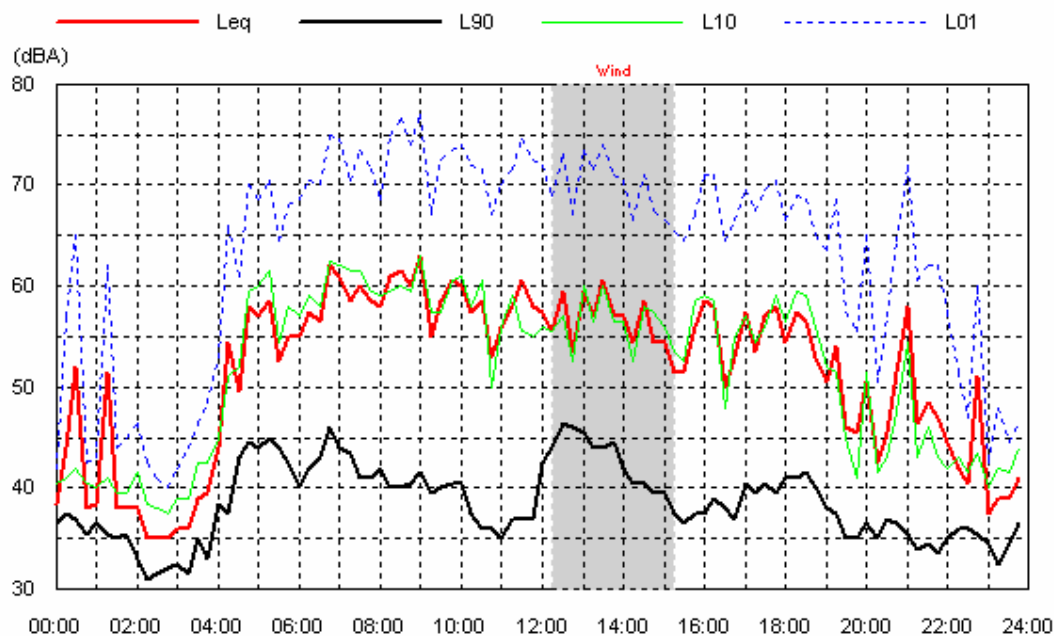
Thu 13 Nov 08



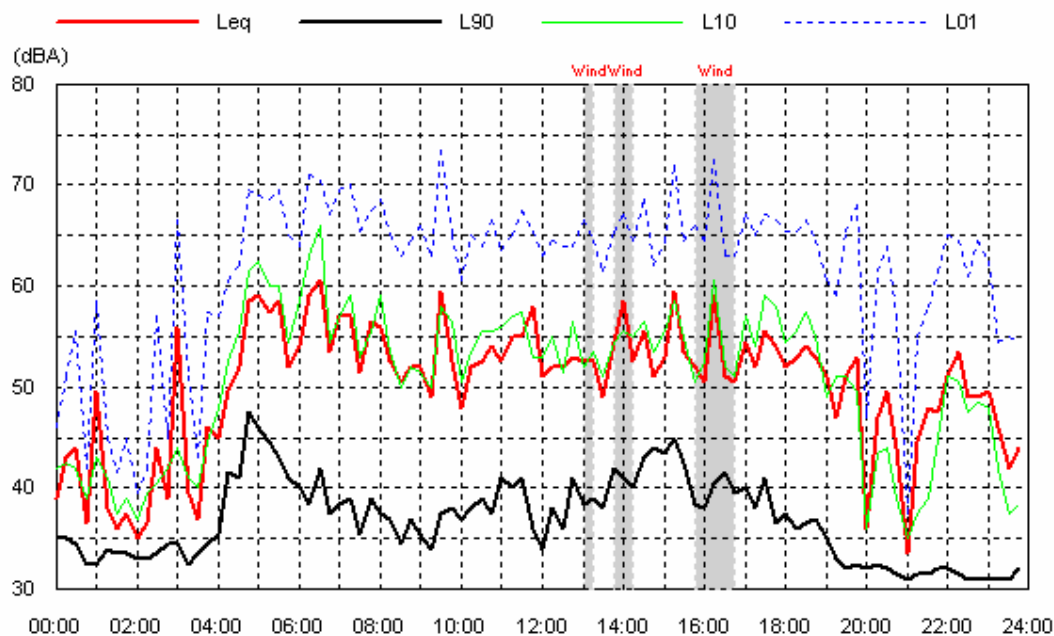
Location C: Burra Hereford Stud, Culcairn Road, Holbrook (DP5540)

Data shaded: Downloading Data; Wind

Fri 14 Nov 08



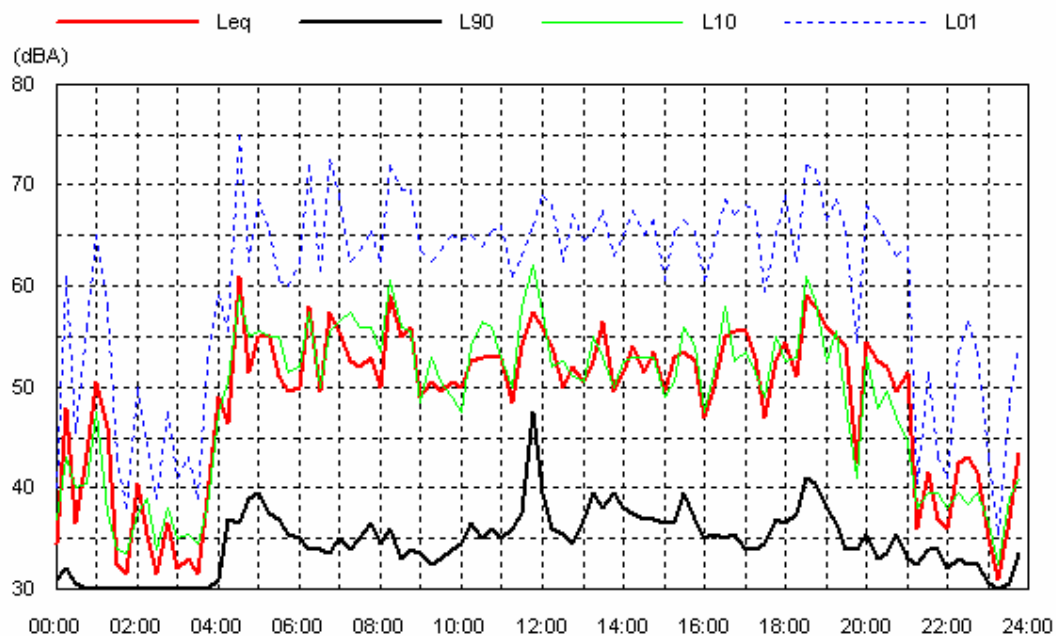
Sat 15 Nov 08



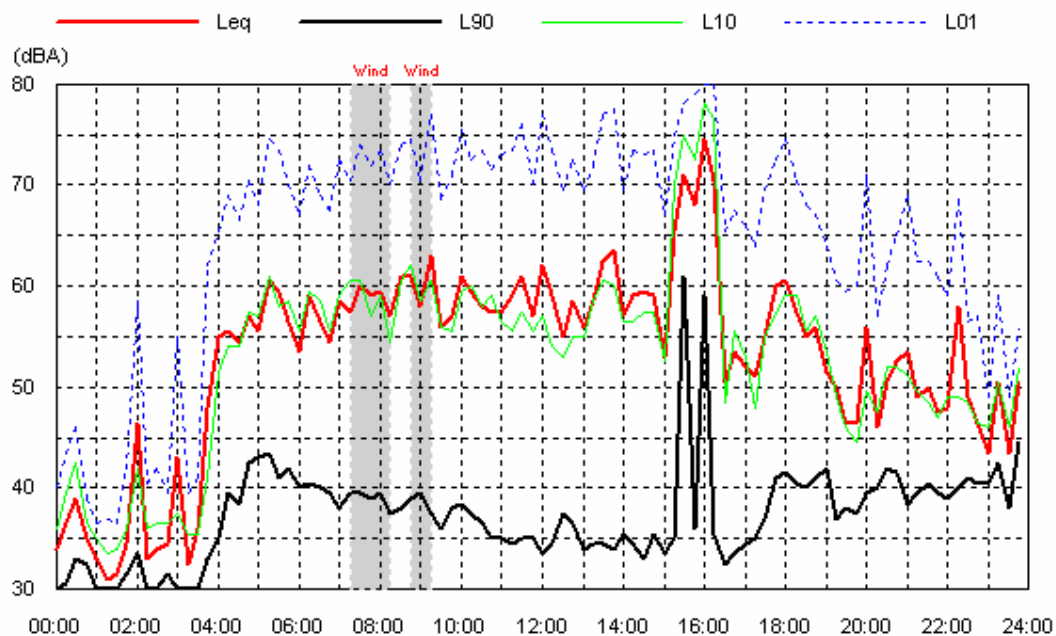
Location C: Burra Hereford Stud, Culcairn Road, Holbrook (DP5540)

Data shaded: Downloading Data; Wind

Sun 16 Nov 08



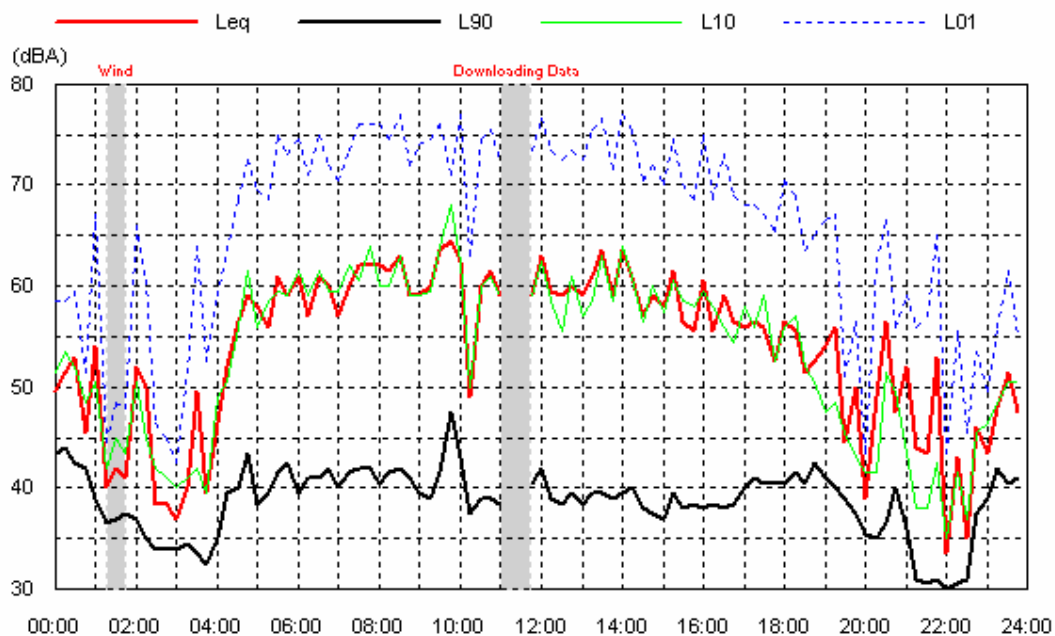
Mon 17 Nov 08



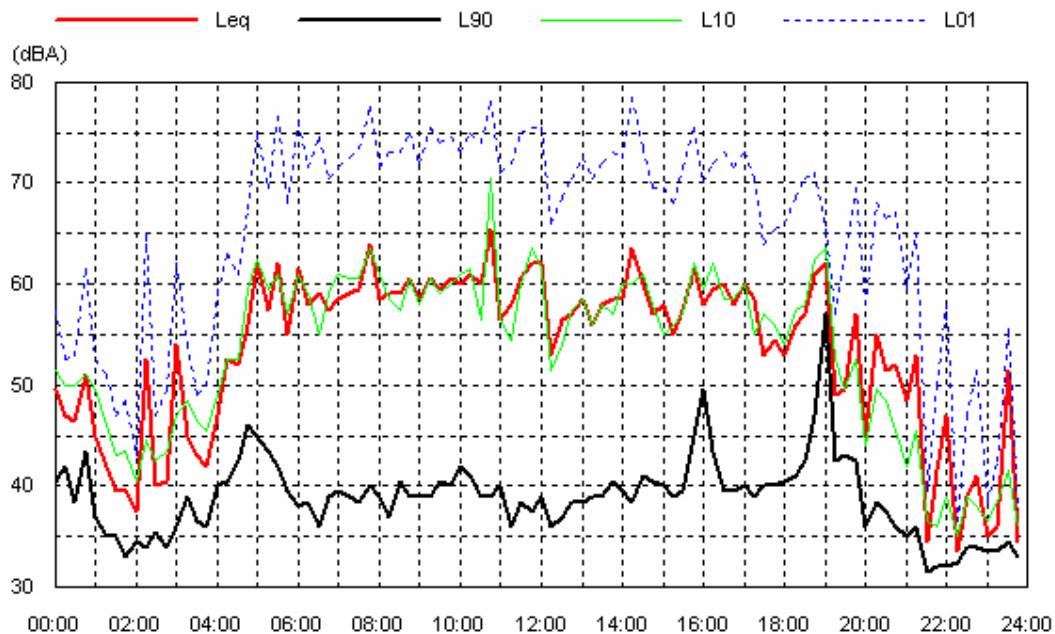
Location C: Burra Hereford Stud, Culcairn Road, Holbrook (DP5540)

Data shaded: Downloading Data; Wind

Tue 18 Nov 08



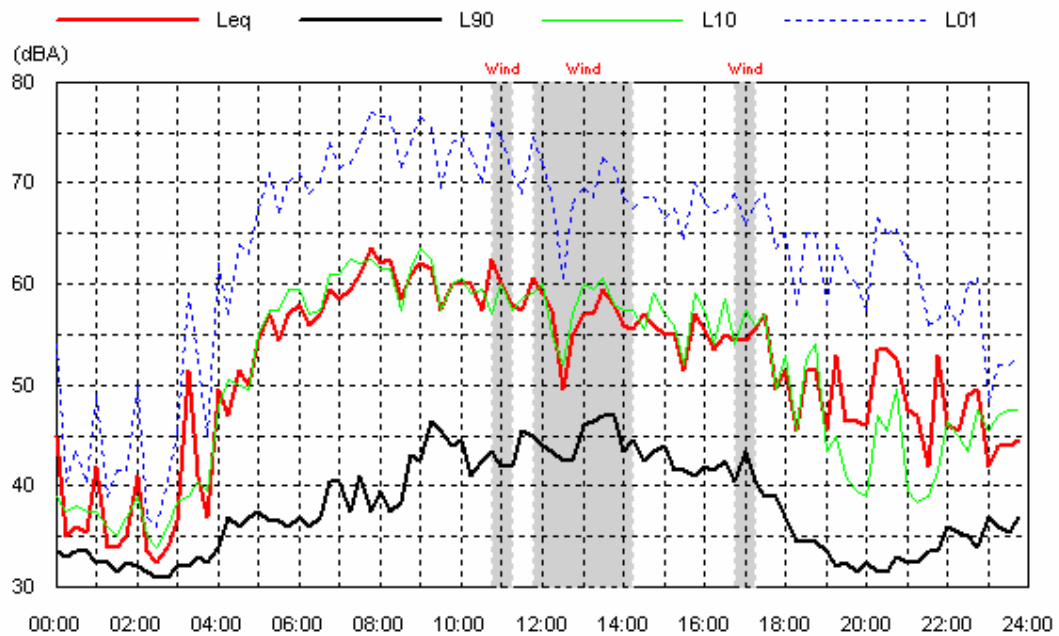
Wed 19 Nov 08



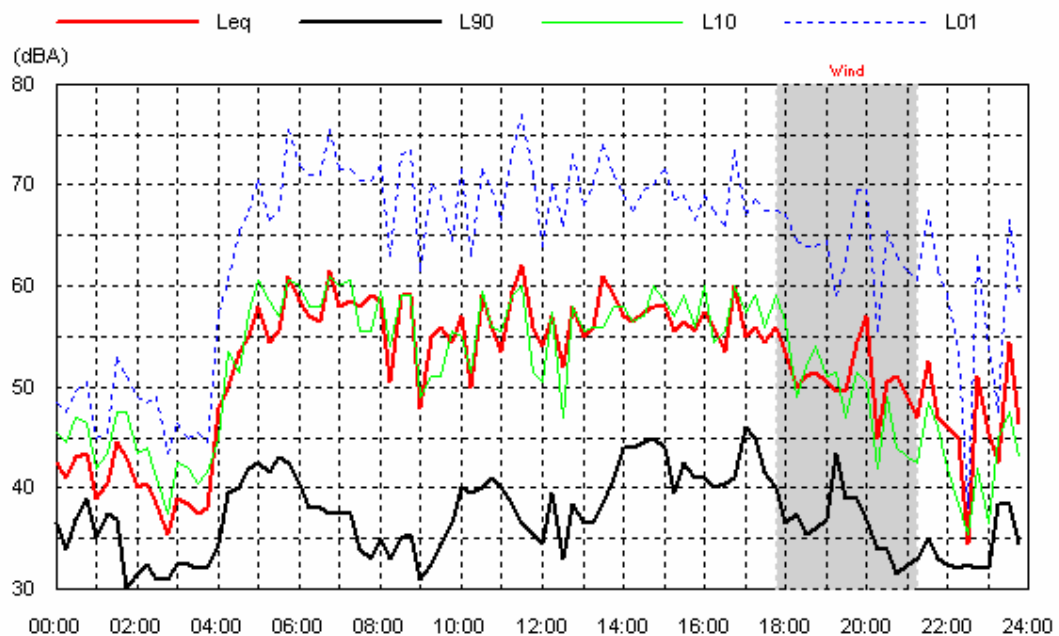
Location C: Burra Hereford Stud, Culcairn Road, Holbrook (DP5540)

Data shaded: Downloading Data; Wind

Thu 20 Nov 08



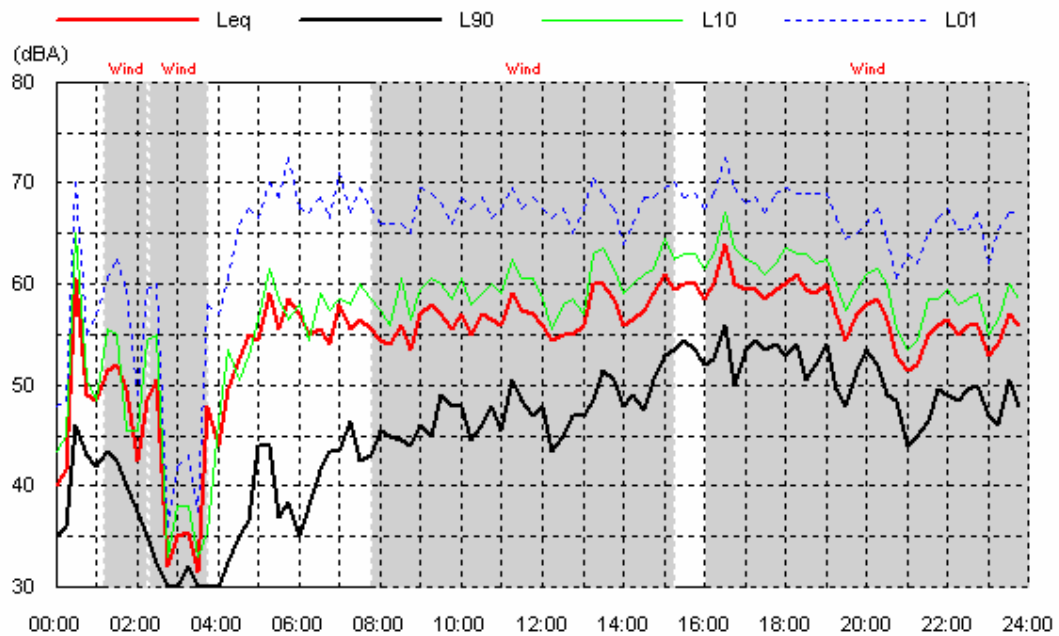
Fri 21 Nov 08



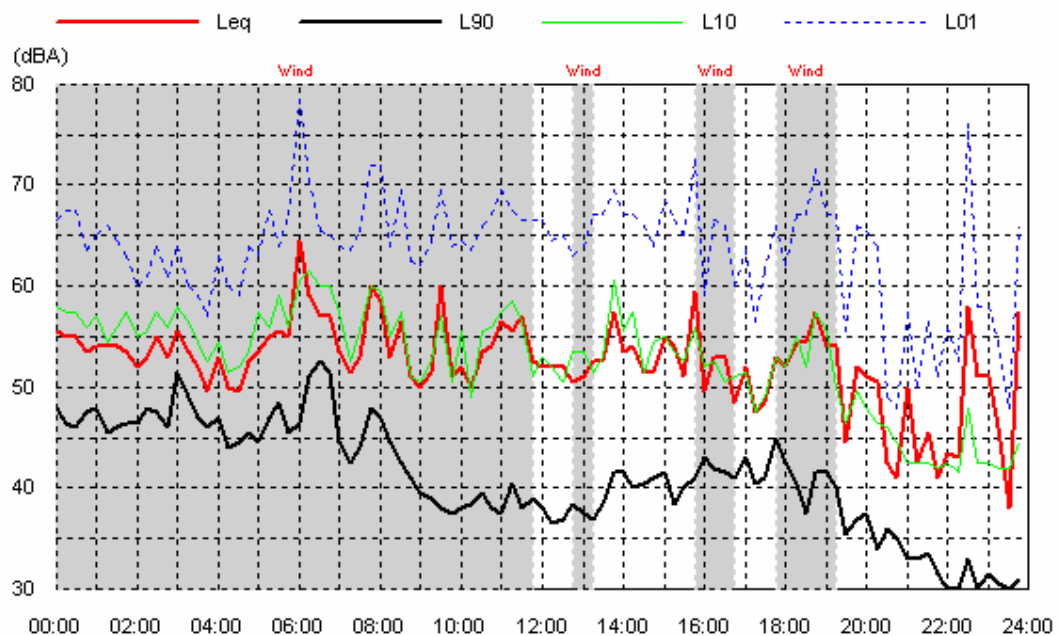
Location C: Burra Hereford Stud, Culcairn Road, Holbrook (DP5540)

Data shaded: Downloading Data; Wind

Sat 22 Nov 08



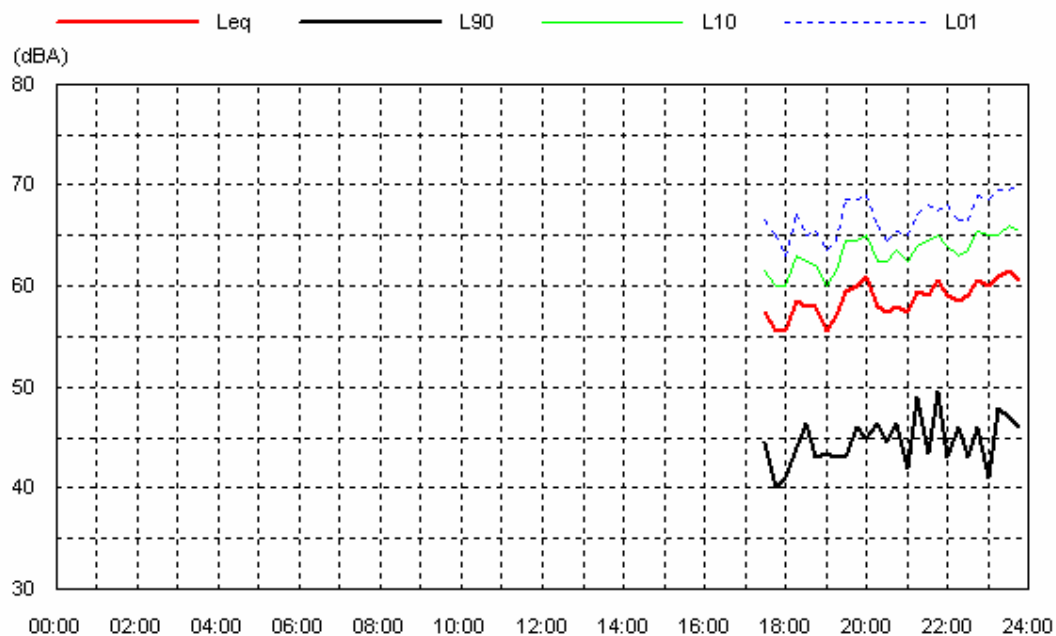
Sun 23 Nov 08



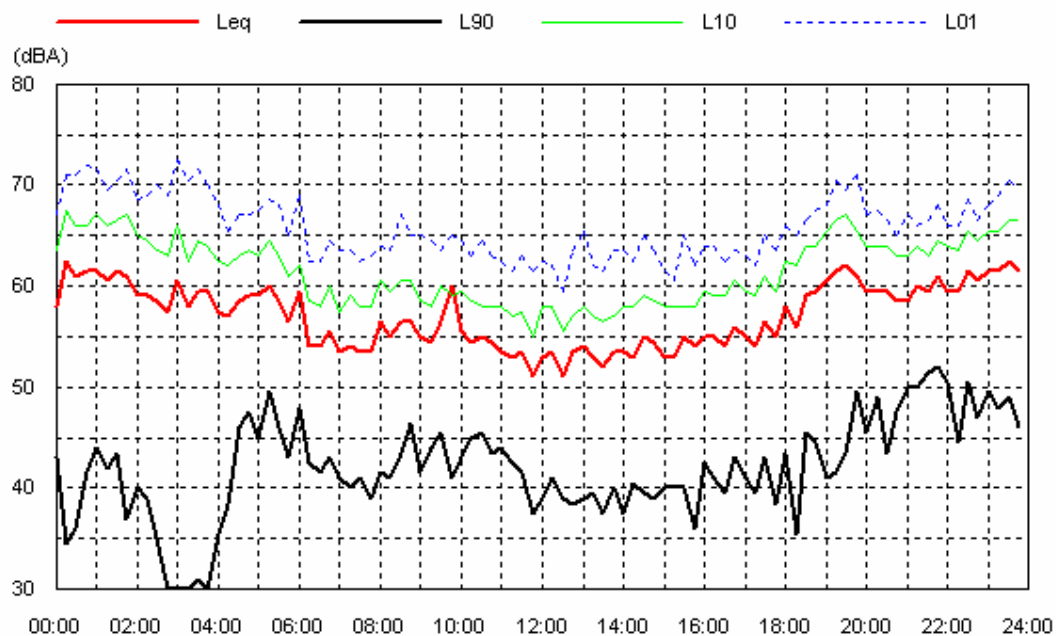
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Tue 04 Nov 08



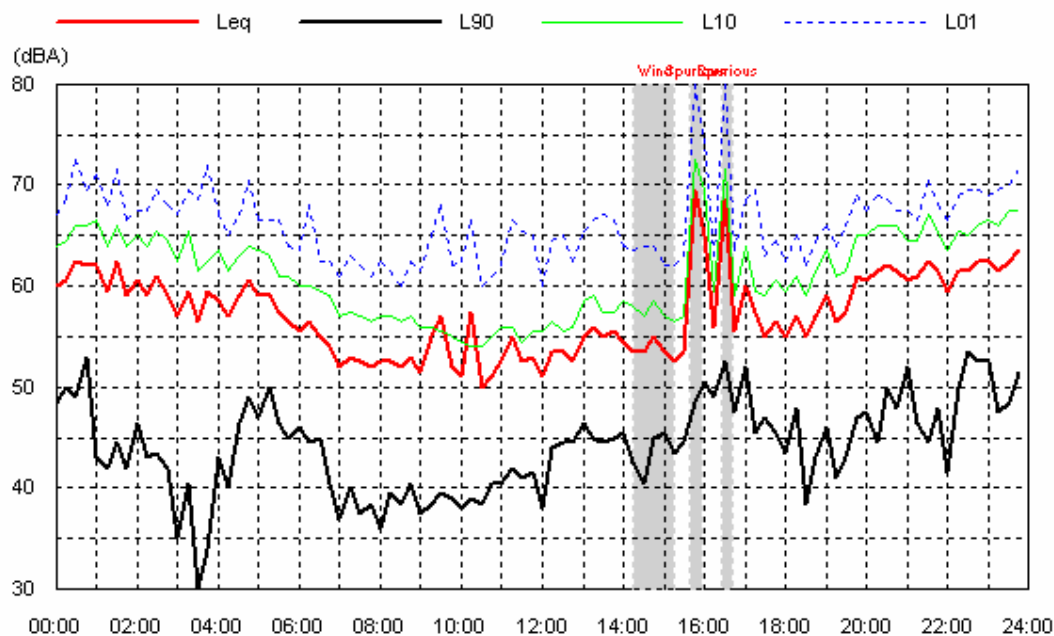
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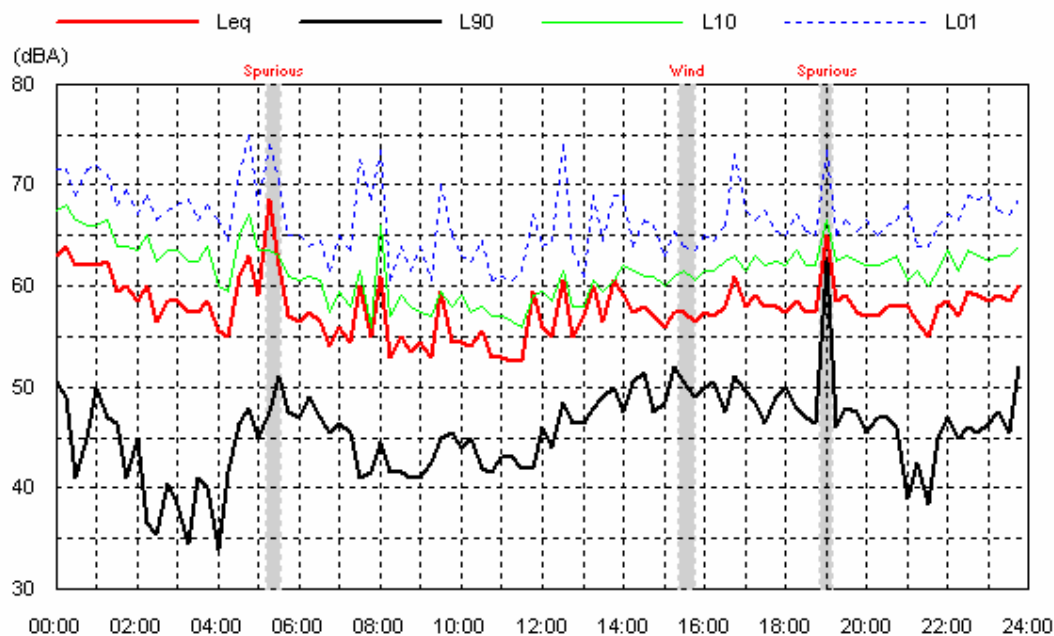
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Thu 06 Nov 08



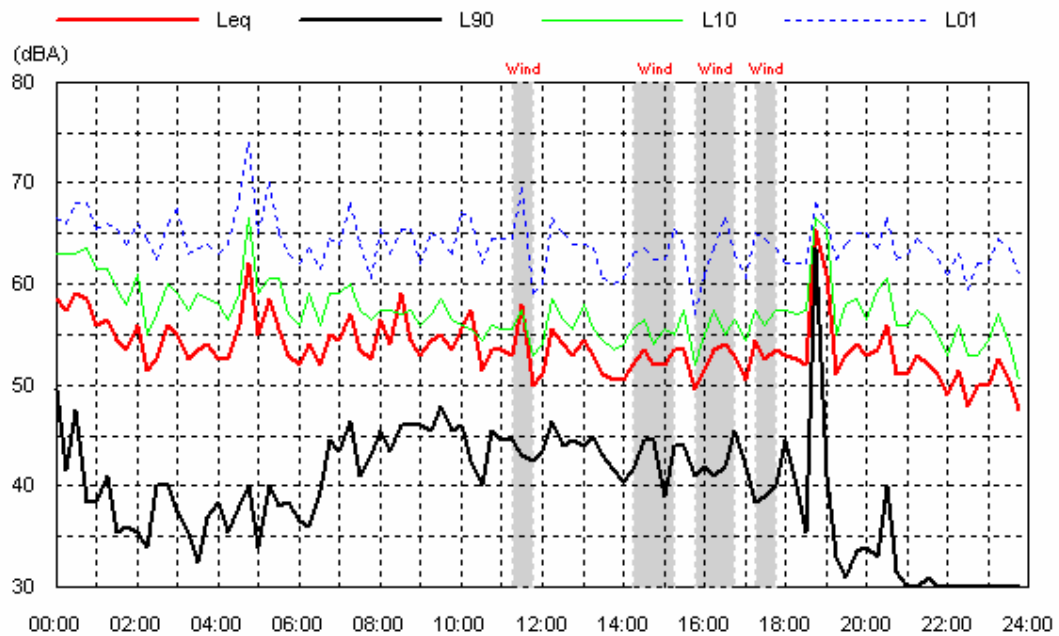
Fri 07 Nov 08



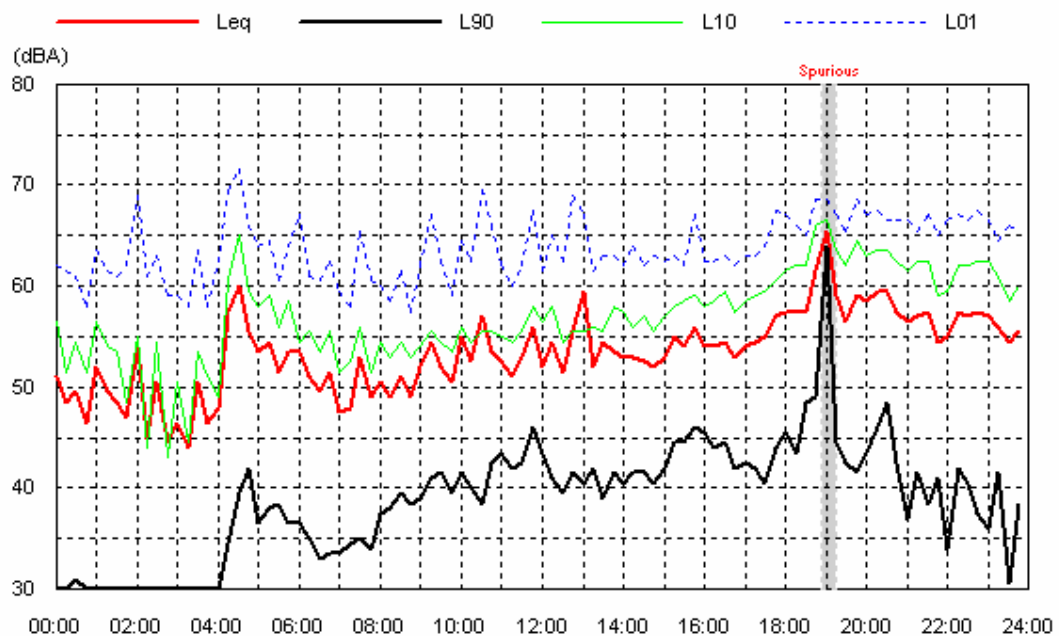
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Sat 08 Nov 08



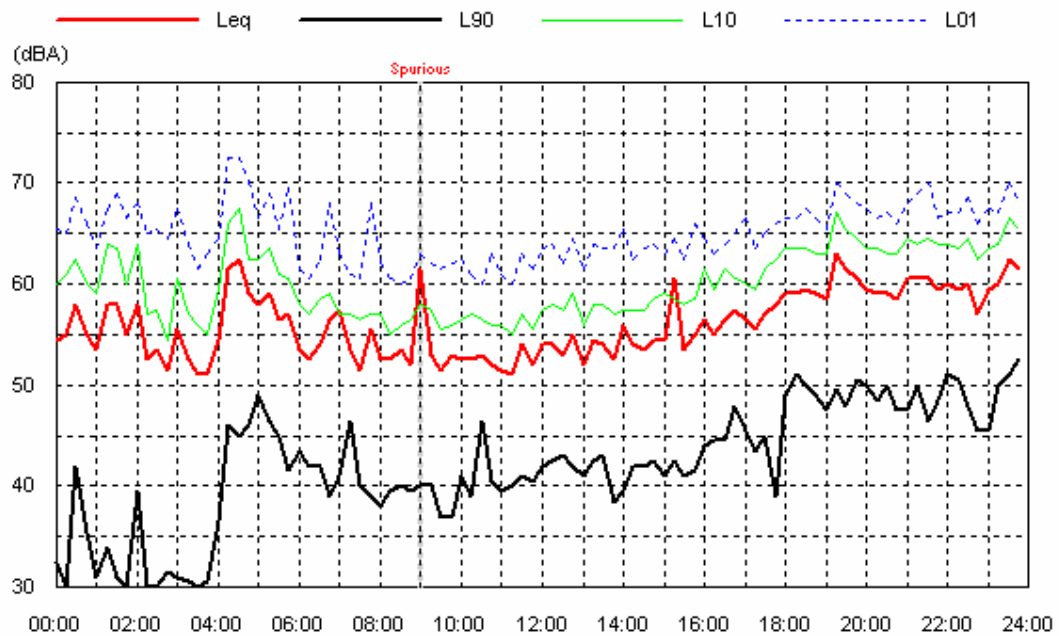
Sun 09 Nov 08



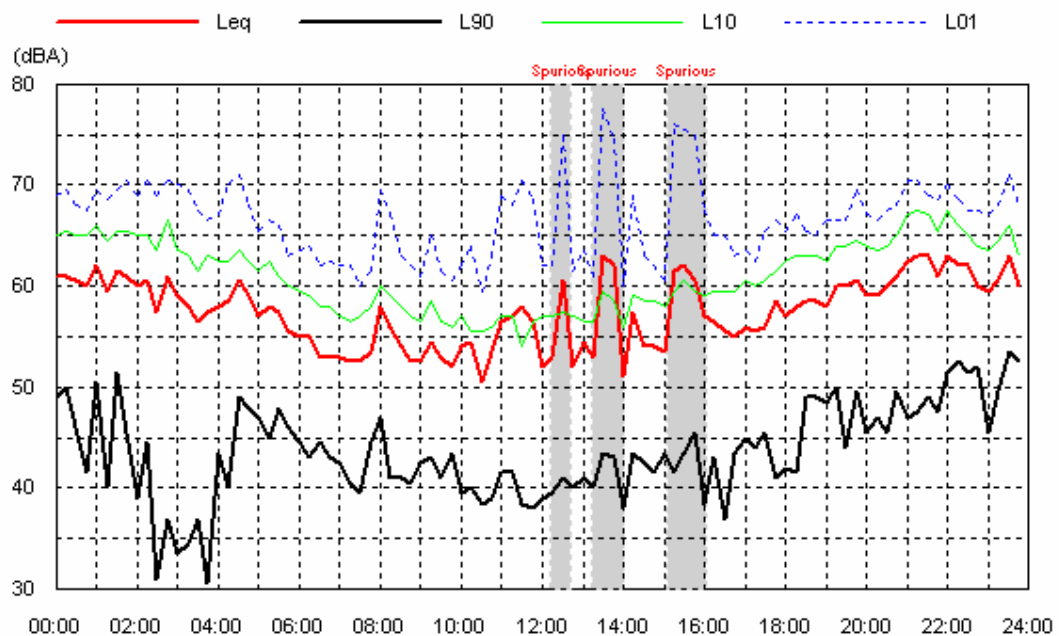
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Mon 10 Nov 08



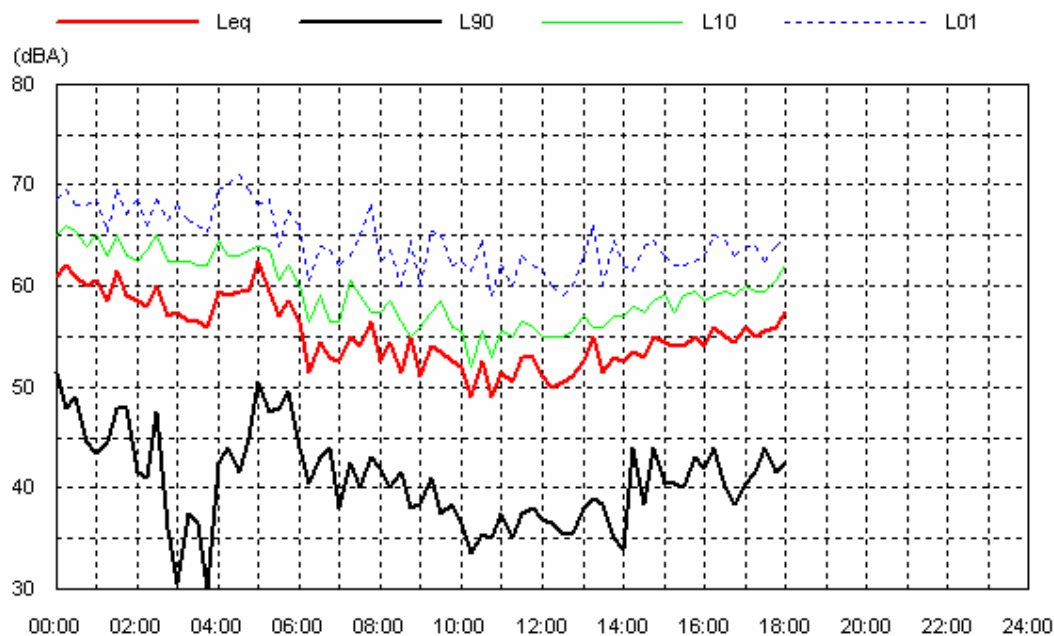
Tue 11 Nov 08



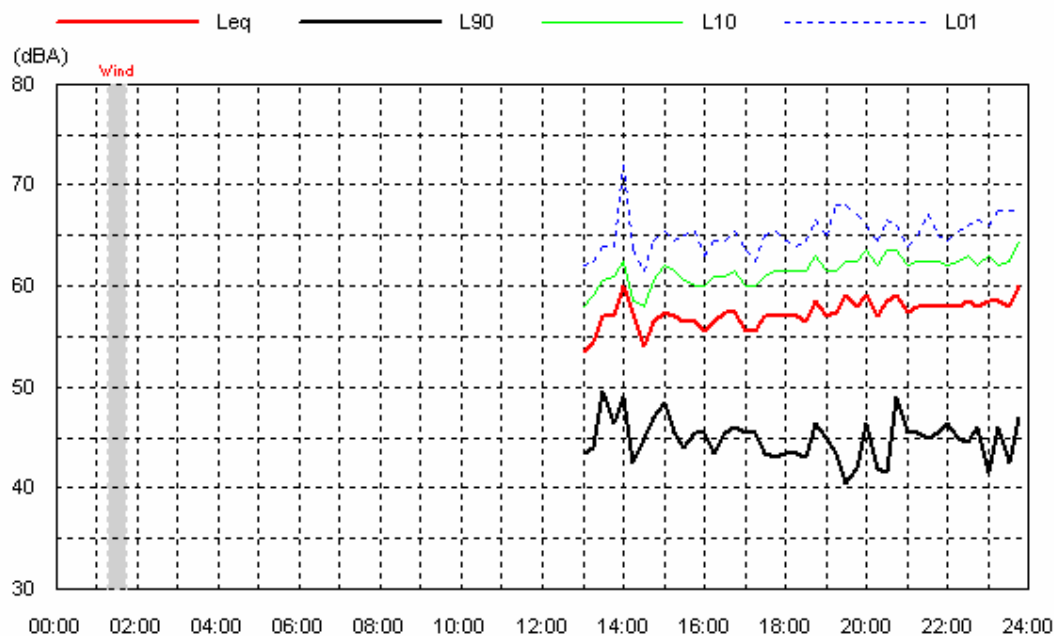
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Wed 12 Nov 08



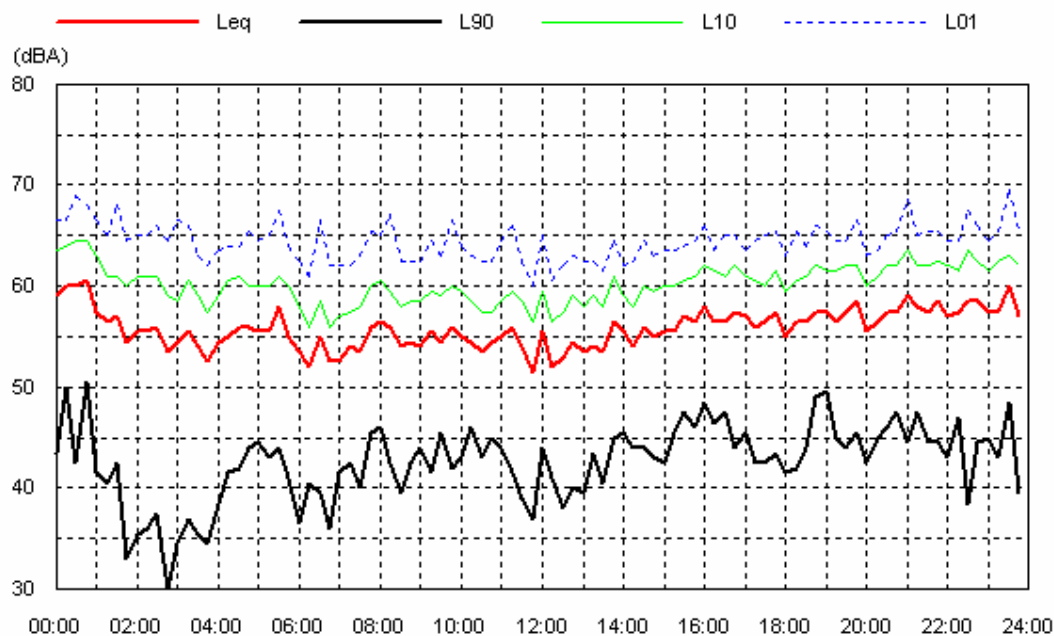
Tue 18 Nov 08



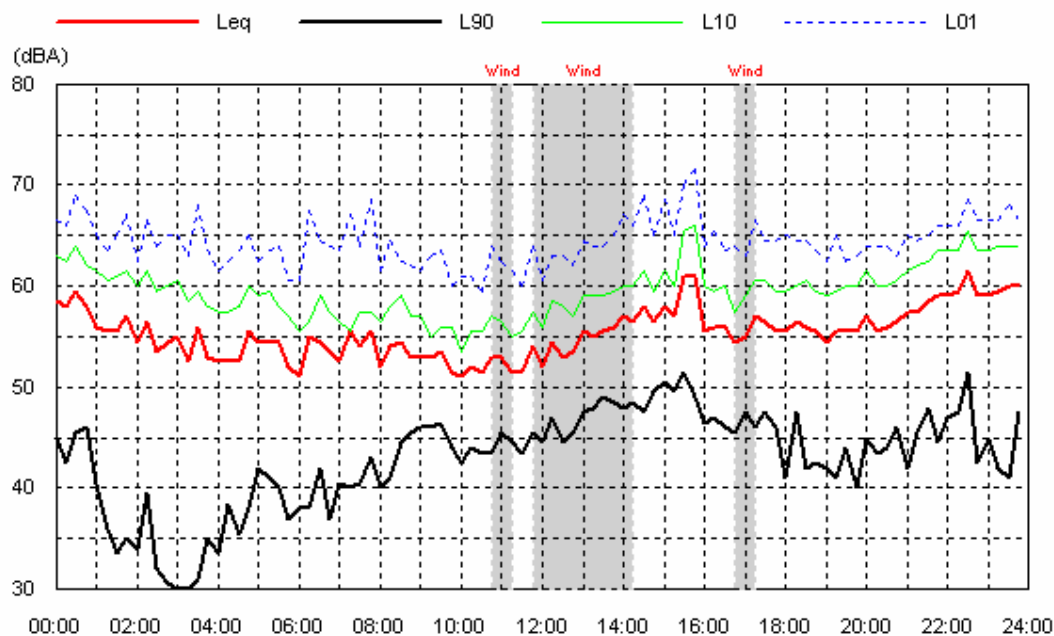
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Wed 19 Nov 08



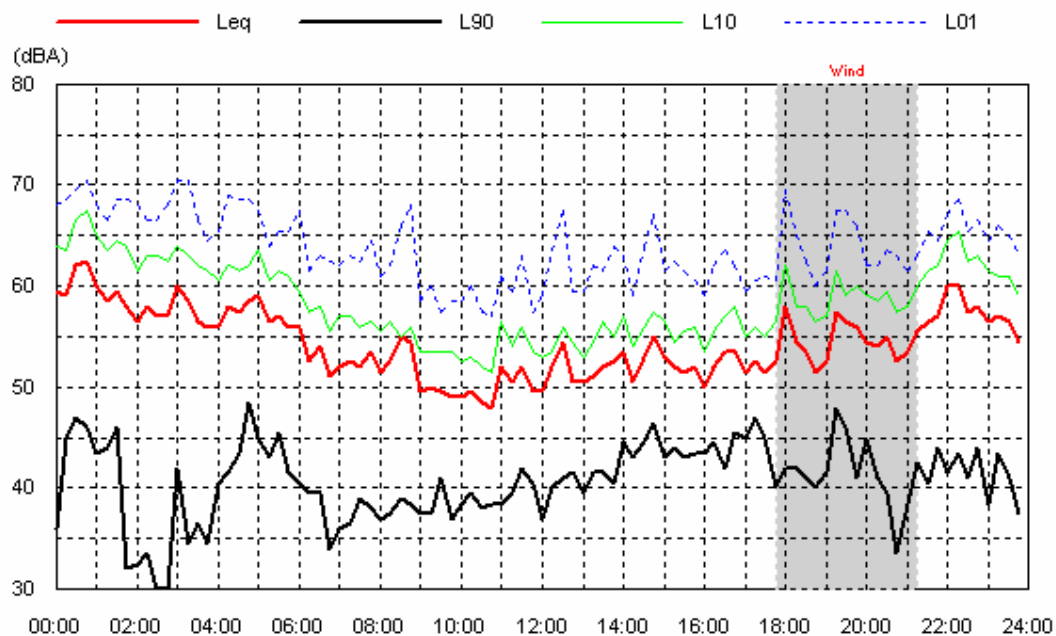
Thu 20 Nov 08



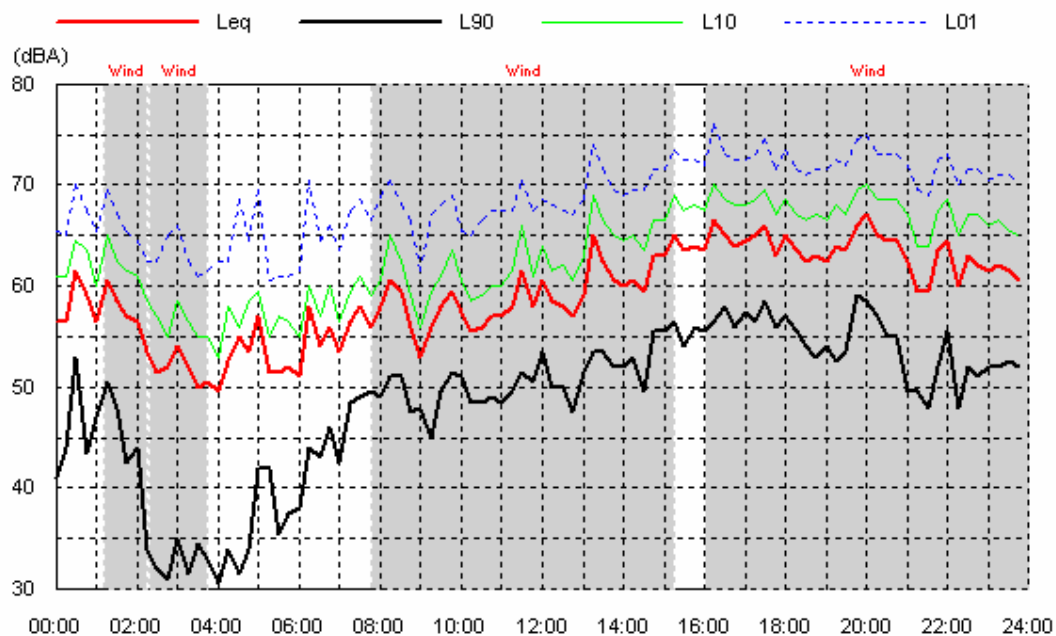
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Fri 21 Nov 08



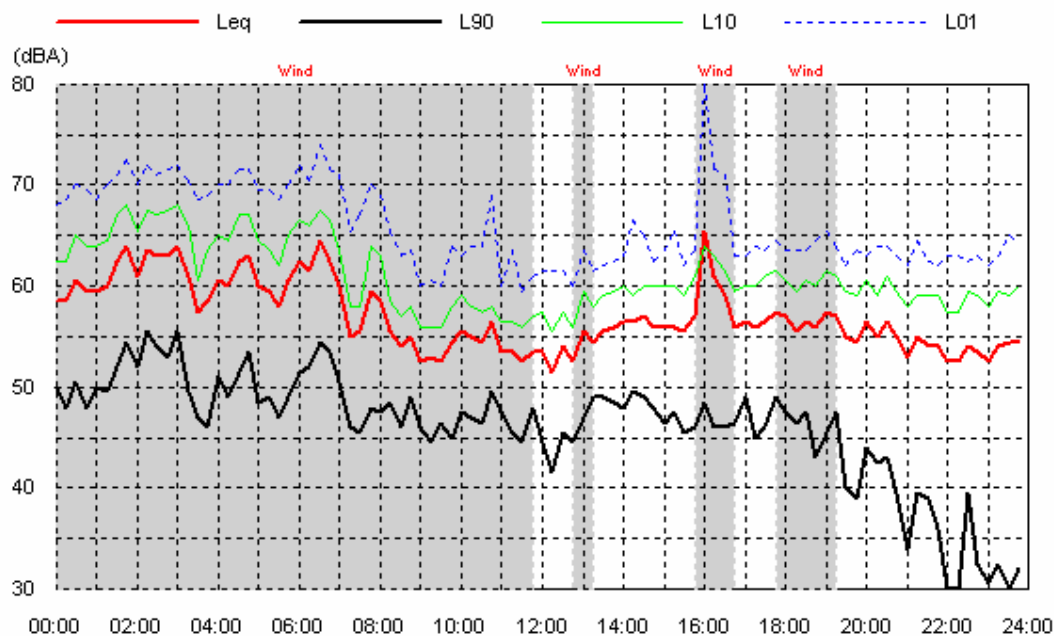
Sat 22 Nov 08



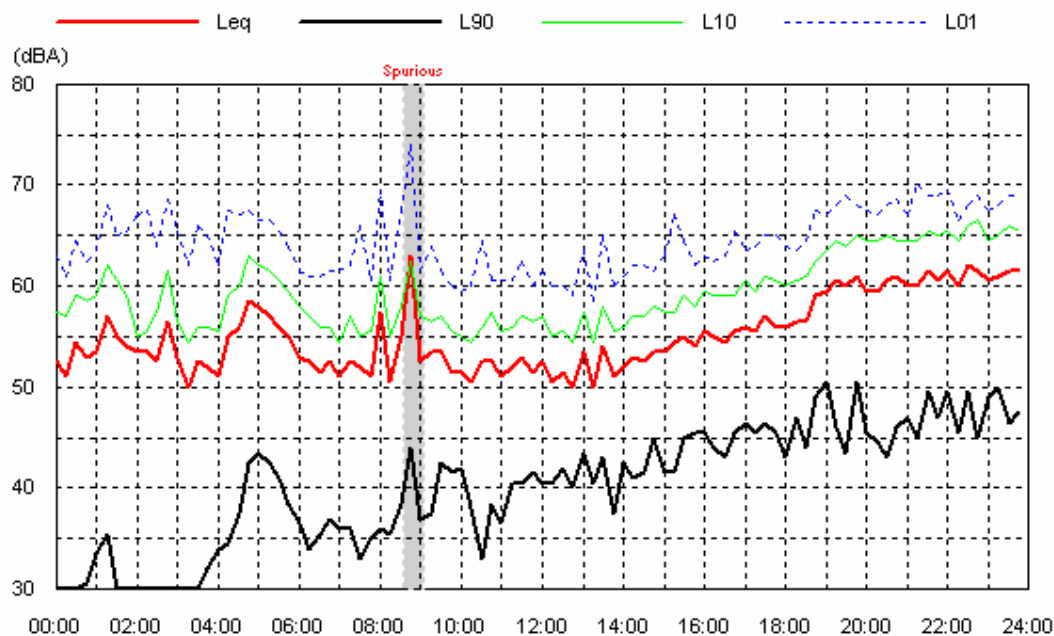
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Sun 23 Nov 08



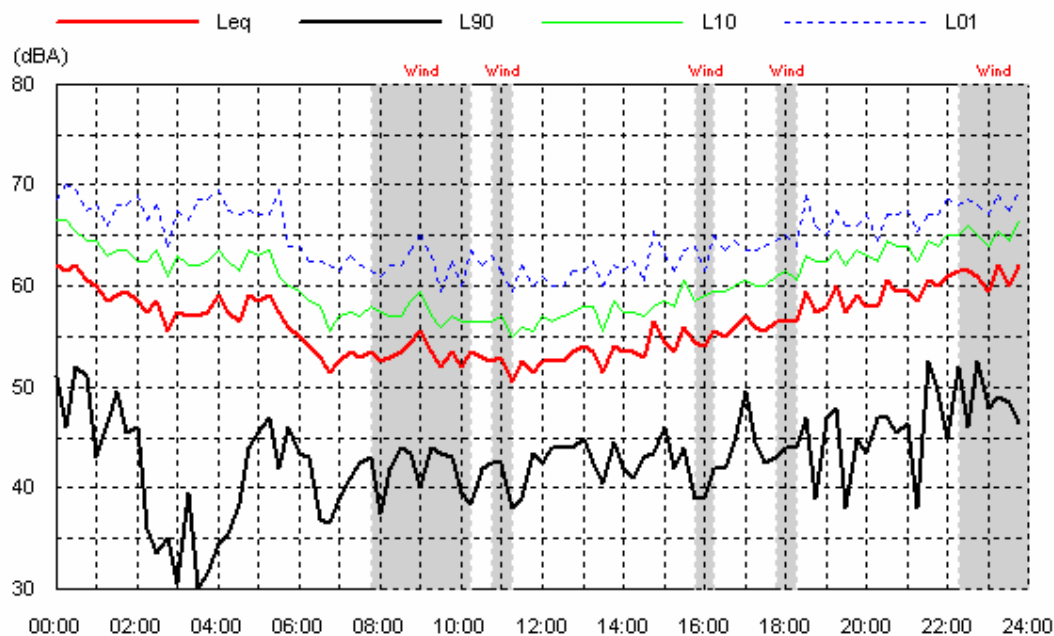
Mon 24 Nov 08



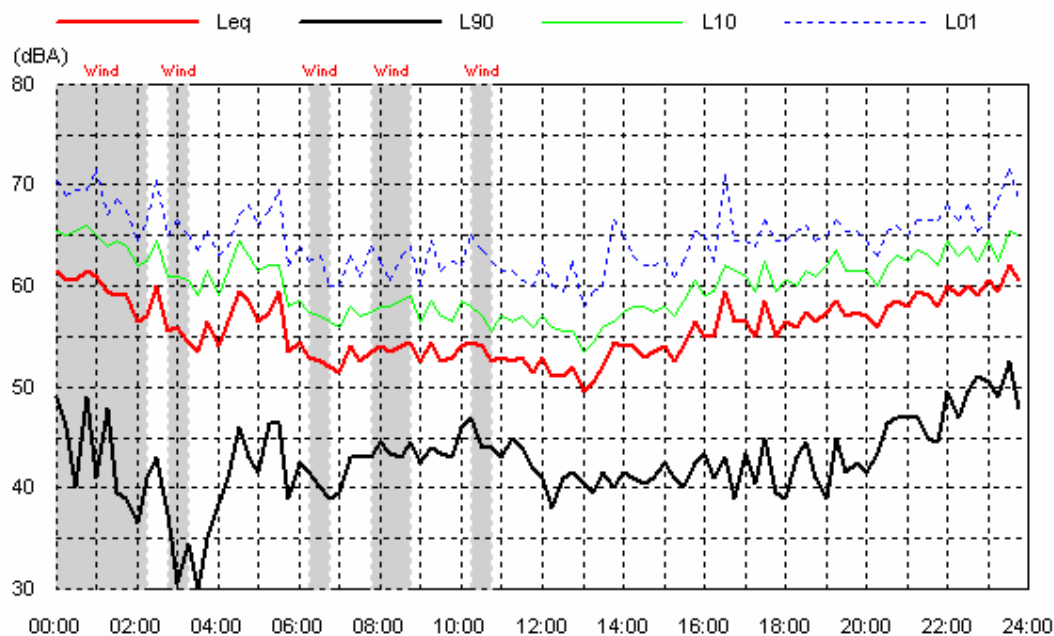
Location D: Montpellier, Hume Highway (DP830535)

Data shaded: Wind; Spurious

Tue 25 Nov 08



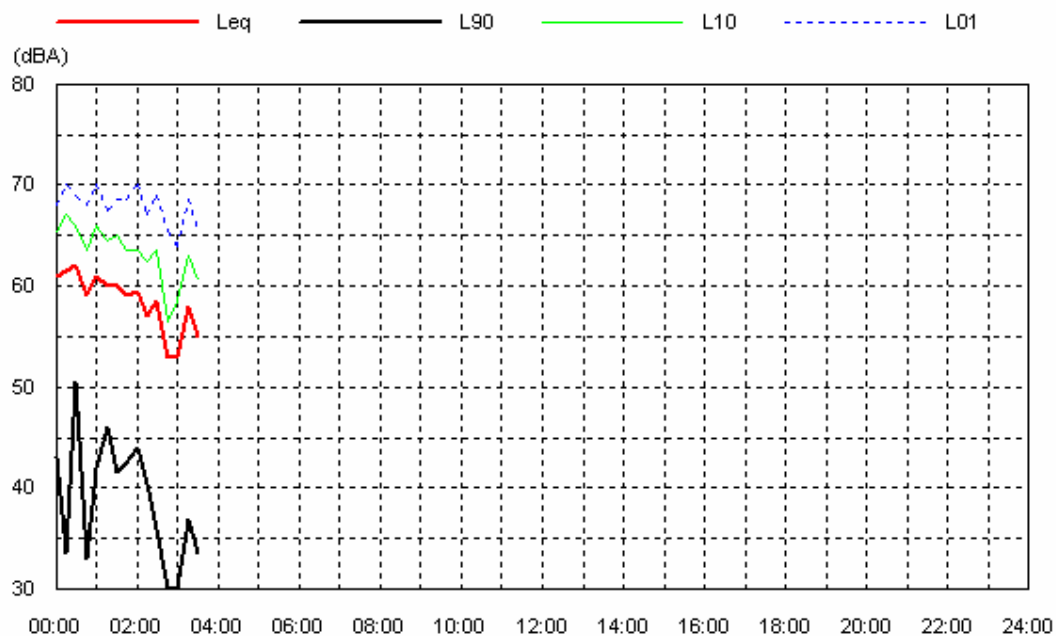
Wed 26 Nov 08



Location D: Montpellier, Hume Highway (DP830535)

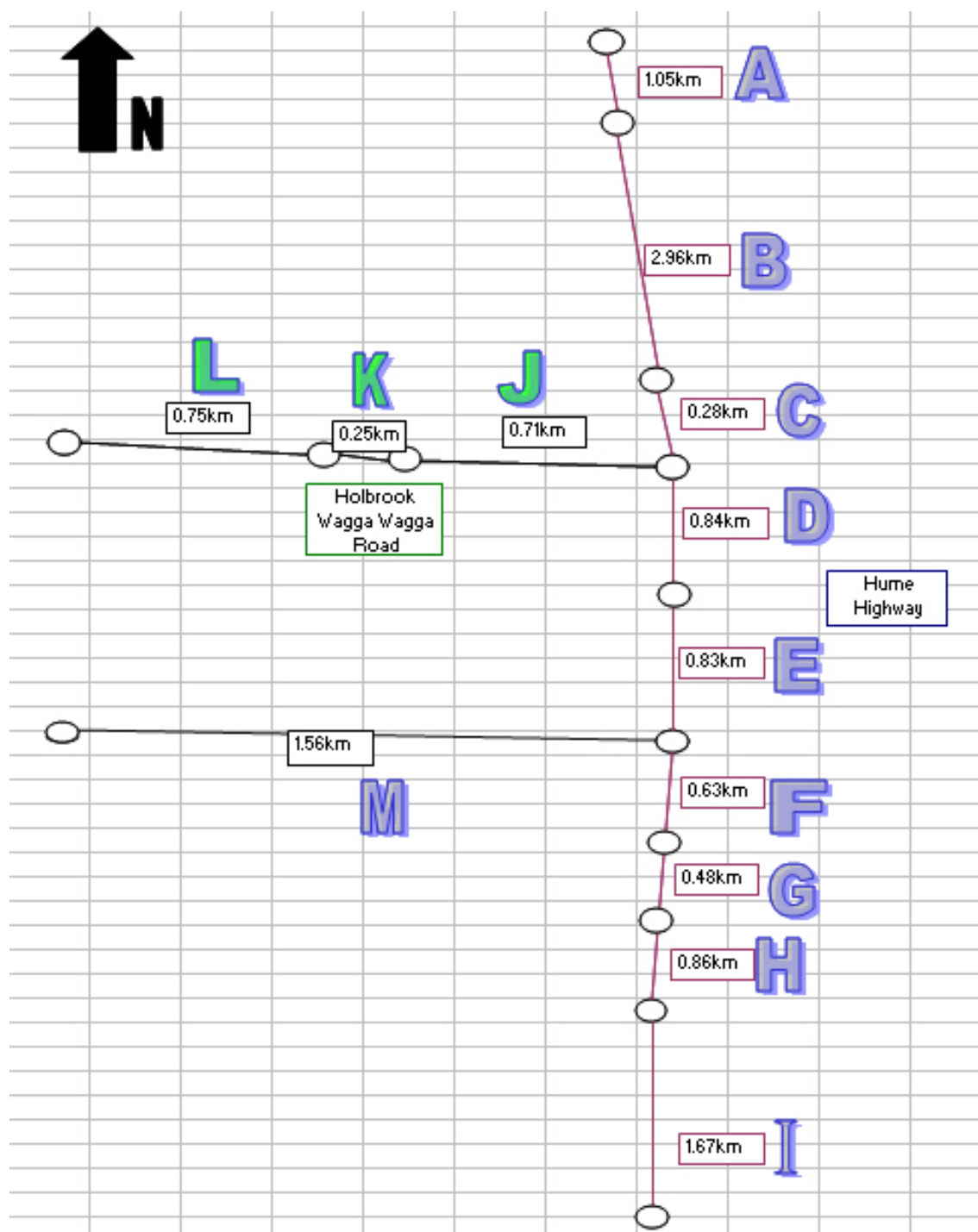
Data shaded: Wind; Spurious

Thu 27 Nov 08

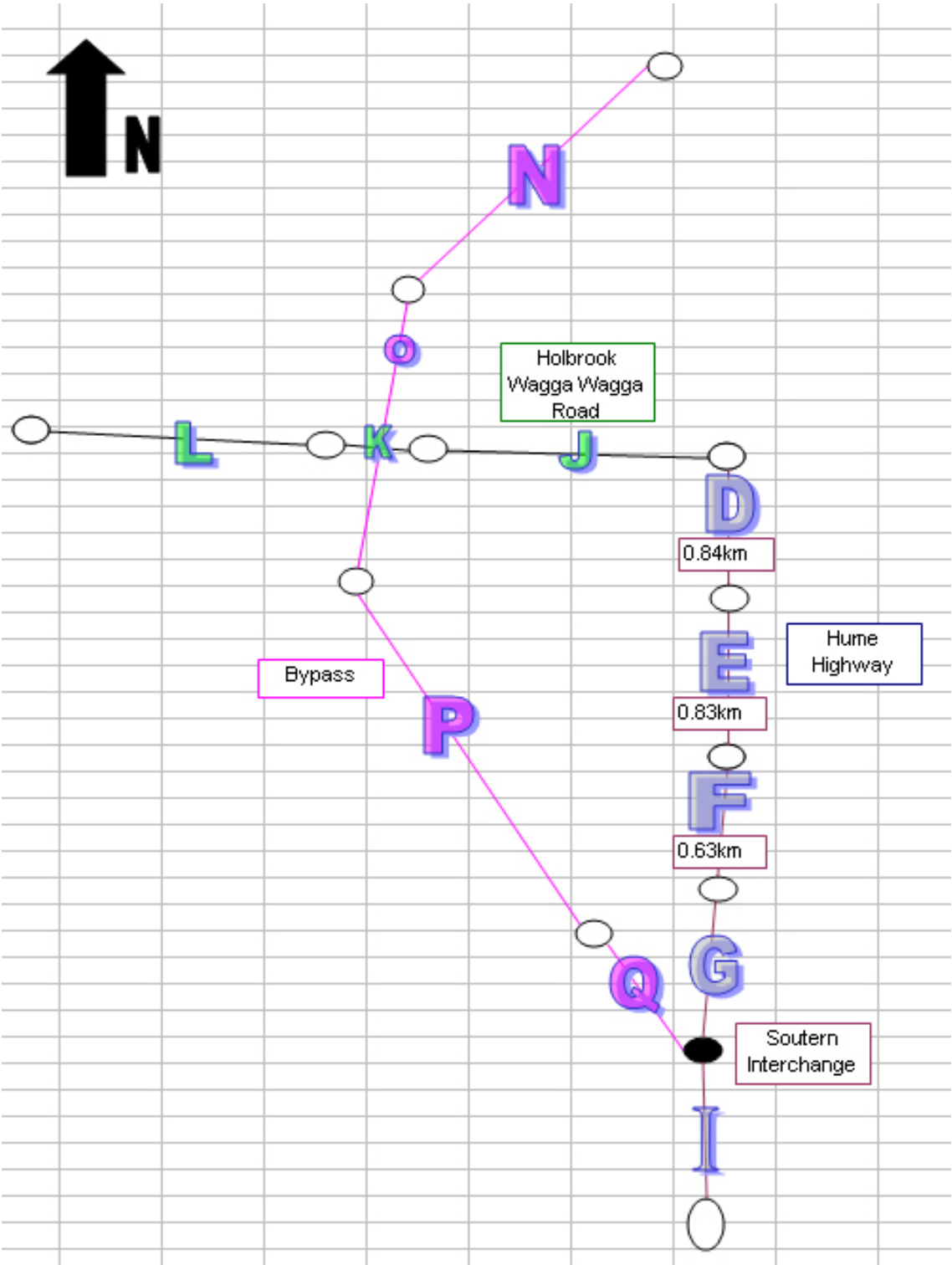


APPENDIX C

TRAFFIC VOLUME DIAGRAM

'Do Nothing' Scenario

Design Scenario



APPENDIX D

NIGHT TIME PREDICTIONS AT RECEIVERS 2022

Tables in this appendix present noise levels at all receivers identified in the noise catchment areas. Because the traffic noise from the bypass will come from different directions for different receivers, noise is assessed at different façades in different NCAs.

Noise values used for the assessment of mitigation requirements are Future Existing levels, and the Combined level at the relevant façade 10 years after opening. These values are shown in italics.

Where noise is to be assessed on the western façade (NCAs 4, 6, 7 & 8), see Table D1.

Where noise is to be assessed on the eastern façade (NCAs 4, 6, 7 & 8) see Table D2.

Where noise is only assessed at one façade (NCAs 1, 2, 3, 5, 9 & 10) see Table D3.

Table D1 - Night Time Noise Predictions – Western Façade (NCAs 4, 6, 7 & 8) - $L_{eq,9hr}$ (dBA)

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
NCA 4	256	<i>60</i>	62	37	54	52	<i>54</i>	50	62	N	N
	257	<i>59</i>	61	37	55	53	<i>55</i>	50	61	N	N
NCA 6	42	<i>47</i>	49	36	50	49	<i>51</i>	50	49	Y	N
	43	<i>47</i>	49	36	51	49	<i>51</i>	50	49	Y	N
	77	<i>53</i>	55	42	49	48	<i>50</i>	50	55	N	N
	78	<i>53</i>	55	42	49	48	<i>50</i>	50	55	N	N
	79	<i>51</i>	53	40	50	48	<i>50</i>	50	53	N	N
	80	<i>52</i>	54	40	49	47	<i>49</i>	50	54	N	N
	81	<i>51</i>	53	40	48	47	<i>49</i>	50	53	N	N
	82	<i>49</i>	51	38	49	48	<i>50</i>	50	51	N	N
	83	<i>48</i>	50	37	49	47	<i>49</i>	50	50	N	N
	84	<i>45</i>	47	35	50	48	<i>50</i>	50	47	N	N
	85	<i>47</i>	49	35	49	47	<i>49</i>	50	49	N	N
	86	<i>44</i>	46	32	48	46	<i>48</i>	50	46	N	N
	87	<i>48</i>	50	36	48	46	<i>48</i>	50	50	N	N
	88	<i>49</i>	51	37	49	47	<i>49</i>	50	51	N	N
	89	<i>49</i>	51	37	49	47	<i>49</i>	50	51	N	N
	90	<i>50</i>	52	39	48	47	<i>49</i>	50	52	N	N
	91	<i>51</i>	53	40	48	47	<i>49</i>	50	53	N	N
	92	<i>52</i>	54	41	48	47	<i>49</i>	50	54	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (> = 60dBA)?
	93	57	59	46	48	48	50	50	59	N	N
	94	56	58	45	47	48	50	50	58	N	N
	95	65	67	55	47	53	55	50	67	N	N
	96	65	67	55	47	53	55	50	67	N	N
	97	55	57	44	47	46	48	50	57	N	N
	98	41	43	30	50	48	50	50	43	N	N
	99	43	45	31	51	49	51	50	45	Y	N
	101	44	46	33	49	48	50	50	46	N	N
	102	46	48	35	50	48	50	50	48	N	N
	103	44	46	32	48	47	49	50	46	N	N
	104	48	50	36	48	47	49	50	50	N	N
	105	49	51	37	49	47	49	50	51	N	N
	106	48	50	37	48	47	49	50	50	N	N
	107	47	49	36	49	47	49	50	49	N	N
	108	48	50	37	48	46	48	50	50	N	N
	109	47	49	36	49	47	49	50	49	N	N
	110	47	49	36	49	47	49	50	49	N	N
	111	47	49	36	49	47	49	50	49	N	N
	112	44	46	34	49	48	50	50	46	N	N
	117	47	49	36	50	48	50	50	49	N	N
	118	48	50	37	49	47	49	50	50	N	N
	119	45	47	34	47	46	48	50	47	N	N
	120	49	51	37	47	45	47	50	51	N	N
	121	51	53	40	47	46	48	50	53	N	N
	122	49	51	38	47	45	47	50	51	N	N
	123	52	54	41	45	45	47	50	54	N	N
	124	51	53	40	48	46	48	50	53	N	N
	125	51	53	40	47	46	48	50	53	N	N
	126	53	55	42	47	46	48	50	55	N	N
	127	52	54	41	48	46	48	50	54	N	N
	128	53	55	42	48	47	49	50	55	N	N
	129	54	56	43	48	47	49	50	56	N	N
	130	53	55	42	48	47	49	50	55	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (> = 60dBA)?
	131	50	52	39	48	47	49	50	52	N	N
	132	50	52	39	48	47	49	50	52	N	N
	133	49	51	38	48	46	48	50	51	N	N
	134	53	55	42	47	46	48	50	55	N	N
	135	53	55	42	47	46	48	50	55	N	N
	136	52	54	41	46	45	47	50	54	N	N
	137	55	57	44	46	46	48	50	57	N	N
	138	65	67	54	47	53	55	50	67	N	N
	139	63	65	52	47	51	53	50	65	N	N
	140	63	65	52	47	51	53	50	65	N	N
	141	64	66	53	47	52	54	50	66	N	N
	142	50	52	39	47	46	48	50	52	N	N
	143	50	52	39	47	46	48	50	52	N	N
	144	47	49	35	49	47	49	50	49	N	N
	145	49	51	38	48	46	48	50	51	N	N
	147	48	50	37	50	48	50	50	50	N	N
	148	53	55	42	47	46	48	50	55	N	N
	151	50	52	39	47	46	48	50	52	N	N
	152	48	50	37	48	46	48	50	50	N	N
	153	48	50	37	47	46	48	50	50	N	N
	154	49	51	39	47	46	48	50	51	N	N
	155	49	51	38	48	46	48	50	51	N	N
	156	48	50	37	48	46	48	50	50	N	N
	157	48	50	37	47	46	48	50	50	N	N
	158	48	50	36	47	46	48	50	50	N	N
	159	48	50	37	47	46	48	50	50	N	N
	160	52	54	41	47	46	48	50	54	N	N
	161	52	54	41	47	46	48	50	54	N	N
	162	52	54	41	47	46	48	50	54	N	N
	163	51	53	40	47	46	48	50	53	N	N
	164	51	53	40	47	46	48	50	53	N	N
	165	51	53	40	47	46	48	50	53	N	N
	166	48	50	37	47	45	47	50	50	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	167	48	50	37	47	45	47	50	50	N	N
	168	50	52	39	46	45	47	50	52	N	N
	169	50	52	39	46	45	47	50	52	N	N
	170	52	54	41	46	45	47	50	54	N	N
	171	51	53	40	44	44	46	50	53	N	N
	172	49	51	38	45	44	46	50	51	N	N
	173	50	52	39	45	44	46	50	52	N	N
	174	52	54	41	46	45	47	50	54	N	N
	175	55	57	44	46	46	48	50	57	N	N
	176	46	48	35	48	46	48	50	48	N	N
	177	46	48	35	48	46	48	50	48	N	N
	178	46	48	35	48	46	48	50	48	N	N
	179	46	48	35	48	46	48	50	48	N	N
	180	48	50	37	48	46	48	50	50	N	N
	181	51	53	40	47	46	48	50	53	N	N
	182	49	51	38	47	46	48	50	51	N	N
	183	50	52	39	48	46	48	50	52	N	N
	184	51	53	40	48	46	48	50	53	N	N
	185	50	52	39	48	46	48	50	52	N	N
	186	50	52	39	48	47	49	50	52	N	N
	187	51	53	40	48	46	48	50	53	N	N
	188	50	52	39	48	47	49	50	52	N	N
	189	50	52	39	49	47	49	50	52	N	N
	190	50	52	39	49	47	49	50	52	N	N
	191	52	54	41	49	47	49	50	54	N	N
	192	54	56	43	48	48	50	50	56	N	N
	193	58	60	47	49	49	51	50	60	N	N
	194	63	65	52	47	51	53	50	65	N	N
	195	63	65	52	47	51	53	50	65	N	N
	196	62	64	51	47	51	53	50	64	N	N
	197	65	67	53	47	52	54	50	67	N	N
	198	65	67	54	47	53	55	50	67	N	N
	199	65	67	54	47	53	55	50	67	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (> = 60dBA)?
	200	64	66	53	47	52	54	50	66	N	N
	201	64	66	53	47	52	54	50	66	N	N
	202	63	65	52	47	51	53	50	65	N	N
	203	64	66	53	47	52	54	50	66	N	N
	204	65	67	54	47	53	55	50	67	N	N
	205	56	58	45	47	47	49	50	58	N	N
	206	53	55	42	47	46	48	50	55	N	N
	207	55	57	44	47	47	49	50	57	N	N
	208	53	55	42	47	46	48	50	55	N	N
	209	53	55	42	47	46	48	50	55	N	N
	210	52	54	41	47	46	48	50	54	N	N
	211	52	54	41	47	46	48	50	54	N	N
	212	50	52	39	48	47	49	50	52	N	N
	213	51	53	40	47	46	48	50	53	N	N
	214	54	56	43	48	47	49	50	56	N	N
	215	51	53	40	47	46	48	50	53	N	N
	216	54	56	43	47	46	48	50	56	N	N
	217	53	55	42	47	46	48	50	55	N	N
	218	54	56	43	47	46	48	50	56	N	N
	219	55	57	44	47	47	49	50	57	N	N
	220	56	58	45	45	46	48	50	58	N	N
	221	53	55	42	45	45	47	50	55	N	N
	222	51	53	40	45	44	46	50	53	N	N
	223	51	53	40	47	45	47	50	53	N	N
	224	52	54	41	46	45	47	50	54	N	N
	225	49	51	38	46	44	46	50	51	N	N
	226	51	53	40	47	46	48	50	53	N	N
	227	48	50	37	47	45	47	50	50	N	N
	228	46	48	35	48	46	48	50	48	N	N
	229	47	49	36	47	45	47	50	49	N	N
	230	49	51	38	46	44	46	50	51	N	N
	231	46	48	35	46	45	47	50	48	N	N
	232	47	49	36	46	44	46	50	49	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (> = 60dBA)?
	233	45	47	34	46	44	46	50	47	N	N
	234	46	48	35	47	45	47	50	48	N	N
	235	47	49	36	47	45	47	50	49	N	N
	236	43	45	32	47	45	47	50	45	N	N
	237	43	45	32	47	45	47	50	45	N	N
	238	46	48	35	47	45	47	50	48	N	N
	239	46	48	34	48	46	48	50	48	N	N
	240	46	48	35	48	46	48	50	48	N	N
	241	46	48	35	47	46	48	50	48	N	N
	242	46	48	35	47	46	48	50	48	N	N
	243	46	48	35	49	47	49	50	48	N	N
	244	45	47	34	49	47	49	50	47	N	N
	245	45	47	34	49	47	49	50	47	N	N
	246	45	47	34	49	47	49	50	47	N	N
	247	45	47	34	48	47	49	50	47	N	N
	248	45	47	34	49	47	49	50	47	N	N
	249	46	48	35	48	46	48	50	48	N	N
	250	43	45	32	49	47	49	50	45	N	N
	251	45	47	34	47	45	47	50	47	N	N
	276	46	48	35	49	47	49	50	48	N	N
	277	47	49	36	49	47	49	50	49	N	N
	278	46	48	35	49	47	49	50	48	N	N
	279	49	51	38	47	45	47	50	51	N	N
	280	48	50	37	48	46	48	50	50	N	N
	281	48	50	37	48	46	48	50	50	N	N
NCA 7	12	47	49	36	53	51	53	50	49	Y	N
	13	46	48	34	52	50	52	50	48	Y	N
	14	46	48	36	53	51	53	50	48	Y	N
	15	54	56	47	58	56	58	50	56	Y	N
	16	55	57	47	59	57	59	50	57	Y	N
	17	48	50	40	55	53	55	50	50	Y	N
	18	48	50	40	57	55	57	50	50	Y	N
	19	45	47	36	56	54	56	50	47	Y	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	20	47	49	38	54	52	54	50	49	Y	N
	21	45	47	36	54	52	54	50	47	Y	N
	22	45	47	35	54	52	54	50	47	Y	N
	23	44	46	33	53	51	53	50	46	Y	N
	24	39	41	29	53	51	53	50	41	Y	N
	25	44	46	33	52	50	52	50	46	Y	N
	26	44	46	33	52	50	52	50	46	Y	N
	27	43	45	33	55	53	55	50	45	Y	N
	28	44	46	33	53	51	53	50	46	Y	N
	29	44	46	33	53	51	53	50	46	Y	N
	30	43	45	32	53	51	53	50	45	Y	N
	31	43	45	32	52	50	52	50	45	Y	N
	32	44	46	33	51	49	51	50	46	Y	N
	33	44	46	34	51	49	51	50	46	Y	N
	34	44	46	33	51	49	51	50	46	Y	N
	35	44	46	32	51	49	51	50	46	Y	N
	36	44	46	33	51	49	51	50	46	Y	N
	37	43	45	32	51	49	51	50	45	Y	N
	38	45	47	35	51	50	52	50	47	Y	N
	39	45	47	34	52	50	52	50	47	Y	N
	40	46	48	36	53	51	53	50	48	Y	N
	41	47	49	38	54	52	54	50	49	Y	N
	44	43	45	36	50	50	52	50	45	Y	N
	45	43	45	36	51	51	53	50	45	Y	N
	46	43	45	32	52	49	51	50	45	Y	N
	47	43	45	33	53	49	51	50	45	Y	N
	48	43	45	32	51	48	50	50	45	N	N
	49	44	46	33	51	48	50	50	46	N	N
	100	46	48	35	51	49	51	50	48	Y	N
	113	46	48	35	50	48	50	50	48	N	N
	114	41	43	30	50	48	50	50	43	N	N
	115	44	46	33	49	47	49	50	46	N	N
	116	46	48	35	49	47	49	50	48	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (> = 60dBA)?
	146	44	46	34	51	49	51	50	46	Y	N
	252	45	47	34	49	47	49	50	47	N	N
	253	45	47	34	49	47	49	50	47	N	N
	254	44	46	34	49	47	49	50	46	N	N
	258	44	46	33	49	47	49	50	46	N	N
	259	44	46	33	49	48	50	50	46	N	N
	260	44	46	33	50	48	50	50	46	N	N
	261	45	47	34	49	47	49	50	47	N	N
	262	44	46	33	48	47	49	50	46	N	N
	263	43	45	32	48	47	49	50	45	N	N
	264	43	45	32	49	47	49	50	45	N	N
	265	43	45	32	49	47	49	50	45	N	N
	266	43	45	33	50	48	50	50	45	N	N
	267	44	46	33	49	47	49	50	46	N	N
	268	45	47	34	49	47	49	50	47	N	N
	269	45	47	34	49	48	50	50	47	N	N
	270	45	47	34	49	47	49	50	47	N	N
	271	45	47	34	49	47	49	50	47	N	N
	272	46	48	35	49	47	49	50	48	N	N
	273	46	48	34	49	47	49	50	48	N	N
	274	45	47	34	50	48	50	50	47	N	N
	275	46	48	35	49	47	49	50	48	N	N
	282	44	46	33	50	48	50	50	46	N	N
	283	44	46	33	50	48	50	50	46	N	N
	284	44	46	33	50	48	50	50	46	N	N
	285	45	47	33	51	49	51	50	47	Y	N
	286	45	47	34	51	49	51	50	47	Y	N
	287	46	48	35	51	50	52	50	48	Y	N
	288	46	48	36	52	50	52	50	48	Y	N
NCA 8	50	56	58	36	55	53	55	50	58	N	N
	51	55	57	35	56	54	56	50	57	Y	N
	52	55	57	34	57	55	57	50	57	Y	N
	53	51	53	33	57	55	57	50	53	Y	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	54	51	53	33	58	56	58	50	53	Y	N
	55	51	53	33	57	55	57	50	53	Y	N
	56	54	56	33	56	54	56	50	56	Y	N
	57	55	57	33	56	54	56	50	57	Y	N
	58	56	58	34	56	54	56	50	58	Y	N
	59	51	53	34	55	53	55	50	53	Y	N
	60	56	58	35	55	53	55	50	58	N	N
	61	51	53	38	56	54	56	50	53	Y	N
	62	58	60	39	55	53	55	50	60	N	N
	63	58	60	39	55	53	55	50	60	N	N
	64	63	65	42	60	58	60	50	65	Y	Y
	65	60	62	47	56	55	57	50	62	N	N
	66	58	60	44	56	54	56	50	60	N	N
	67	57	59	44	54	53	55	50	59	N	N
	68	61	63	49	54	54	56	50	63	N	N
	69	53	55	41	53	51	53	50	55	N	N
	70	54	56	41	52	51	53	50	56	N	N
	71	56	58	44	51	50	52	50	58	N	N
	72	56	58	45	51	50	52	50	58	N	N
	73	63	65	52	51	52	54	50	65	N	N
	74	53	55	42	50	49	51	50	55	N	N
	75	63	65	52	50	52	54	50	65	N	N
	76	56	58	44	51	50	52	50	58	N	N

Table D2 - Night Time Noise Predictions – Eastern Façade (NCAs 4, 6, 7 & 8)

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (> =60dBA)?
NCA 4	256	60	62	45	46	47	49	50	62	N	N
	257	59	61	45	47	47	49	50	61	N	N
NCA 6	42	47	49	44	42	44	46	50	49	N	N
	43	47	49	44	43	44	46	50	49	N	N
	77	53	55	50	41	48	50	50	55	N	N
	78	53	55	50	41	49	51	50	55	N	N
	79	51	53	48	42	47	49	50	53	N	N
	80	52	54	48	41	47	49	50	54	N	N
	81	51	53	48	40	47	49	50	53	N	N
	82	49	51	46	41	45	47	50	51	N	N
	83	48	50	45	41	44	46	50	50	N	N
	84	45	47	43	42	43	45	50	47	N	N
	85	47	49	43	41	43	45	50	49	N	N
	86	44	46	40	40	41	43	50	46	N	N
	87	48	50	44	40	44	46	50	50	N	N
	88	49	51	45	41	45	47	50	51	N	N
	89	49	51	45	41	45	47	50	51	N	N
	90	50	52	47	40	46	48	50	52	N	N
	91	51	53	48	40	47	49	50	53	N	N
	92	52	54	49	40	47	49	50	54	N	N
	93	57	59	54	40	52	54	50	59	N	N
	94	56	58	53	39	52	54	50	58	N	N
	95	65	67	63	39	61	63	50	67	N	Y
	96	65	67	63	39	61	63	50	67	N	Y
	97	55	57	52	39	50	52	50	57	N	N
	98	41	43	38	42	41	43	50	43	N	N
	99	43	45	39	43	42	44	50	45	N	N
	101	44	46	41	41	42	44	50	46	N	N
	102	46	48	43	42	43	45	50	48	N	N
	103	44	46	40	40	41	43	50	46	N	N
	104	48	50	44	40	44	46	50	50	N	N
	105	49	51	45	41	45	47	50	51	N	N
	106	48	50	45	40	44	46	50	50	N	N
	107	47	49	44	41	44	46	50	49	N	N
	108	48	50	45	40	44	46	50	50	N	N
	109	47	49	44	41	44	46	50	49	N	N
	110	47	49	44	41	44	46	50	49	N	N
	111	47	49	44	41	43	45	50	49	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	112	44	46	42	41	42	44	50	46	N	N
	117	47	49	44	42	44	46	50	49	N	N
	118	48	50	45	41	44	46	50	50	N	N
	119	45	47	42	39	42	44	50	47	N	N
	120	49	51	45	39	44	46	50	51	N	N
	121	51	53	48	39	46	48	50	53	N	N
	122	49	51	46	39	44	46	50	51	N	N
	123	52	54	49	37	47	49	50	54	N	N
	124	51	53	48	40	47	49	50	53	N	N
	125	51	53	48	39	46	48	50	53	N	N
	126	53	55	50	39	48	50	50	55	N	N
	127	52	54	49	40	48	50	50	54	N	N
	128	53	55	50	40	49	51	50	55	N	N
	129	54	56	51	40	49	51	50	56	N	N
	130	53	55	50	40	49	51	50	55	N	N
	131	50	52	47	40	46	48	50	52	N	N
	132	50	52	47	40	46	48	50	52	N	N
	133	49	51	46	40	45	47	50	51	N	N
	134	53	55	50	39	48	50	50	55	N	N
	135	53	55	50	39	48	50	50	55	N	N
	136	52	54	49	38	48	50	50	54	N	N
	137	55	57	52	38	50	52	50	57	N	N
	138	65	67	62	39	61	63	50	67	N	Y
	139	63	65	60	39	58	60	50	65	N	Y
	140	63	65	60	39	58	60	50	65	N	Y
	141	64	66	61	39	59	61	50	66	N	Y
	142	50	52	47	39	46	48	50	52	N	N
	143	50	52	47	39	46	48	50	52	N	N
	144	47	49	43	41	43	45	50	49	N	N
	145	49	51	46	40	45	47	50	51	N	N
	147	48	50	45	42	44	46	50	50	N	N
	148	53	55	50	39	49	51	50	55	N	N
	151	50	52	47	39	46	48	50	52	N	N
	152	48	50	45	40	44	46	50	50	N	N
	153	48	50	45	39	44	46	50	50	N	N
	154	49	51	47	39	45	47	50	51	N	N
	155	49	51	46	40	45	47	50	51	N	N
	156	48	50	45	40	44	46	50	50	N	N
	157	48	50	45	39	44	46	50	50	N	N
	158	48	50	44	39	44	46	50	50	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	159	48	50	45	39	44	46	50	50	N	N
	160	52	54	49	39	48	50	50	54	N	N
	161	52	54	49	39	48	50	50	54	N	N
	162	52	54	49	39	47	49	50	54	N	N
	163	51	53	48	39	47	49	50	53	N	N
	164	51	53	48	39	47	49	50	53	N	N
	165	51	53	48	39	47	49	50	53	N	N
	166	48	50	45	39	44	46	50	50	N	N
	167	48	50	45	39	44	46	50	50	N	N
	168	50	52	47	38	45	47	50	52	N	N
	169	50	52	47	38	45	47	50	52	N	N
	170	52	54	49	38	47	49	50	54	N	N
	171	51	53	48	36	46	48	50	53	N	N
	172	49	51	46	37	44	46	50	51	N	N
	173	50	52	47	37	45	47	50	52	N	N
	174	52	54	49	38	48	50	50	54	N	N
	175	55	57	52	38	50	52	50	57	N	N
	176	46	48	43	40	43	45	50	48	N	N
	177	46	48	43	40	43	45	50	48	N	N
	178	46	48	43	40	43	45	50	48	N	N
	179	46	48	43	40	43	45	50	48	N	N
	180	48	50	45	40	45	47	50	50	N	N
	181	51	53	48	39	46	48	50	53	N	N
	182	49	51	46	39	45	47	50	51	N	N
	183	50	52	47	40	46	48	50	52	N	N
	184	51	53	48	40	47	49	50	53	N	N
	185	50	52	47	40	46	48	50	52	N	N
	186	50	52	47	40	46	48	50	52	N	N
	187	51	53	48	40	46	48	50	53	N	N
	188	50	52	47	40	46	48	50	52	N	N
	189	50	52	47	41	46	48	50	52	N	N
	190	50	52	47	41	46	48	50	52	N	N
	191	52	54	49	41	48	50	50	54	N	N
	192	54	56	51	40	50	52	50	56	N	N
	193	58	60	55	41	53	55	50	60	N	N
	194	63	65	60	39	58	60	50	65	N	Y
	195	63	65	60	39	58	60	50	65	N	Y
	196	62	64	59	39	57	59	50	64	N	N
	197	65	67	61	39	59	61	50	67	N	Y
	198	65	67	62	39	60	62	50	67	N	Y

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	199	65	67	62	39	60	62	50	67	N	Y
	200	64	66	61	39	59	61	50	66	N	Y
	201	64	66	61	39	59	61	50	66	N	Y
	202	63	65	60	39	58	60	50	65	N	Y
	203	64	66	61	39	59	61	50	66	N	Y
	204	65	67	62	39	60	62	50	67	N	Y
	205	56	58	53	39	51	53	50	58	N	N
	206	53	55	50	39	49	51	50	55	N	N
	207	55	57	52	39	50	52	50	57	N	N
	208	53	55	50	39	48	50	50	55	N	N
	209	53	55	50	39	48	50	50	55	N	N
	210	52	54	49	39	47	49	50	54	N	N
	211	52	54	49	39	48	50	50	54	N	N
	212	50	52	47	40	46	48	50	52	N	N
	213	51	53	48	39	46	48	50	53	N	N
	214	54	56	51	40	49	51	50	56	N	N
	215	51	53	48	39	47	49	50	53	N	N
	216	54	56	51	39	49	51	50	56	N	N
	217	53	55	50	39	49	51	50	55	N	N
	218	54	56	51	39	49	51	50	56	N	N
	219	55	57	52	39	51	53	50	57	N	N
	220	56	58	53	37	51	53	50	58	N	N
	221	53	55	50	37	48	50	50	55	N	N
	222	51	53	48	37	46	48	50	53	N	N
	223	51	53	48	39	46	48	50	53	N	N
	224	52	54	49	38	48	50	50	54	N	N
	225	49	51	46	38	44	46	50	51	N	N
	226	51	53	48	39	46	48	50	53	N	N
	227	48	50	45	39	44	46	50	50	N	N
	228	46	48	43	40	43	45	50	48	N	N
	229	47	49	44	39	43	45	50	49	N	N
	230	49	51	46	38	44	46	50	51	N	N
	231	46	48	43	38	42	44	50	48	N	N
	232	47	49	44	38	43	45	50	49	N	N
	233	45	47	42	38	41	43	50	47	N	N
	234	46	48	43	39	42	44	50	48	N	N
	235	47	49	44	39	43	45	50	49	N	N
	236	43	45	40	39	40	42	50	45	N	N
	237	43	45	40	39	41	43	50	45	N	N
	238	46	48	43	39	42	44	50	48	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	239	46	48	42	40	42	44	50	48	N	N
	240	46	48	43	40	43	45	50	48	N	N
	241	46	48	43	39	42	44	50	48	N	N
	242	46	48	43	39	43	45	50	48	N	N
	243	46	48	43	41	43	45	50	48	N	N
	244	45	47	42	41	43	45	50	47	N	N
	245	45	47	42	41	42	44	50	47	N	N
	246	45	47	42	41	42	44	50	47	N	N
	247	45	47	42	40	42	44	50	47	N	N
	248	45	47	42	41	42	44	50	47	N	N
	249	46	48	43	40	43	45	50	48	N	N
	250	43	45	40	41	41	43	50	45	N	N
	251	45	47	42	39	42	44	50	47	N	N
	276	46	48	43	41	43	45	50	48	N	N
	277	47	49	44	41	44	46	50	49	N	N
	278	46	48	43	41	43	45	50	48	N	N
	279	49	51	46	39	45	47	50	51	N	N
	280	48	50	45	40	44	46	50	50	N	N
	281	48	50	45	40	44	46	50	50	N	N
NCA 7	12	47	49	44	45	45	47	50	49	N	N
	13	46	48	42	44	44	46	50	48	N	N
	14	46	48	44	45	45	47	50	48	N	N
	15	54	56	55	50	54	56	50	56	Y	N
	16	55	57	55	51	55	57	50	57	Y	N
	17	48	50	48	47	48	50	50	50	N	N
	18	48	50	48	49	49	51	50	50	N	N
	19	45	47	44	48	47	49	50	47	N	N
	20	47	49	46	46	47	49	50	49	N	N
	21	45	47	44	46	46	48	50	47	N	N
	22	45	47	43	46	46	48	50	47	N	N
	23	44	46	41	45	45	47	50	46	N	N
	24	39	41	37	45	44	46	50	41	N	N
	25	44	46	41	44	44	46	50	46	N	N
	26	44	46	41	44	44	46	50	46	N	N
	27	43	45	41	47	46	48	50	45	N	N
	28	44	46	41	45	44	46	50	46	N	N
	29	44	46	41	45	44	46	50	46	N	N
	30	43	45	40	45	44	46	50	45	N	N
	31	43	45	40	44	44	46	50	45	N	N
	32	44	46	41	43	43	45	50	46	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	33	44	46	42	43	44	46	50	46	N	N
	34	44	46	41	43	43	45	50	46	N	N
	35	44	46	40	43	43	45	50	46	N	N
	36	44	46	41	43	43	45	50	46	N	N
	37	43	45	40	43	43	45	50	45	N	N
	38	45	47	43	43	44	46	50	47	N	N
	39	45	47	42	44	44	46	50	47	N	N
	40	46	48	44	45	45	47	50	48	N	N
	41	47	49	46	46	47	49	50	49	N	N
	44	43	45	40	44	44	46	50	45	N	N
	45	43	45	41	45	44	46	50	45	N	N
	46	43	45	40	43	43	45	50	45	N	N
	47	43	45	41	43	43	45	50	45	N	N
	48	43	45	40	42	42	44	50	45	N	N
	49	44	46	41	42	42	44	50	46	N	N
	100	46	48	43	43	44	46	50	48	N	N
	113	46	48	43	42	44	46	50	48	N	N
	114	41	43	38	42	41	43	50	43	N	N
	115	44	46	41	41	42	44	50	46	N	N
	116	46	48	43	41	43	45	50	48	N	N
	146	44	46	42	43	43	45	50	46	N	N
	252	45	47	42	41	42	44	50	47	N	N
	253	45	47	42	41	42	44	50	47	N	N
	254	44	46	42	41	42	44	50	46	N	N
	258	44	46	41	41	42	44	50	46	N	N
	259	44	46	41	41	42	44	50	46	N	N
	260	44	46	41	42	42	44	50	46	N	N
	261	45	47	42	41	42	44	50	47	N	N
	262	44	46	41	40	42	44	50	46	N	N
	263	43	45	40	40	41	43	50	45	N	N
	264	43	45	40	41	41	43	50	45	N	N
	265	43	45	40	41	42	44	50	45	N	N
	266	43	45	41	42	42	44	50	45	N	N
	267	44	46	41	41	42	44	50	46	N	N
	268	45	47	42	41	42	44	50	47	N	N
	269	45	47	42	41	43	45	50	47	N	N
	270	45	47	42	41	42	44	50	47	N	N
	271	45	47	42	41	42	44	50	47	N	N
	272	46	48	43	41	43	45	50	48	N	N
	273	46	48	42	41	43	45	50	48	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	274	45	47	42	42	43	45	50	47	N	N
	275	46	48	43	41	43	45	50	48	N	N
	282	44	46	41	42	42	44	50	46	N	N
	283	44	46	41	42	43	45	50	46	N	N
	284	44	46	41	42	43	45	50	46	N	N
	285	45	47	41	43	43	45	50	47	N	N
	286	45	47	42	43	44	46	50	47	N	N
	287	46	48	43	43	44	46	50	48	N	N
	288	46	48	44	44	45	47	50	48	N	N
NCA 8	50	56	58	44	47	47	49	50	58	N	N
	51	55	57	43	48	47	49	50	57	N	N
	52	55	57	42	49	47	49	50	57	N	N
	53	51	53	41	49	48	50	50	53	N	N
	54	51	53	41	50	48	50	50	53	N	N
	55	51	53	41	49	48	50	50	53	N	N
	56	54	56	41	48	47	49	50	56	N	N
	57	55	57	41	48	47	49	50	57	N	N
	58	56	58	42	48	47	49	50	58	N	N
	59	51	53	42	47	46	48	50	53	N	N
	60	56	58	43	47	46	48	50	58	N	N
	61	51	53	46	48	48	50	50	53	N	N
	62	58	60	47	47	48	50	50	60	N	N
	63	58	60	47	47	48	50	50	60	N	N
	64	63	65	50	52	52	54	50	65	N	N
	65	60	62	55	48	53	55	50	62	N	N
	66	58	60	52	48	51	53	50	60	N	N
	67	57	59	52	46	51	53	50	59	N	N
	68	61	63	57	46	56	58	50	63	N	N
	69	53	55	49	45	48	50	50	55	N	N
	70	54	56	49	44	49	51	50	56	N	N
	71	56	58	52	43	51	53	50	58	N	N
	72	56	58	53	43	51	53	50	58	N	N
	73	63	65	60	43	58	60	50	65	N	Y
	74	53	55	50	42	49	51	50	55	N	N
	75	63	65	60	42	58	60	50	65	N	Y
	76	56	58	52	43	51	53	50	58	N	N

Table D3 - Night Time Noise Predictions – NCAs 1, 2, 3, 5, 9 & 10

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (> =60dBA)?
NCA 1	1	57	59	59	24	57	59	55	59	N	N
	2	42	44	48	35	47	49	50	44	N	N
	3	44	46	51	35	49	51	50	46	Y	N
	4	54	56	58	55	58	60	50	56	Y	N
	5	50	52	62	51	60	62	50	52	Y	Y
	6	41	43	56	40	54	56	50	43	Y	N
	7	37	39	55	36	53	55	50	39	Y	N
NCA 2	8	42	44	48	40	47	49	50	44	N	N
	9	50	52	57	49	56	58	50	52	Y	N
	10	53	55	56	53	56	58	50	55	Y	N
	11	52	54	62	42	60	62	50	54	Y	Y
NCA 3	291	57	59	54	40	52	54	50	59	N	N
	292	55	57	51	41	49	51	50	57	N	N
	293	53	55	51	39	49	51	50	55	N	N
	294	53	55	50	41	48	50	50	55	N	N
	295	52	54	49	40	48	50	50	54	N	N
	296	50	52	49	39	47	49	50	52	N	N
	297	50	52	48	40	47	49	50	52	N	N
	298	50	52	48	40	47	49	50	52	N	N
	580	60	62	51	45	50	52	50	62	N	N
	581	51	53	50	38	48	50	50	53	N	N
	582	49	51	48	37	47	49	50	51	N	N
	583	48	50	47	38	45	47	50	50	N	N
	587	52	54	51	39	49	51	50	54	N	N
NCA 5	299	45	47	44	39	43	45	50	47	N	N
	300	46	48	44	40	43	45	50	48	N	N
	301	46	48	45	41	44	46	50	48	N	N
	302	47	49	45	42	45	47	50	49	N	N
	303	47	49	45	41	44	46	50	49	N	N
	304	46	48	44	41	44	46	50	48	N	N
	305	45	47	43	40	43	45	50	47	N	N
	306	45	47	42	41	42	44	50	47	N	N
	307	46	48	44	42	44	46	50	48	N	N
	308	48	50	46	44	46	48	50	50	N	N
	309	48	50	45	43	45	47	50	50	N	N
	310	47	49	45	43	45	47	50	49	N	N
	311	47	49	45	43	45	47	50	49	N	N
	312	45	47	44	39	43	45	50	47	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	313	45	47	43	41	43	45	50	47	N	N
	314	45	47	43	40	43	45	50	47	N	N
	315	45	47	43	41	43	45	50	47	N	N
	316	46	48	43	42	43	45	50	48	N	N
	317	47	49	44	43	44	46	50	49	N	N
	318	46	48	44	43	45	47	50	48	N	N
	319	47	49	44	44	45	47	50	49	N	N
	320	47	49	44	43	45	47	50	49	N	N
	321	47	49	44	44	45	47	50	49	N	N
	322	47	49	44	44	45	47	50	49	N	N
	323	47	49	44	43	45	47	50	49	N	N
	324	47	49	44	44	45	47	50	49	N	N
	325	48	50	44	45	46	48	50	50	N	N
	326	48	50	44	44	45	47	50	50	N	N
	327	50	52	45	47	47	49	50	52	N	N
	328	50	52	45	47	47	49	50	52	N	N
	329	52	54	45	49	48	50	50	54	N	N
	330	49	51	45	46	46	48	50	51	N	N
	331	49	51	45	46	46	48	50	51	N	N
	332	49	51	45	46	46	48	50	51	N	N
	333	48	50	44	45	46	48	50	50	N	N
	334	48	50	44	44	45	47	50	50	N	N
	335	48	50	44	45	45	47	50	50	N	N
	336	50	52	45	47	47	49	50	52	N	N
	337	50	52	45	47	47	49	50	52	N	N
	338	50	52	45	47	47	49	50	52	N	N
	339	49	51	44	46	46	48	50	51	N	N
	340	49	51	44	46	46	48	50	51	N	N
	341	49	51	45	45	46	48	50	51	N	N
	342	50	52	45	47	47	49	50	52	N	N
	343	52	54	45	49	48	50	50	54	N	N
	344	52	54	45	49	49	51	50	54	N	N
	345	52	54	45	49	49	51	50	54	N	N
	346	51	53	45	48	48	50	50	53	N	N
	347	50	52	45	47	47	49	50	52	N	N
	348	48	50	43	45	45	47	50	50	N	N
	349	47	49	43	43	44	46	50	49	N	N
	350	47	49	42	43	44	46	50	49	N	N
	351	46	48	43	43	44	46	50	48	N	N
	352	48	50	44	45	45	47	50	50	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	353	46	48	43	43	44	46	50	48	N	N
	354	46	48	43	42	43	45	50	48	N	N
	355	45	47	43	42	43	45	50	47	N	N
	356	45	47	41	41	42	44	50	47	N	N
	357	45	47	42	41	42	44	50	47	N	N
	358	45	47	43	41	43	45	50	47	N	N
	359	45	47	44	41	44	46	50	47	N	N
	360	45	47	42	41	43	45	50	47	N	N
	361	45	47	42	41	43	45	50	47	N	N
	362	45	47	43	41	43	45	50	47	N	N
	363	46	48	45	42	45	47	50	48	N	N
	364	47	49	45	44	46	48	50	49	N	N
	365	46	48	45	42	45	47	50	48	N	N
	366	43	45	41	39	41	43	50	45	N	N
	367	44	46	44	39	43	45	50	46	N	N
	368	44	46	42	40	42	44	50	46	N	N
	369	43	45	40	39	41	43	50	45	N	N
	370	51	53	46	47	48	50	50	53	N	N
	371	50	52	45	46	47	49	50	52	N	N
	372	50	52	45	46	47	49	50	52	N	N
	373	49	51	45	46	47	49	50	51	N	N
	374	49	51	45	45	46	48	50	51	N	N
	375	49	51	46	45	46	48	50	51	N	N
	376	49	51	46	45	46	48	50	51	N	N
	377	50	52	46	47	47	49	50	52	N	N
	378	51	53	46	48	48	50	50	53	N	N
	379	50	52	46	47	47	49	50	52	N	N
	380	48	50	44	44	45	47	50	50	N	N
	381	52	54	46	49	49	51	50	54	N	N
	382	53	55	46	50	49	51	50	55	N	N
	383	53	55	46	50	50	52	50	55	N	N
	384	51	53	46	48	48	50	50	53	N	N
	385	51	53	46	48	48	50	50	53	N	N
	386	51	53	46	48	48	50	50	53	N	N
	387	51	53	46	48	48	50	50	53	N	N
	388	52	54	46	49	49	51	50	54	N	N
	389	52	54	45	49	49	51	50	54	N	N
	390	51	53	44	48	47	49	50	53	N	N
	391	51	53	45	47	47	49	50	53	N	N
	392	48	50	45	45	46	48	50	50	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	393	48	50	44	45	45	47	50	50	N	N
	394	49	51	45	46	46	48	50	51	N	N
	395	52	54	45	49	49	51	50	54	N	N
	396	53	55	46	50	49	51	50	55	N	N
	397	53	55	46	50	50	52	50	55	N	N
	398	54	56	46	51	50	52	50	56	N	N
	399	51	53	47	48	49	51	50	53	N	N
	400	51	53	48	47	48	50	50	53	N	N
	401	51	53	48	47	48	50	50	53	N	N
	402	51	53	48	47	48	50	50	53	N	N
	403	52	54	49	48	49	51	50	54	N	N
	404	51	53	48	46	48	50	50	53	N	N
	405	49	51	48	44	47	49	50	51	N	N
	406	50	52	48	45	48	50	50	52	N	N
	407	49	51	49	44	48	50	50	51	N	N
	408	51	53	50	45	49	51	50	53	N	N
	409	52	54	50	48	50	52	50	54	N	N
	410	53	55	51	48	51	53	50	55	N	N
	411	65	67	50	62	60	62	50	67	N	Y
	412	62	64	50	58	57	59	50	64	N	N
	413	56	58	50	52	52	54	50	58	N	N
	414	55	57	49	51	51	53	50	57	N	N
	415	55	57	49	52	52	54	50	57	N	N
	416	53	55	49	49	50	52	50	55	N	N
	417	55	57	47	51	51	53	50	57	N	N
	418	54	56	47	50	50	52	50	56	N	N
	419	63	65	51	60	59	61	50	65	N	Y
	420	64	66	52	61	59	61	50	66	N	Y
	421	55	57	50	51	52	54	50	57	N	N
	422	56	58	51	51	52	54	50	58	N	N
	423	53	55	51	47	51	53	50	55	N	N
	424	50	52	50	41	49	51	50	52	N	N
	425	51	53	50	46	49	51	50	53	N	N
	426	50	52	50	43	49	51	50	52	N	N
	427	49	51	49	43	48	50	50	51	N	N
	428	48	50	48	43	47	49	50	50	N	N
	429	48	50	48	42	47	49	50	50	N	N
	430	47	49	47	41	46	48	50	49	N	N
	431	44	46	43	40	43	45	50	46	N	N
	432	46	48	45	41	44	46	50	48	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	433	48	50	49	42	48	50	50	50	N	N
	434	54	56	53	46	52	54	50	56	N	N
	435	47	49	48	42	47	49	50	49	N	N
	436	46	48	47	40	46	48	50	48	N	N
	437	45	47	47	39	45	47	50	47	N	N
	438	45	47	46	39	45	47	50	47	N	N
	439	45	47	46	39	45	47	50	47	N	N
	440	45	47	47	40	45	47	50	47	N	N
	441	45	47	46	40	45	47	50	47	N	N
	442	45	47	45	40	45	47	50	47	N	N
	443	44	46	44	39	43	45	50	46	N	N
	444	45	47	46	39	45	47	50	47	N	N
	445	45	47	46	39	45	47	50	47	N	N
	446	45	47	46	39	45	47	50	47	N	N
	447	43	45	44	37	43	45	50	45	N	N
	449	45	47	46	38	45	47	50	47	N	N
	450	43	45	45	37	43	45	50	45	N	N
	451	63	65	49	60	58	60	50	65	N	Y
	452	63	65	49	60	58	60	50	65	N	Y
	453	64	66	49	61	59	61	50	66	N	Y
	454	56	58	48	53	52	54	50	58	N	N
	455	54	56	48	51	51	53	50	56	N	N
	456	53	55	48	49	49	51	50	55	N	N
	457	55	57	47	52	51	53	50	57	N	N
	458	64	66	47	61	60	62	50	66	N	Y
	459	64	66	47	62	60	62	50	66	N	Y
	460	66	68	47	63	61	63	50	68	N	Y
	461	66	68	46	63	62	64	50	68	N	Y
	462	65	67	46	62	61	63	50	67	N	Y
	463	65	67	46	62	60	62	50	67	N	Y
	464	64	66	46	61	60	62	50	66	N	Y
	465	54	56	46	51	51	53	50	56	N	N
	466	54	56	46	51	51	53	50	56	N	N
	467	54	56	46	51	51	53	50	56	N	N
	468	54	56	46	51	50	52	50	56	N	N
	469	54	56	47	51	50	52	50	56	N	N
	470	56	58	47	53	52	54	50	58	N	N
	471	55	57	46	53	51	53	50	57	N	N
	472	56	58	46	53	52	54	50	58	N	N
	473	56	58	46	53	52	54	50	58	N	N

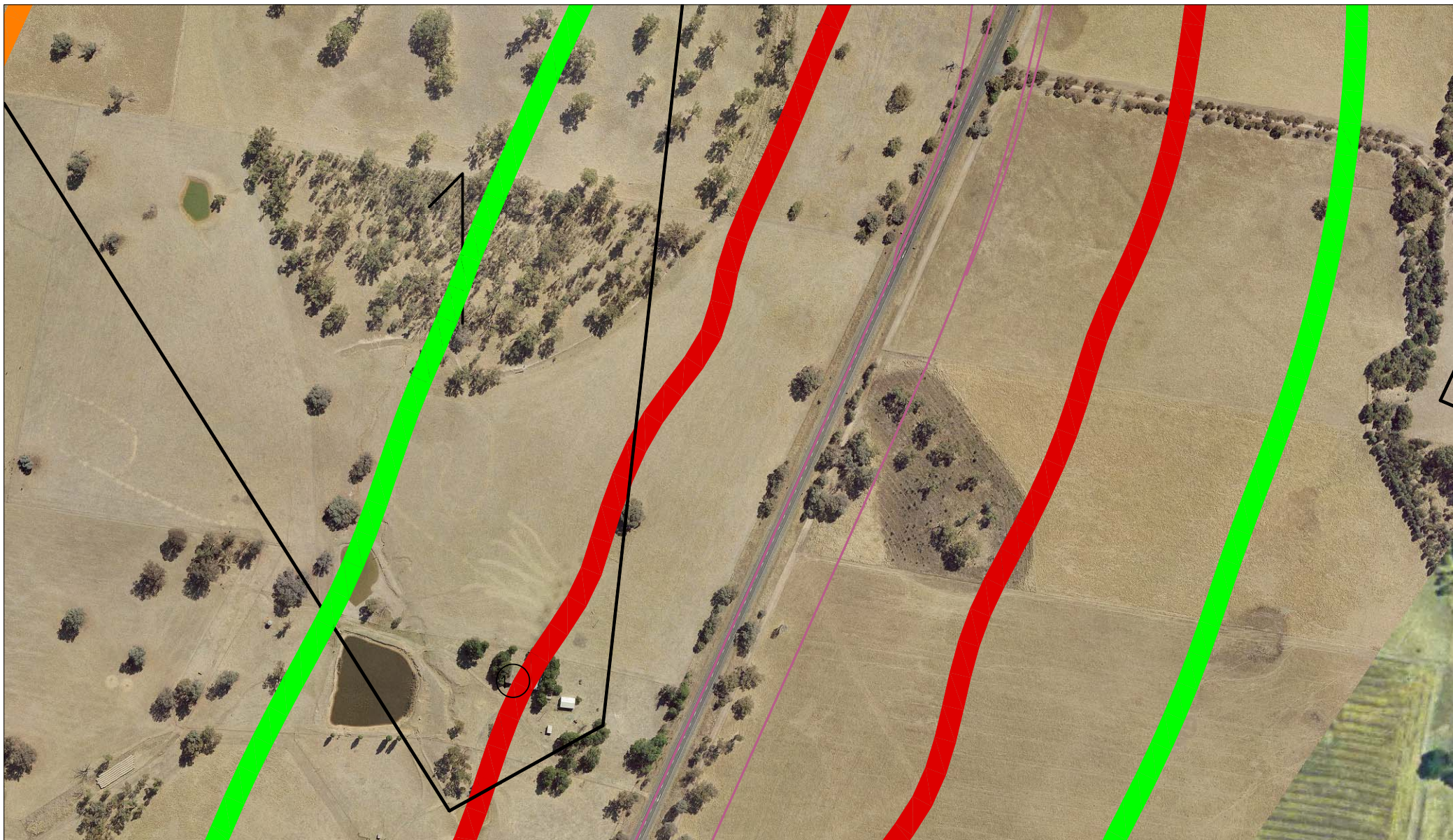
NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	474	56	58	46	53	52	54	50	58	N	N
	475	56	58	46	53	52	54	50	58	N	N
	476	56	58	46	53	52	54	50	58	N	N
	477	56	58	46	53	52	54	50	58	N	N
	478	56	58	46	53	52	54	50	58	N	N
	479	56	58	45	54	52	54	50	58	N	N
	480	58	60	46	55	54	56	50	60	N	N
	481	53	55	46	50	50	52	50	55	N	N
	482	53	55	46	50	49	51	50	55	N	N
	483	53	55	46	50	49	51	50	55	N	N
	484	53	55	46	50	49	51	50	55	N	N
	485	54	56	46	51	50	52	50	56	N	N
	486	54	56	46	51	50	52	50	56	N	N
	487	54	56	46	51	50	52	50	56	N	N
	488	53	55	46	50	49	51	50	55	N	N
	489	53	55	46	50	50	52	50	55	N	N
	490	51	53	45	48	48	50	50	53	N	N
	491	49	51	45	46	46	48	50	51	N	N
	492	50	52	45	47	47	49	50	52	N	N
	493	50	52	45	47	47	49	50	52	N	N
	494	49	51	45	46	47	49	50	51	N	N
	495	49	51	45	46	47	49	50	51	N	N
	496	49	51	45	46	47	49	50	51	N	N
	497	48	50	44	44	45	47	50	50	N	N
	498	48	50	44	44	45	47	50	50	N	N
	499	48	50	44	45	45	47	50	50	N	N
	500	48	50	44	44	45	47	50	50	N	N
	501	48	50	44	44	45	47	50	50	N	N
	502	48	50	44	44	45	47	50	50	N	N
	503	50	52	46	47	47	49	50	52	N	N
	504	51	53	46	47	48	50	50	53	N	N
	505	49	51	46	46	47	49	50	51	N	N
	506	52	54	45	49	49	51	50	54	N	N
	507	56	58	46	54	52	54	50	58	N	N
	509	51	53	46	47	48	50	50	53	N	N
	510	50	52	46	46	47	49	50	52	N	N
	511	50	52	46	46	47	49	50	52	N	N
	512	50	52	46	46	47	49	50	52	N	N
	513	50	52	46	46	47	49	50	52	N	N
	514	50	52	46	46	47	49	50	52	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	515	49	51	46	45	47	49	50	51	N	N
	516	49	51	46	45	46	48	50	51	N	N
	517	48	50	45	45	46	48	50	50	N	N
	518	49	51	45	45	46	48	50	51	N	N
	519	48	50	45	45	46	48	50	50	N	N
	520	48	50	45	44	46	48	50	50	N	N
	521	48	50	45	45	46	48	50	50	N	N
	522	49	51	45	46	46	48	50	51	N	N
	523	48	50	45	44	45	47	50	50	N	N
	524	48	50	45	44	45	47	50	50	N	N
	525	48	50	45	44	45	47	50	50	N	N
	526	47	49	45	44	45	47	50	49	N	N
	527	47	49	44	44	45	47	50	49	N	N
	528	47	49	44	44	45	47	50	49	N	N
	529	48	50	45	45	46	48	50	50	N	N
	530	47	49	44	43	44	46	50	49	N	N
	531	47	49	44	43	45	47	50	49	N	N
	532	46	48	44	43	44	46	50	48	N	N
	533	47	49	44	43	45	47	50	49	N	N
	534	47	49	44	43	45	47	50	49	N	N
	535	47	49	44	43	44	46	50	49	N	N
	536	47	49	45	44	45	47	50	49	N	N
	537	47	49	44	43	45	47	50	49	N	N
	538	46	48	43	42	43	45	50	48	N	N
	539	47	49	44	43	45	47	50	49	N	N
	540	50	52	47	46	47	49	50	52	N	N
	541	51	53	47	48	49	51	50	53	N	N
	542	50	52	47	46	47	49	50	52	N	N
	543	50	52	46	45	47	49	50	52	N	N
	544	48	50	46	45	46	48	50	50	N	N
	545	49	51	46	45	46	48	50	51	N	N
	546	49	51	46	45	46	48	50	51	N	N
	547	50	52	46	46	47	49	50	52	N	N
	548	49	51	47	45	47	49	50	51	N	N
	549	52	54	48	49	49	51	50	54	N	N
	550	51	53	47	47	48	50	50	53	N	N
	551	50	52	47	47	48	50	50	52	N	N
	552	51	53	47	48	48	50	50	53	N	N
	553	54	56	47	50	50	52	50	56	N	N
	554	53	55	48	50	50	52	50	55	N	N

NCA	Receiver No.	Future Existing Level 2012	Do Nothing Level 2022	Hume Hwy 2022 (with Bypass)	Bypass 2022	Combined Hume Hwy and Bypass 2012	Combined Hume Hwy and Bypass 2022	Night Base Criteria	Future Existing Level 2012 + 2dBA	Does the Receiver need Mitigation according to ENMM guidelines?	Design Noise 2022 Acute (>=60dBA)?
	555	53	55	47	50	50	52	50	55	N	N
	556	53	55	47	50	50	52	50	55	N	N
	557	53	55	47	50	50	52	50	55	N	N
	558	53	55	47	50	50	52	50	55	N	N
	559	53	55	47	50	50	52	50	55	N	N
	560	53	55	47	50	49	51	50	55	N	N
	561	54	56	47	51	50	52	50	56	N	N
	562	53	55	46	51	50	52	50	55	N	N
	563	53	55	46	50	49	51	50	55	N	N
	564	57	59	48	54	53	55	50	59	N	N
	565	56	58	48	53	52	54	50	58	N	N
	566	56	58	48	53	52	54	50	58	N	N
	567	47	49	45	44	45	47	50	49	N	N
	568	48	50	45	43	45	47	50	50	N	N
	569	48	50	45	43	45	47	50	50	N	N
	570	48	50	45	43	45	47	50	50	N	N
	571	48	50	46	43	46	48	50	50	N	N
	572	49	51	46	44	46	48	50	51	N	N
	573	49	51	47	45	47	49	50	51	N	N
	574	60	62	49	57	55	57	50	62	N	N
	575	57	59	49	54	53	55	50	59	N	N
	576	58	60	50	55	55	57	50	60	N	N
	577	59	61	52	52	53	55	50	61	N	N
	578	60	62	52	50	52	54	50	62	N	N
	579	56	58	50	47	50	52	50	58	N	N
NCA 9	448	42	44	41	38	41	43	50	44	N	N
	584	43	45	41	37	41	43	50	45	N	N
	585	40	42	40	35	39	41	50	42	N	N
	586	40	42	41	34	39	41	50	42	N	N
	588	42	44	34	36	36	38	50	44	N	N
	589	38	40	39	31	38	40	50	40	N	N
	594	37	39	38	27	36	38	50	39	N	N
	596	37	39	35	29	34	36	50	39	N	N
	597	32	34	28	27	28	30	50	34	N	N
	598	30	32	26	24	26	28	50	32	N	N
	599	39	41	41	31	39	41	50	41	N	N
	600	38	40	40	30	38	40	50	40	N	N
NCA 10	289	48	50	52	33	50	52	55	50	N	N
	290	48	50	51	34	49	51	55	50	N	N

APPENDIX E

NIGHT TIME NOISE CONTOURS, BYPASS ONLY 2022, BEFORE
MITIGATION



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Hobrook Bypass Project

2022 Night Time noise contours
NO NOISE MITIGATION

NCA01/a

Legend

- | | | | |
|---|-------------------|---|-------|
|  | Receiver Location |  | 60dBA |
|  | NCA Boundaries |  | 55dBA |
|  | Bypass Alignment |  | 50dBA |
| | |  | 45dBA |
| | |  | 40dBA |





WILKINSON  MURRAY

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Hobrook Bypass Project

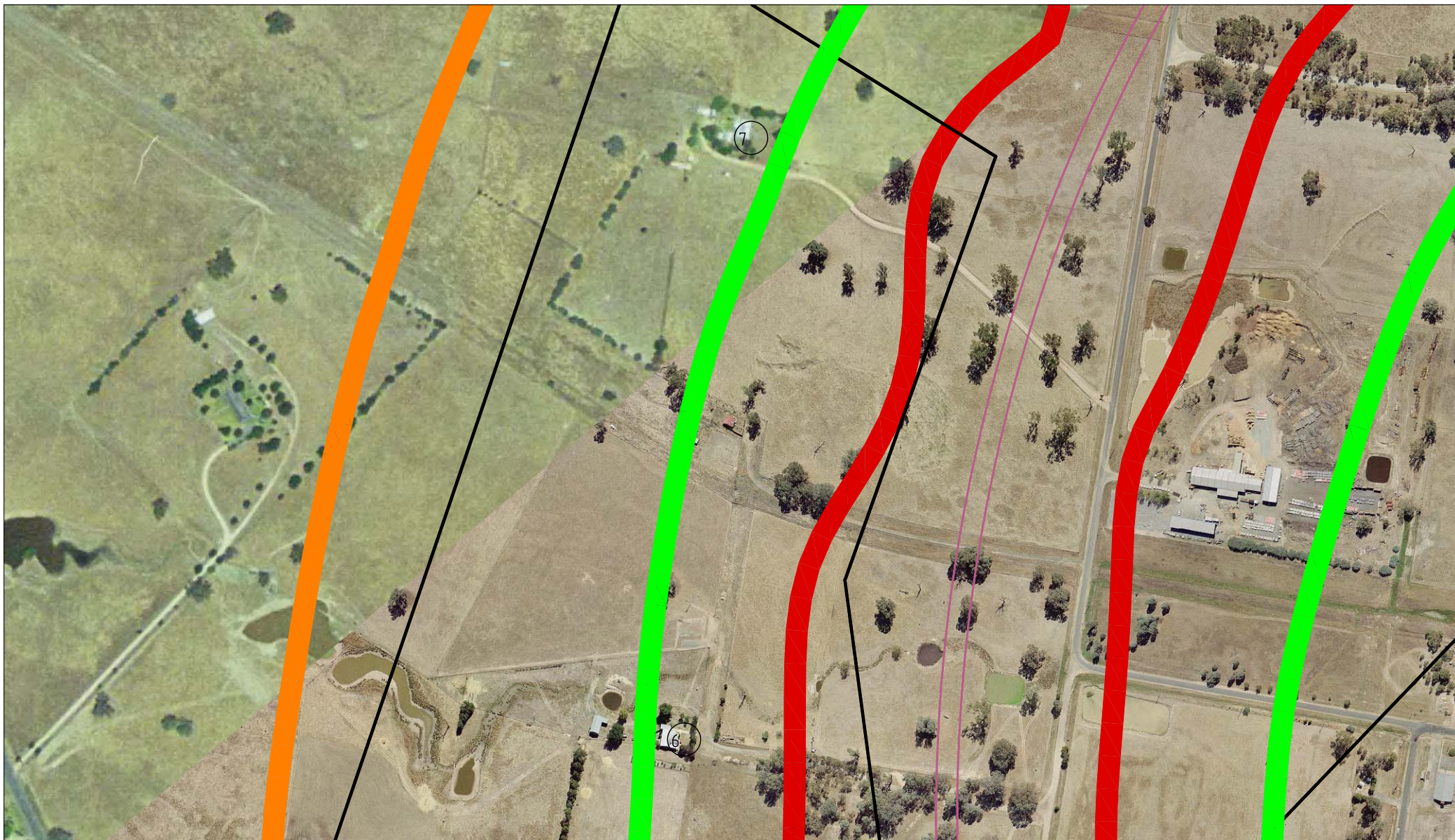
2022 Night Time noise contours
NO NOISE MITIGATION

NCA01/b

Legend

- | | | | |
|---|-------------------|---|-------|
|  | Receiver Location |  | 60dBA |
|  | NCA Boundaries |  | 55dBA |
|  | Bypass Alignment |  | 50dBA |
| | |  | 45dBA |
| | |  | 40dBA |





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Project 07277-H
Hobrook Bypass Project

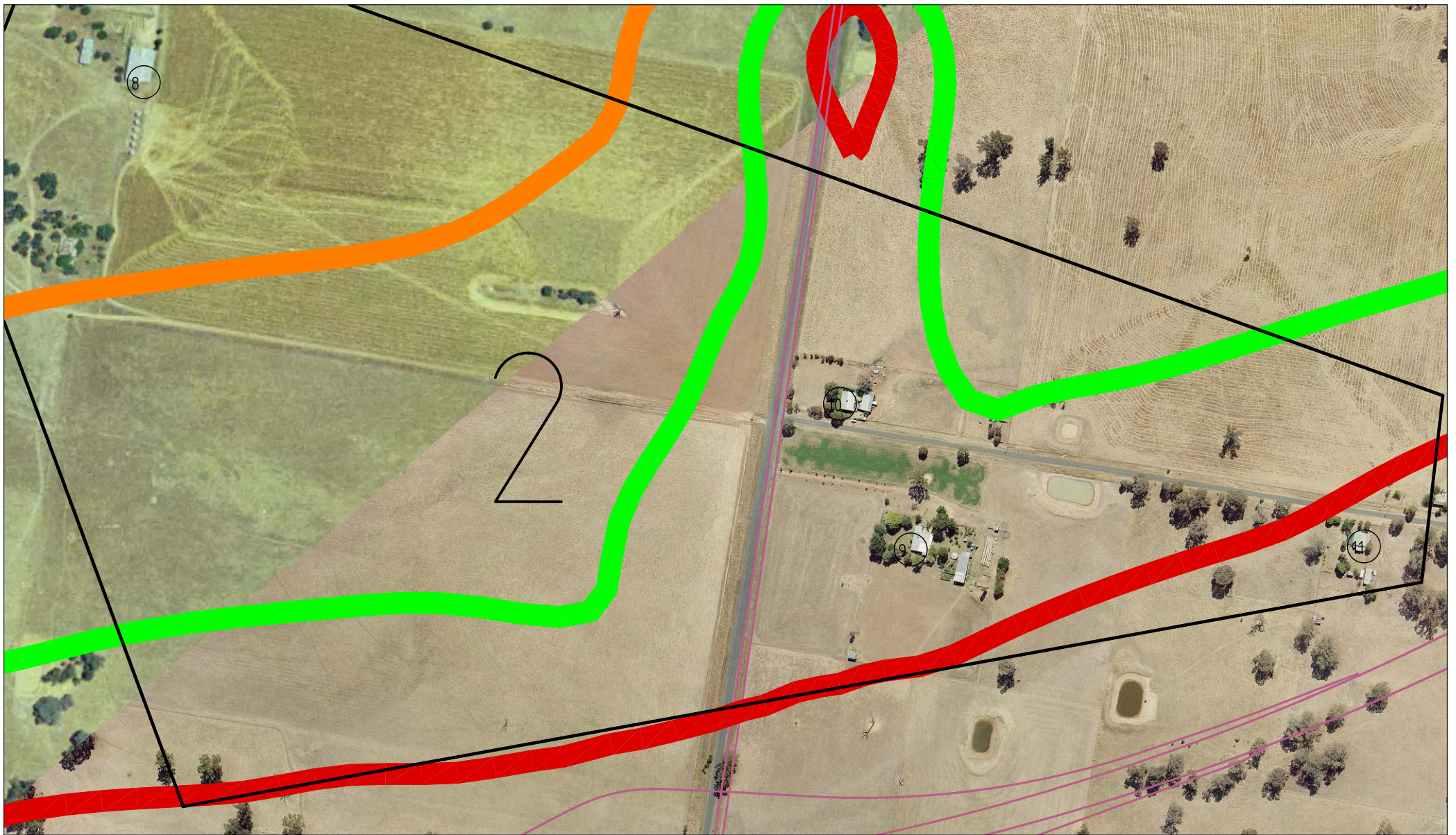
2022 Night Time noise contours
NO NOISE MITIGATION

NCA01/c

Legend

- | | | | |
|---|-------------------|---|-------|
|  | Receiver Location |  | 60dBA |
|  | NCA Boundaries |  | 55dBA |
|  | Bypass Alignment |  | 50dBA |
| | |  | 45dBA |
| | |  | 40dBA |





WILKINSON MURRAY

Project 07277-H
Hobrook Bypass Project

2022 Night Time noise contours
NO NOISE MITIGATION

NCA02

Legend

- | | | | |
|---|-------------------|---|-------|
|  | Receiver Location |  | 60dBA |
|  | NCA Boundaries |  | 55dBA |
|  | Bypass Alignment |  | 50dBA |
| | |  | 45dBA |
| | |  | 40dBA |

