Appendix H

Noise and Vibration Assessment

Appendix H1: Construction noise exceedance maps

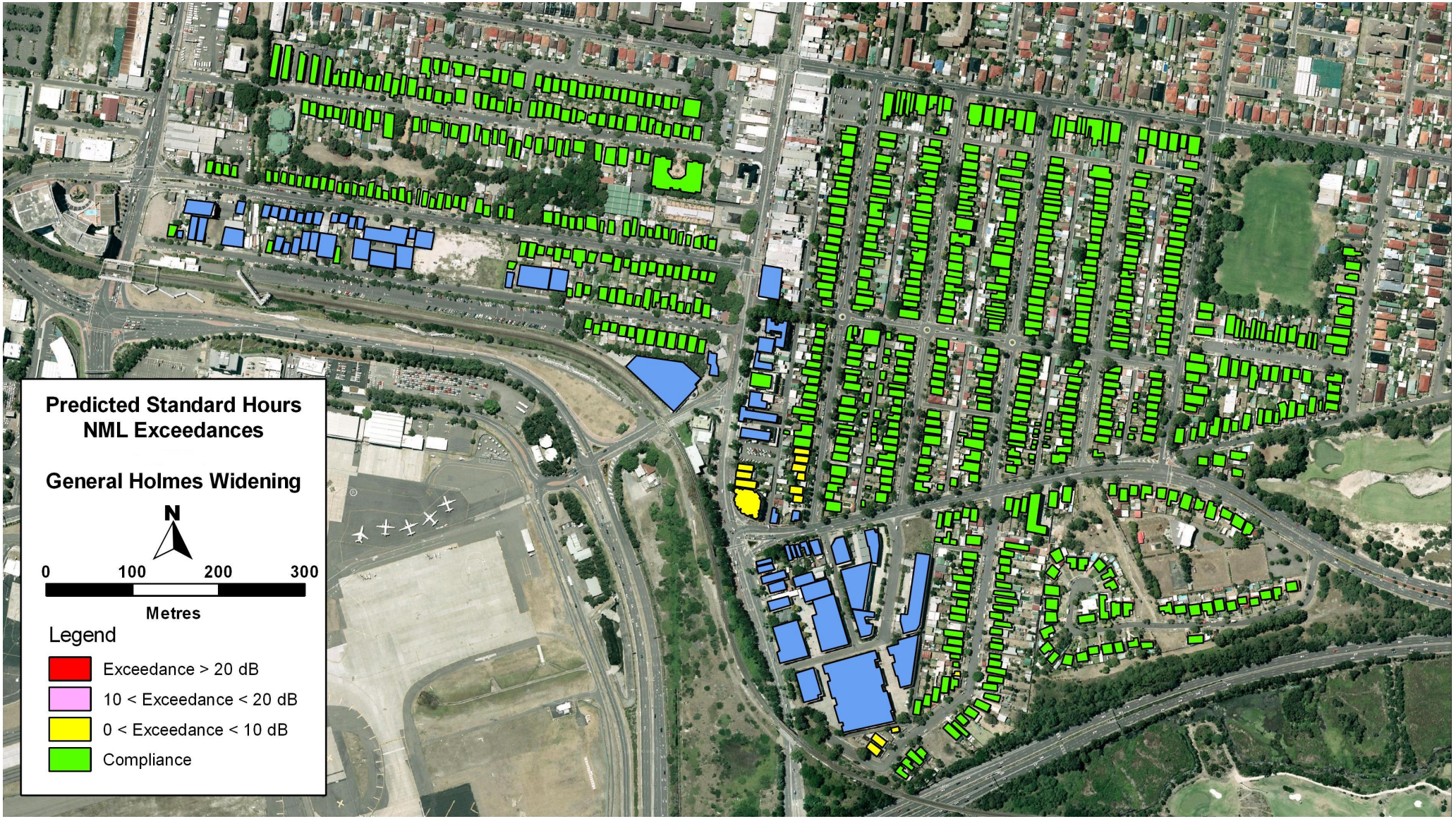

Figure 1: Predicted standard hours NML exceedances during General Holmes Drive widening

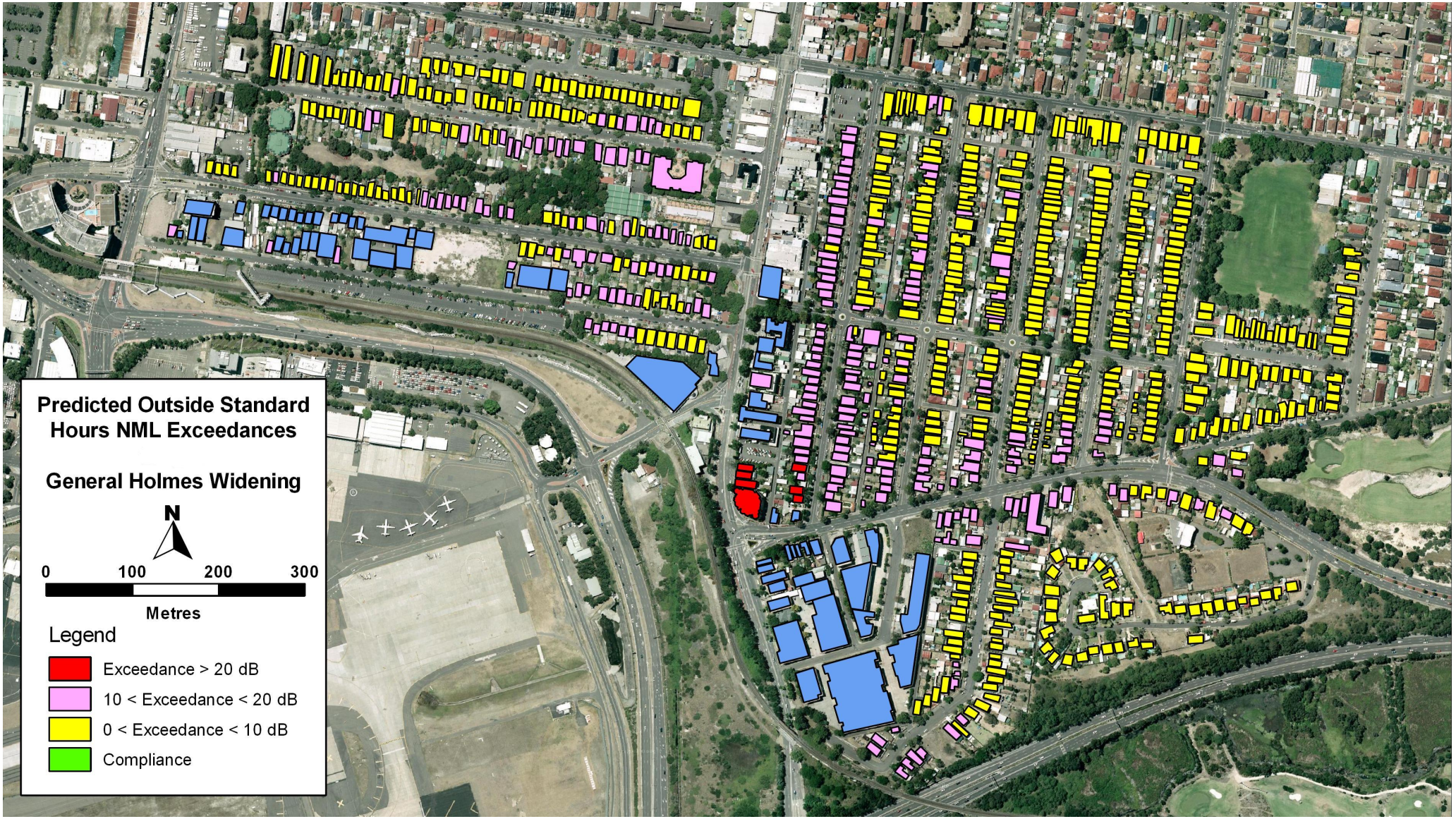

Figure 2: Predicted out-of-hours NML exceedances during General Holmes Drive widening

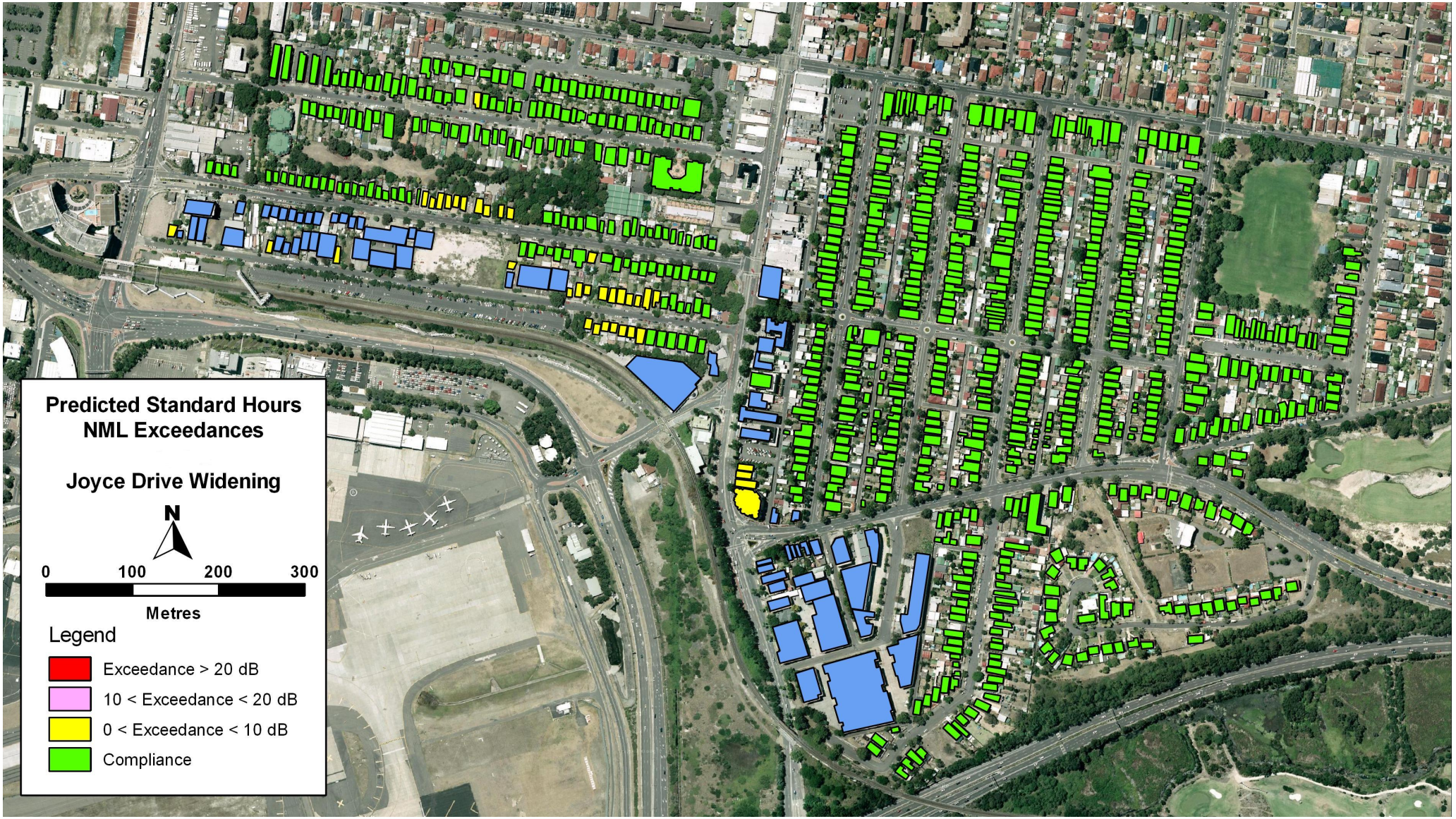

Figure 3: Predicted standard hours NML exceedances during Joyce Drive widening

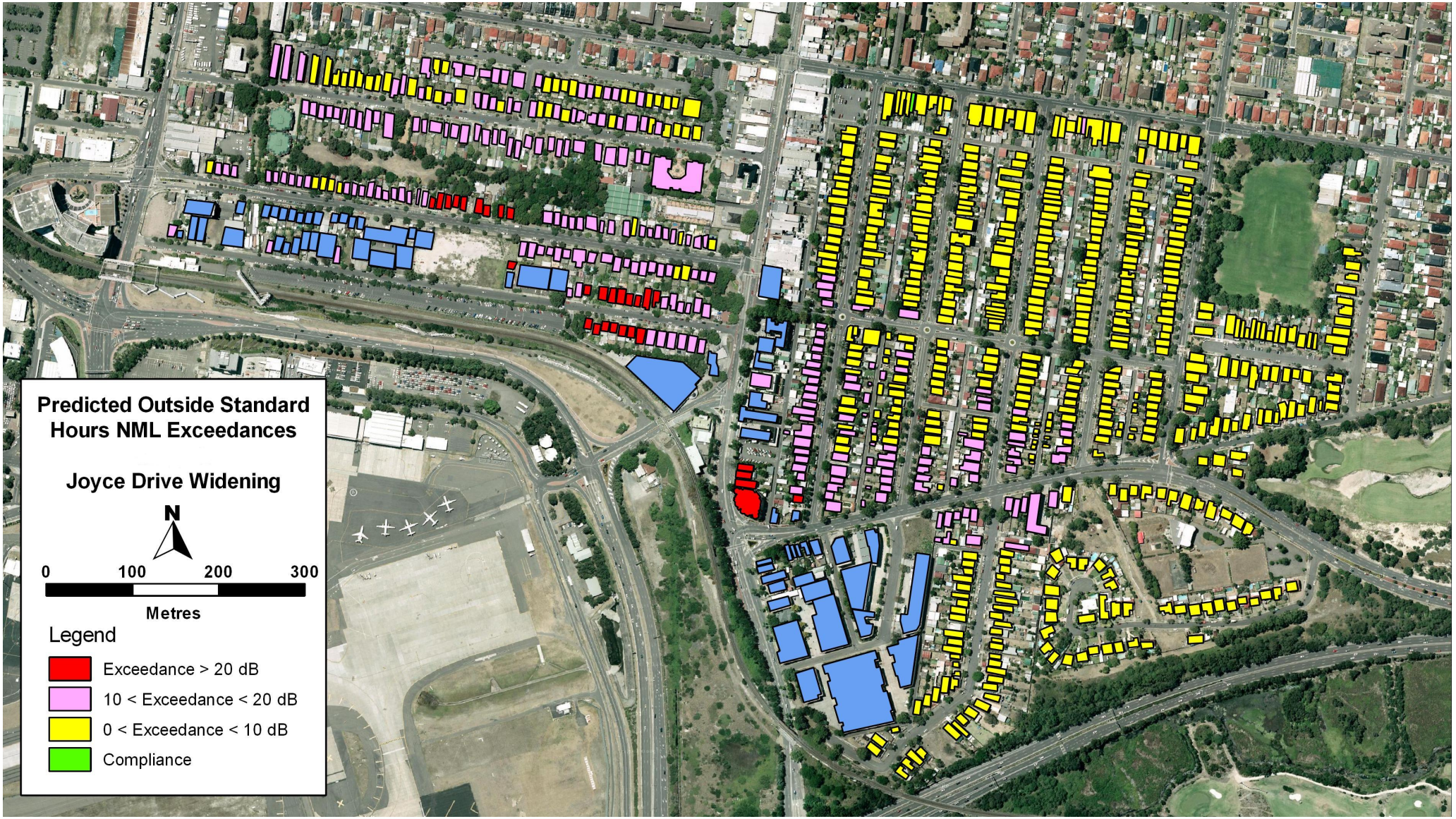

Figure 4: Predicted out-of-hours NML exceedances during Joyce Drive widening

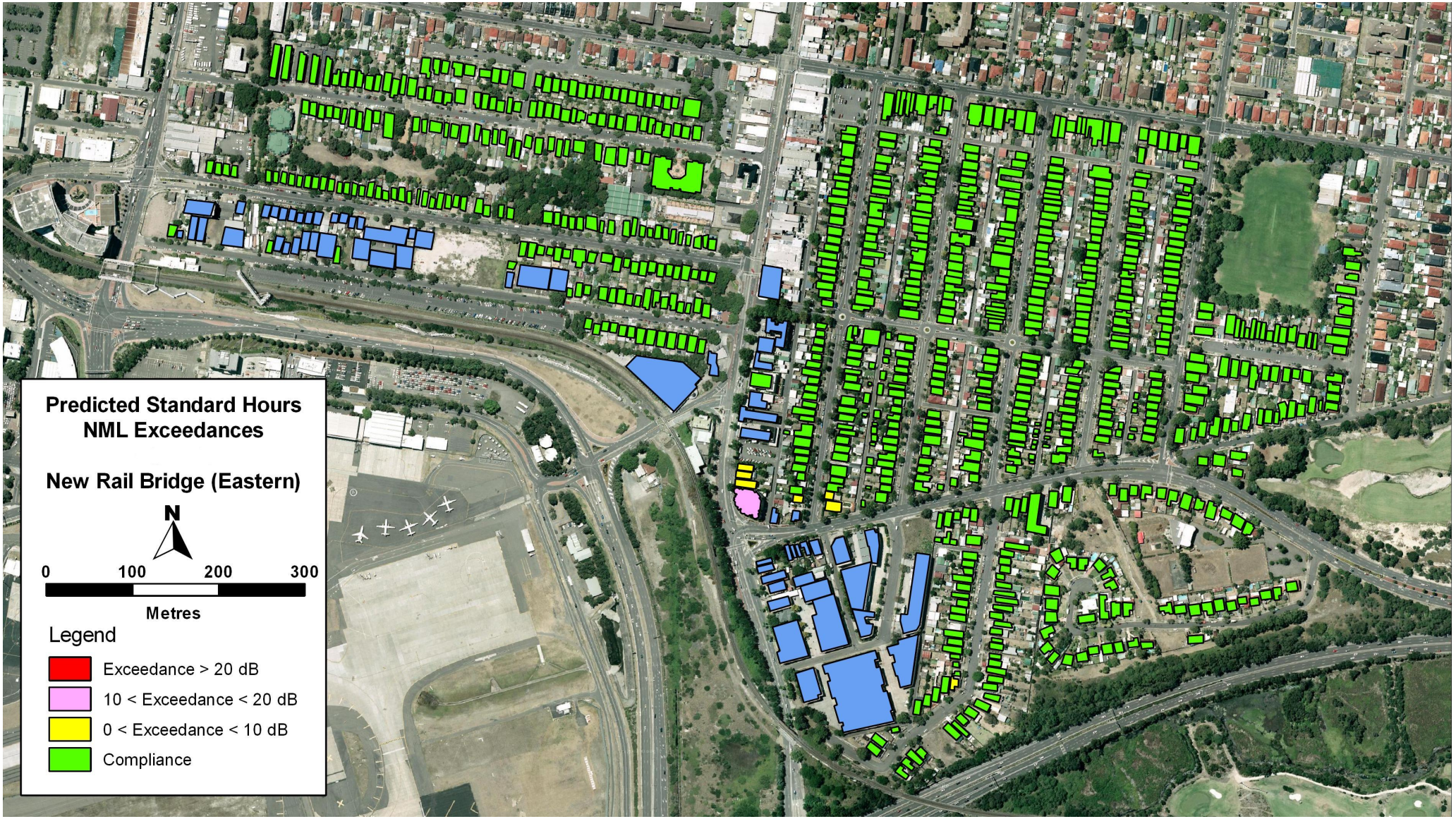

Figure 5: Predicted standard hours NML exceedances during rail bridge construction

Figure 6: Predicted out-of-hours NML exceedances during rail bridge construction

Figure 7: Predicted standard hours NML exceedances during intersection upgrade works

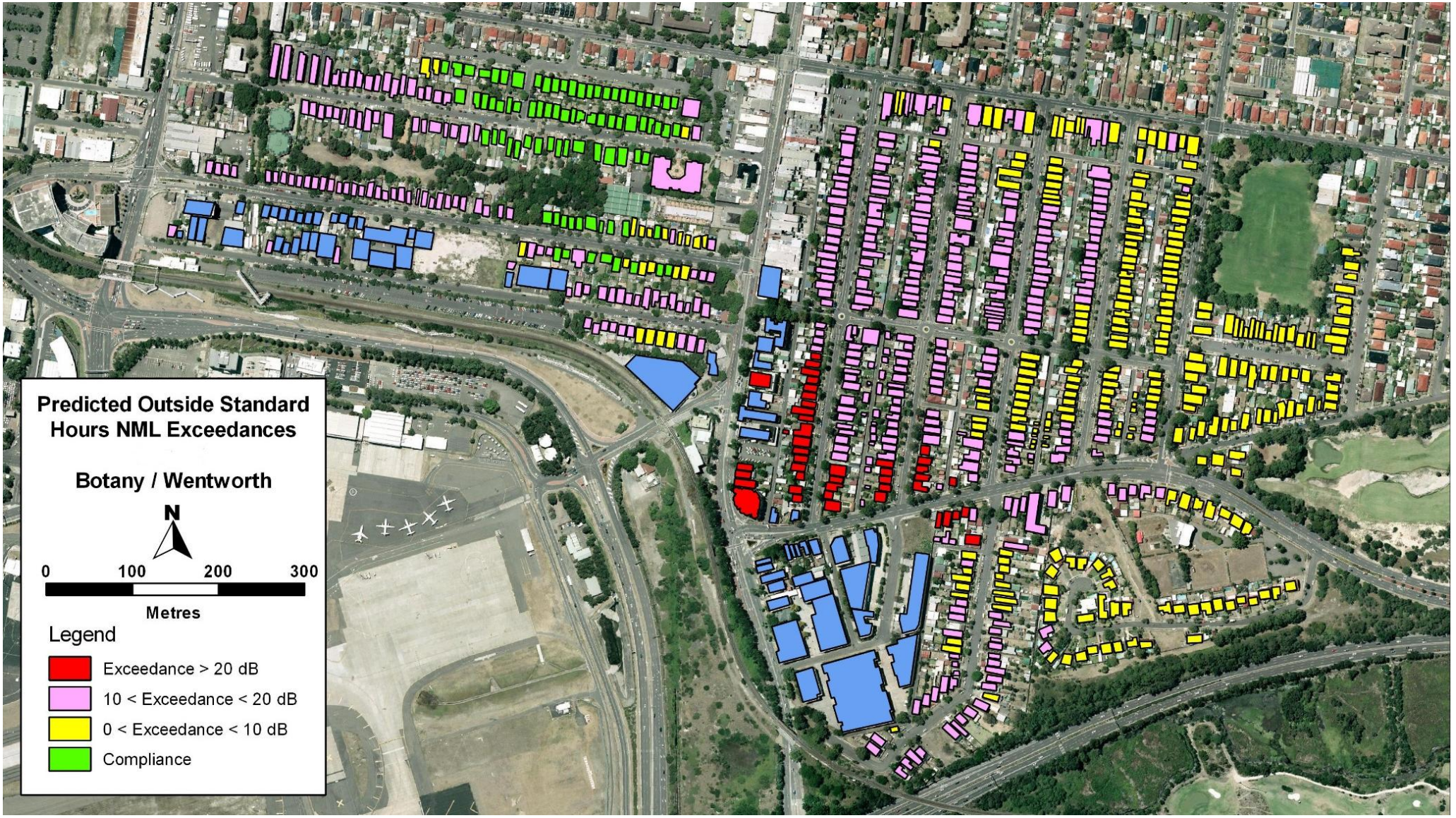

Figure 8: Predicted out-of-hours NML exceedances during intersection upgrade works

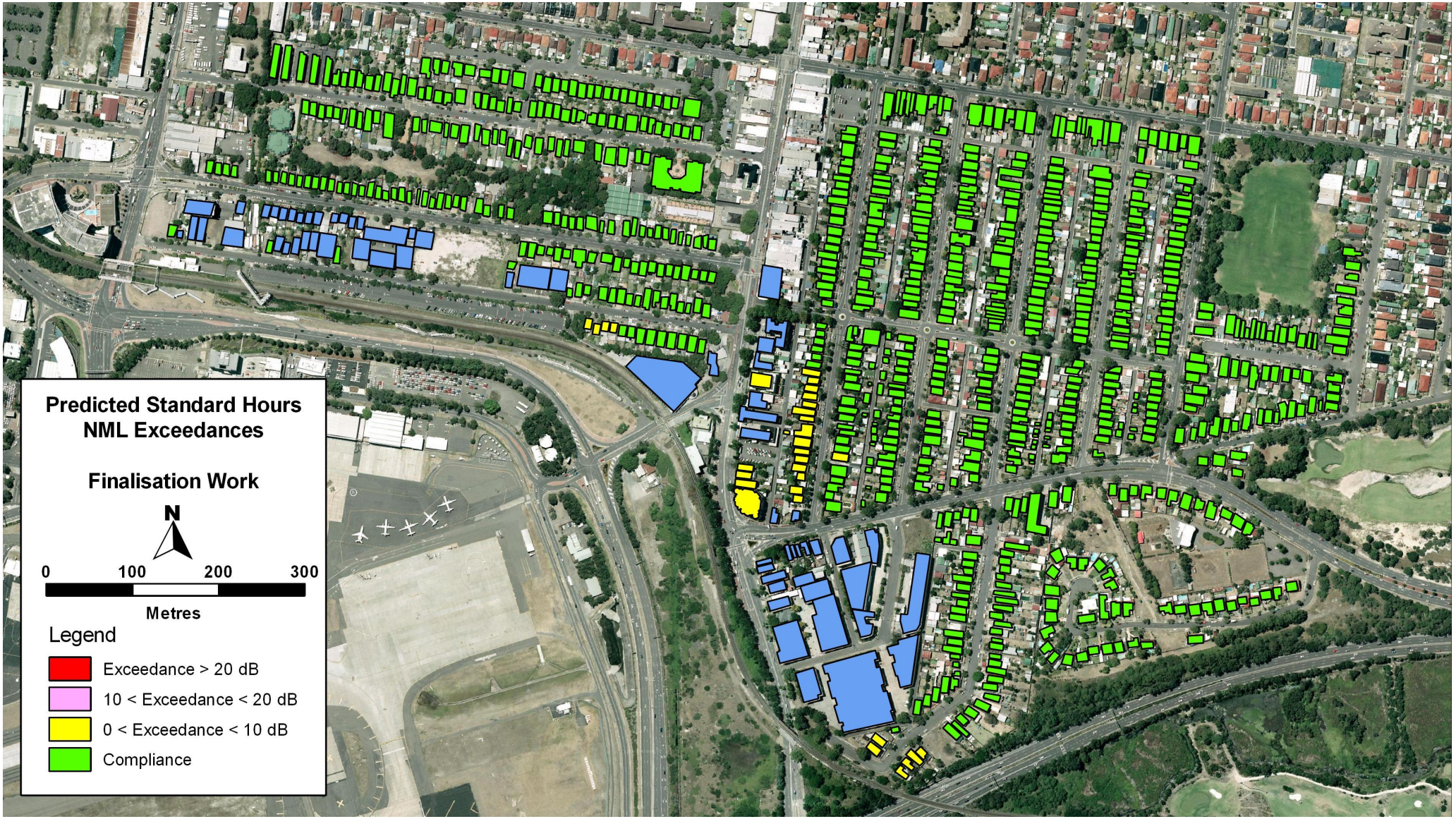

Figure 9: Predicted standard hours NML exceedances during finalisation works

Figure 10: Predicted out-of-hours NML exceedances during finalisation works

Appendix H2: Construction noise and vibration impact assessment

ACOUSTICS AND AIR

WESTCONNEX ENABLING WORKS (AIRPORT EAST)

CONSTRUCTION NOISE & VIBRATION IMPACT STATEMENT

REPORT NO. 14174
VERSION B

NOVEMBER 2014

PREPARED FOR

ROADS AND MARITIME SERVICES
27 ARGYLE STREET
PARRAMATTA NSW 2150

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DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	29 July 2014	Sean Flaherty	-
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Note

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Celebrating 50 Years in 2012

Wilkinson Murray is an independent firm established in 1962, originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. 2010 saw the introduction of our Queensland office and 2011 the introduction of our Orange office to service a growing client base in these regions. From these offices, Wilkinson Murray services the entire Asia-Pacific region.

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APPENDIX A – Noise Measurement Results

APPENDIX B – Draft Schedule of Construction Equipment & Associated Sound Power Levels Applied

APPENDIX C – Predicted Construction Noise Levels

APPENDIX D – Predicted Construction Noise Exceedance Maps

GLOSSARY OF ACOUSTIC TERMS

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 below, 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.

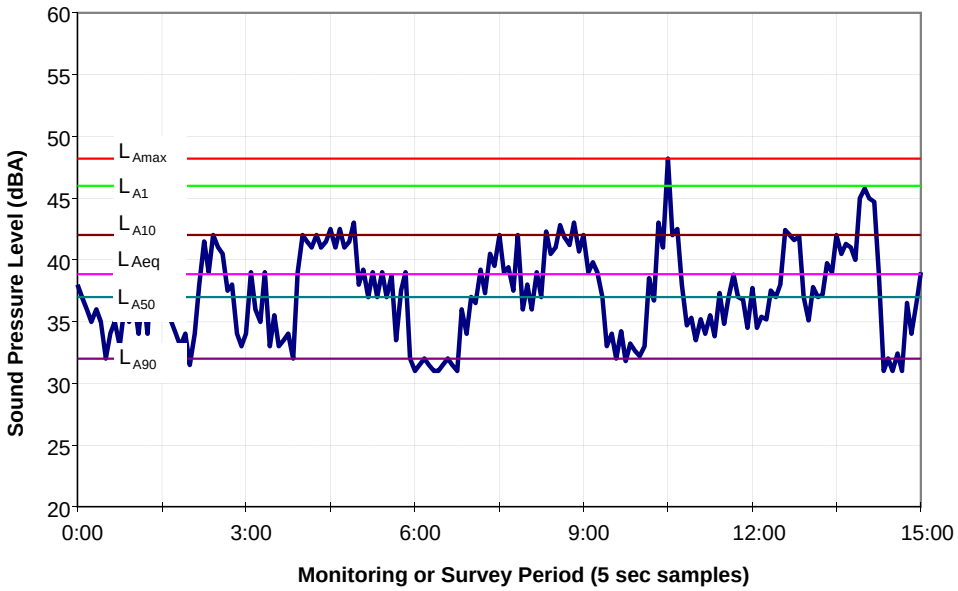
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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.

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.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

Roads and Maritime Services (RMS) is planning to upgrade roads east of Sydney airport and remove the General Holmes Drive rail level crossing. This will improve traffic flow and access to the airport, Port Botany and, in the future, the WestConnex motorway.

On behalf of RMS, MIEngineers (MIE) has prepared a Construction Method Statement (CMS) for the WestConnex Enabling Works – Airport East Precinct Project (the Project).

Wilkinson Murray has been engaged by RMS to undertake a construction noise and vibration assessment for the proposed works, based on the proposed staging of the construction works and plant and equipment detailed in the Construction Method Statement.

This construction and noise and vibration impact statement (CNVIS) for the concept design has been undertaken in accordance with the *NSW Interim Construction Noise Guideline 2009* (DECC), *Assessing Vibration: A Technical Guideline* (OEH) and German Standard *DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures*.

2 SITE DESCRIPTION & CONSTRUCTION STAGING

The proposed works would be undertaken on General Holmes Drive, Joyce Drive, Wentworth Avenue, Botany Road and Mill Pond Road. A general arrangement plan of the preferred Option (Option 4 7E) is included as Appendix A of the CMS and reproduced below in Figure 2-1.

The Project Map extracted from the RMS Community Update WestConnex Enabling Works – Airport East Precinct November 2013 is additionally included below, in Figure 2-2.

Figure 2-1 General Arrangement Plan of Option 4 7E (Extracted from Appendix A of the Construction Method Statement)

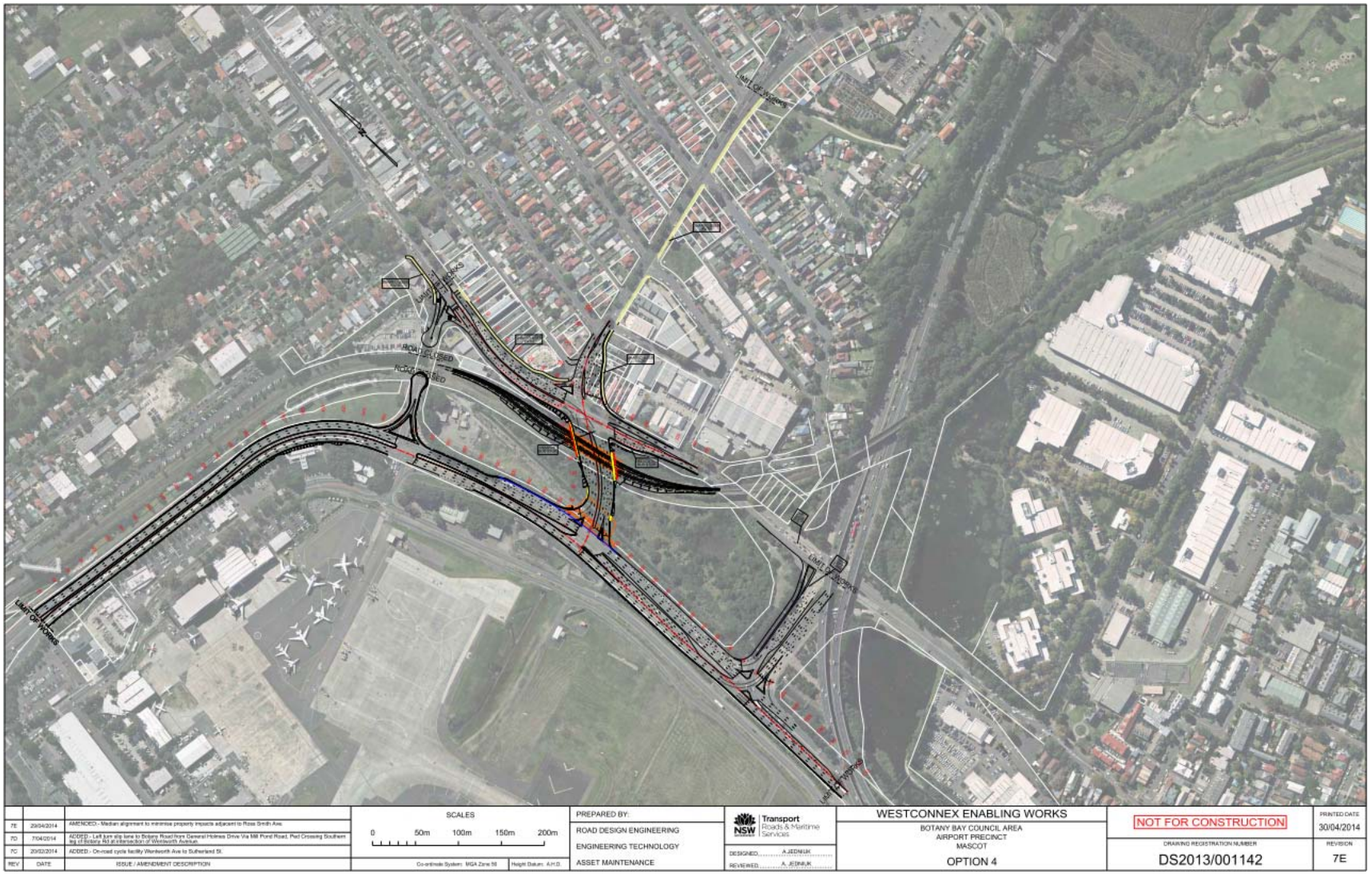
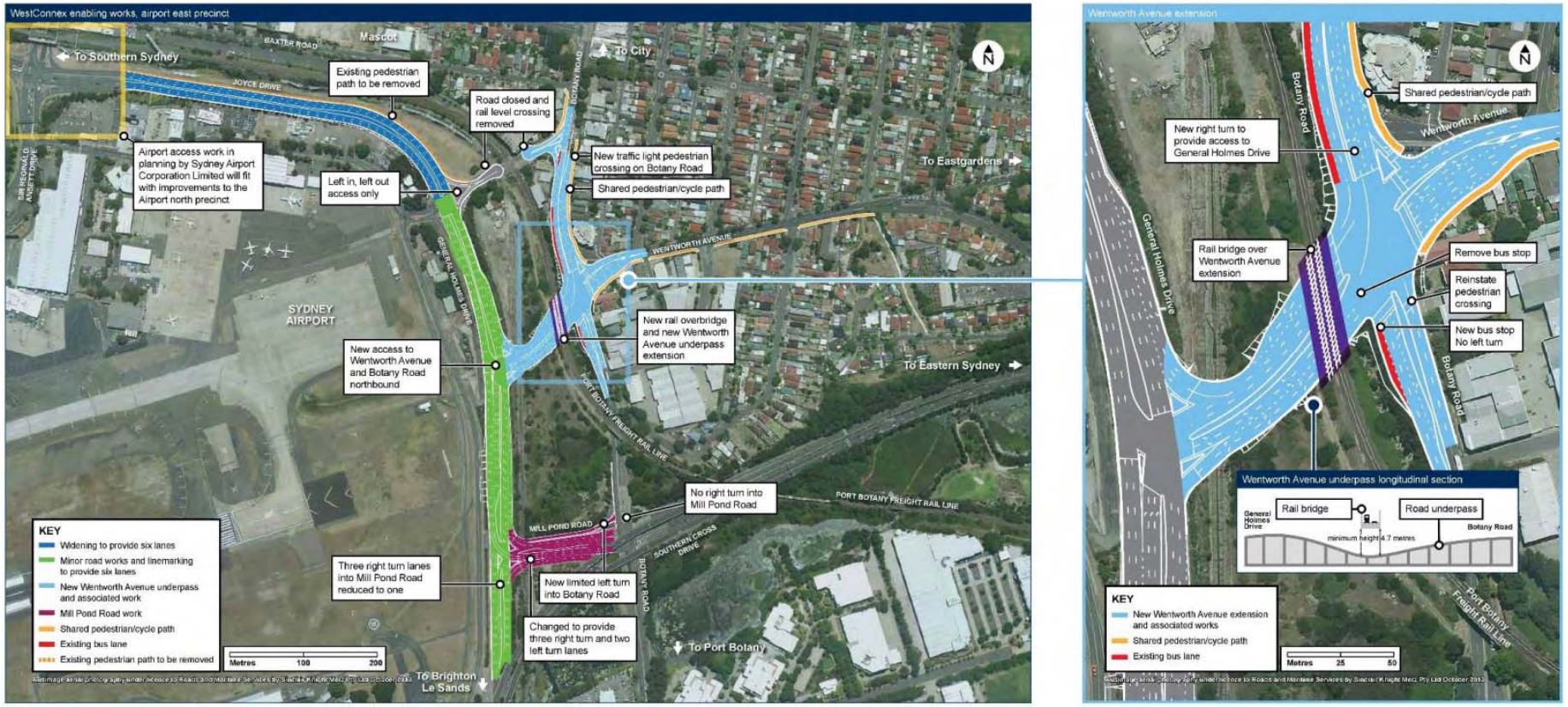


Figure 2-2 Project Map Extracted from RMS Community Update WestConnex Enabling Works – Airport East Precinct November 2013



2.1 Construction Stages

The CMS breaks the works into six stages as presented in Table 2-1.

Table 2-1 Construction Stages

Activity Number	Activity	Activity Details
1	Utilities Relocation	Includes relocation of existing electricity, gas, water, sewer and telecoms services.
2	General Holmes Drive Widening, Utility Protection Slab & Bridge Over Stormwater Canal	Activity has been broken into 11 sub-stages, as defined by the CMS.
3	Joyce Drive Widening	Activity has been broken into 3 sub stages, as defined by the CMS.
4	New Rail Bridges (Western, followed by Eastern, followed by Decline Construction)	Western Bridge Activity has been broken into 10 sub-stages. The Eastern Bridge Activity has been broken into 9 sub-stages. The Decline Construction Activity has been broken into 4 sub-stages. These are defined by the CMS.
5	Botany Road / Wentworth Avenue Intersection Upgrade	Activity has been broken into 6 sub stages, as defined by the CMS.
6	Finalisation Works	Includes placement of final asphalt, medians and line marking throughout.

These six major activity stages are each broken into several sub-stages by the CMS, totalling a total of 44 sub-stages. Given the number of sub-stages to be considered, this assessment focusses on the typical worst-case noise scenarios within each of the major activity stage.

Detailed staging descriptions and drawings are included in Volume 2 of the CMS. The CMS additionally notes that the stages are largely independent of each other.

Volume 2 of the CMS identifies the anticipated construction plant that would be expected to be deployed for Activities 2-6. It is noted however, that equipment quantities have not been clearly defined. On this basis the equipment details provided are considered only preliminary. It would be expected that the construction equipment schedules would be updated as understanding of the project grows. For the purpose of this assessment, construction noise emissions have been based on the current schedules, assuming that one of each type of plant would operate concurrently. Construction plant details and sound power levels are further discussed in Section 6 of this report.

It would be expected that construction compounds and casting yards or holding areas would be established to support the works. The locations of these are not clear from the CMS. Notwithstanding this, best practice management would be applied at the compounds which would limit noise emissions. The noise levels predicted by this assessment, based on typical worst-case noise scenarios, would not be expected to be influenced by noise emissions from the compounds.

2.2 Construction Programme

An outline construction programme based on the staging identified above is provided in Appendix D of the CMS. This programme is subject to further revision as understanding of the project and project constraints develop. The current expectation is that construction would commence in November 2015 and take approximately two years to complete. The CMS notes that there has been no consideration of works being undertaken concurrently and no allowance for rain, public holidays, etc.

A key constraint on the project relates to Sydney Airport's Obstacle Limitation Surface (OLS). On this matter the CMS notes:

> *"The entire General Holmes Drive Widening, Utility Protection Slab & Bridge Over Stormwater Canal works are to be constructed under the lowest portion of the OLS. The OLS is within 4m of the existing road surface in this area. Almost all construction activities will require plant to penetrate the OLS (ie tippers with tray up, excavators loading trucks, etc). As a result, a large portion of the works during this Stage will need to be undertaken during East West Runway closures at night.*
>
> *Construction techniques (such as cased piles) would be adopted to allow the works to be undertaken in short night shifts.*
>
> *Over height plant (especially piling rigs and cranes) will need to retreat from the work sites to a "Tall Vehicle Storage Area" located to the south of the existing General Holmes Drive Level Crossing. This allows storage of plant and equipment up to ~25m in height without penetrating the OLS.*
>
> *Further development of the programme would be undertaken once some of the stages (such as utilities relocation early works) and constraints (such as East West Runway closures) are confirmed. Concurrent works would then be assessed and the timeframe for completion more accurately determined."*

3 SENSITIVE RECEIVERS

A number of existing residential and commercial receivers surround the proposed work sites. The potentially most affected of these are located in Baxter Road, Botany Road, Wentworth Avenue (and roads adjoining Wentworth Avenue to the north) and McBurney Avenue. Additionally a Church is located close to south of the Botany Road / Wentworth Avenue Intersection, at 1293-1295 Botany Road.

Table 3-1 provides a summary of the potentially most impacted receivers within the study area. These receivers are consistent with those identified by the operational noise assessment undertaken for this project and are shown graphically in Figure 3-1.

It should be noted that the addresses identified in Table 3-1 have been interpreted from review of Googlemaps aerial imagery and Googlemaps Streetview and have not been confirmed by ground-truthing. On this basis the identified addresses should be considered approximate only.

A number of properties would need to be acquired to accommodate the Botany Road / Wentworth Avenue intersection and therefore these have not been considered as sensitive to construction noise and vibration. These properties would be demolished during Stage 1 of Activity 5. They highlighted in blue in Figure 3-1.

Predicted construction noise exceedance maps are provided in Appendix D, and include receivers beyond the extent identified in Figure 3-1. It should be noted that the accurate prediction of noise levels within urban areas, with many buildings and structures becomes difficult at large distances from the sources of noise. Therefore the results shown in these maps should be regarded as indicative only. Levels predicted beyond several rows of house are likely to be somewhat overstated.

Table 3-1 Sensitive Receivers Considered by this Assessment

ID	Address	ID	Address	ID	Address	ID	Address	ID	Address	ID	Address
R1	2 Baxter Rd	R26	25 Baxter Rd	R51	50 Hardie St	R76	67 Johnson St	R101	62 Wentworth Ave	C2	37 Baxter Rd
R2	4 Baxter Rd	R27	29 Baxter Rd	R52	52 Hardie St	R77	65 Johnson St	R102	60 Wentworth Ave	C3	79 Baxter Rd
R3	6-8 Baxter Rd	R28	31 Baxter Rd	R53	54 Hardie St	R78	63 Johnson St	R103	56 Wentworth Ave	C4	81-85 Baxter Rd
R4	10-12 Baxter Rd	R29	33 Baxter Rd	R54	56 Hardie St	R79	61 Johnson St	R104	54 Wentworth Ave	C5	95-97 Baxter Rd
R5	14-16 Baxter Rd	R30	93 Baxter Rd	R55	58 Hardie St	R80	78 Alfred St	R105	52 Wentworth Ave	C6	101 Baxter Rd
R6	18-20 Baxter Rd	R31	105 Baxter Rd	R56	60 Hardie St	R81	74 Alfred St	R106	50 Wentworth Ave	C7	113-121 Baxter Rd
R7	22-24 Baxter Rd	R32	133 Baxter Rd	R57	62 Hardie St	R82	70 Alfred St	R107	48 Wentworth Ave	C8	127 Baxter Rd
R8	26 Baxter Rd	R33	1247 Botany Rd	R58	64 Hardie St	R83	75A Alfred St	R108	46 Wentworth Ave	C9	1209 Botany Rd
R9	28 Baxter Rd	R34	1273 Botany Rd	R59	66 Hardie St	R84	75 Alfred St	R109	44 Wentworth Ave	C10	1225 Botany Rd
R10	30 Baxter Rd	R35	1275 Botany Rd	R60	68 Hardie St	R85	73 Alfred St	R110	42 Wentworth Ave	C11	1237 Botany Rd
R11	32 Baxter Rd	R36	1277 Botany Rd	R61	70 Hardie St	R86	71 Alfred St	R111	40 Wentworth Ave	C12	1245 Botany Rd
R12	34 Baxter Rd	R37	1285 Botany Rd	R62	72 Hardie St	R87	69 Frogmore St	R112	38 Wentworth Ave	C13	1263 Botany Rd
R13	36 Baxter Rd	R38	86 Hardie St	R63	74 Hardie St	R88	67 Frogmore St	R113	36 Wentworth Ave	C14	1265 Botany Rd
R14	1 Baxter Rd	R39	87 Hardie St	R64	76 Hardie St	R89	65 Frogmore St	R114	44B Wentworth Ave	C15	1269 Botany Rd
R15	3 Baxter Rd	R40	90 Johnson St	R65	80 Hardie St	R90	63 Frogmore St	R115	1 McBurney Ave	C16	1297 Botany Rd
R16	5 Baxter Rd	R41	69 Johnson St	R66	82 Hardie St	R91	64 Frogmore St	R116	57 McBurney Ave	C17	1303 Botany Rd
R17	7 Baxter Rd	R42	5 Johnson Ln	R67	84 Hardie St	R92	62 Frogmore St	R117	59 McBurney Ave	C18	1307 Botany Rd
R18	9 Baxter Rd	R43	80 Alfred St	R68	85 Hardie St	R93	60 Frogmore St	R118	61 McBurney Ave	C19	1309 Botany Rd
R19	11 Baxter Rd	R44	77 Alfred St	R69	85 Hardie St	R94	58 Frogmore St	R119	63 McBurney Ave	C20	1305 Botany Rd
R20	13 Baxter Rd	R45	71 Frogmore St	R70	83 Hardie St	R95	182 Sutherland St	R120	40 McBurney Ave	C21	1305 Botany Rd
R21	15 Baxter Rd	R46	66 Frogmore St	R71	81 Hardie St	R96	180 Sutherland St	R121	42 McBurney Ave	C22	1309 Botany Rd
R22	17 Baxter Rd	R47	184 Sutherland St	R72	88 Johnson St	R97	178 Sutherland St			C23	22 Merchant St
R23	19 Baxter Rd	R48	44 Hardie St	R73	86 Johnson St	R98	68 Wentworth Ave	Church	1293-1295 Botany Rd	C24	6 Merchant St
R24	21 Baxter Rd	R49	46 Hardie St	R74	84 Johnson St	R99	66 Wentworth Ave			C25	14 Wentworth Ave
R25	23 Baxter Rd	R50	48 Hardie St	R75	82 Johnson St	R100	64 Wentworth Ave	C1	35 Baxter Rd	C26	14 Wentworth Ave

Note: The addresses identified have been interpreted from review of *Googlemaps* aerial imagery and *Googlemaps Streetview* and have not been confirmed by ground-truthing. The identified addresses should be consider approximate only

Figure 3-1: Sensitive Receivers Considered by this Assessment

4 EXISTING ACOUSTIC ENVIRONMENT

Wilkinson Murray undertook an initial inspection of the proposed works sites and surrounding area on 10 June 2014 in order to evaluate the potential noise exposure to the closest sensitive receivers and to assess their existing noise exposure.

Receivers R13 (36 Baxter Road), R38 (3 Wentworth Avenue)[1] and R117 (59 McBurney Avenue) were considered to be potentially the most affected by construction noise associated with the proposed works. On this basis, these receiver locations were selected for background noise monitoring assessment, in order to quantify their existing noise exposure.

Based on observations during the site inspections, it is considered that the background noise levels measured at R13, R38 and R117 are broadly representative of the background noise levels occurring throughout the respective localities of the study area.

Figure 4-1 Noise Monitoring Location at 36 Baxter Road, Mascot

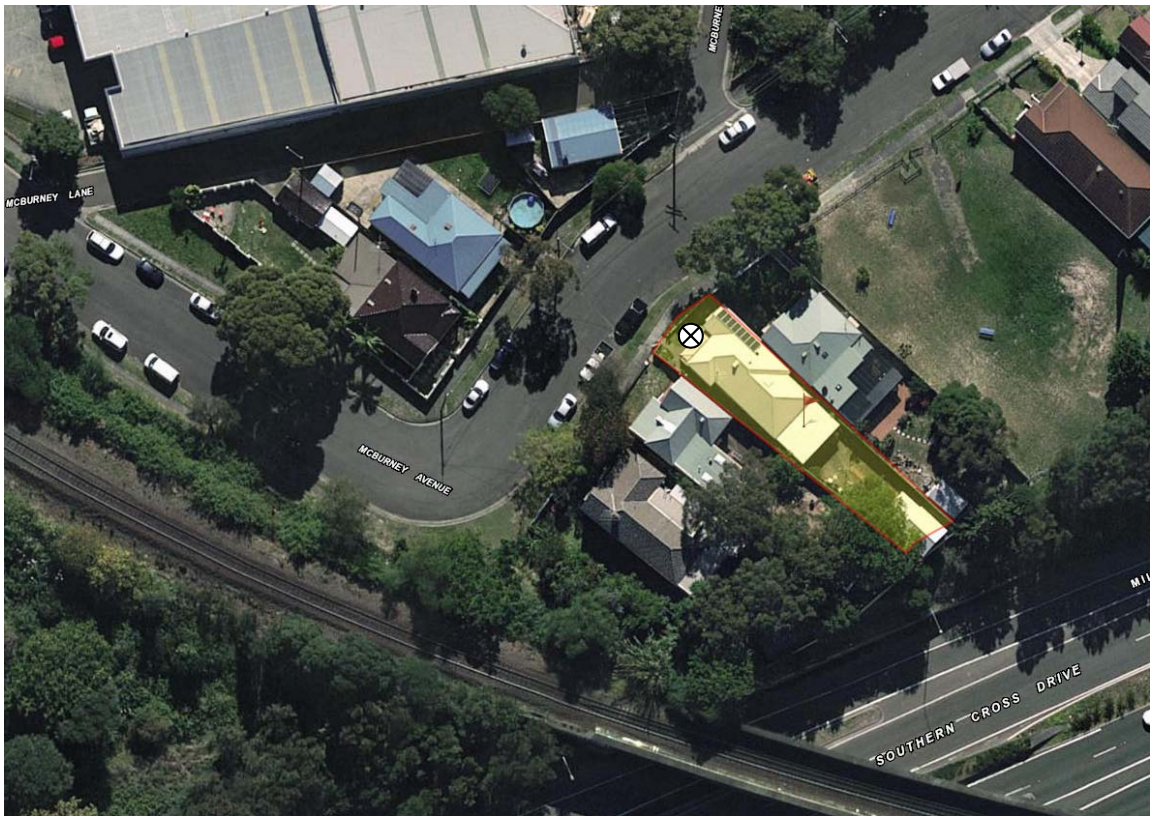
Note: Logger located on top of backyard shed (roof is 2m above ground) in free-field conditions. Mic height is 3.5m above ground so in direct line of sight with Joyce Drive.

[1] Note: Background noise monitoring was undertaken at 3 Wentworth Avenue. As this property would be acquired predicted noise levels have not been reported for this address. Predictions have been provided for the closest receiver bordering the site to the north (86 Hardie Street).

Figure 4-2 Noise Monitoring Location at 3 Wentworth Avenue, Mascot

Note: Logger located in backyard, in free-field location.

Figure 4-3 Noise Monitoring Location at 59 McBurney Avenue, Mascot



Note: Logger location in front yard, in free-field location.

4.1 Noise Measurement Methodology

Noise loggers were located as described above. The instruments were positioned in free-field locations with their microphones at 1.2 metres above ground level. A-weighting and fast time response settings were selected and the instruments were set to statistically process and store the measured statistical noise levels every 15 minutes for a total monitoring period of seven days.

The instruments were calibrated before logging and the calibration was checked after logging using an acoustic calibrator. No material drift was noted in the pre and post reference calibration measurements.

These noise measurements were undertaken in general accordance with AS 1055:1997 *"Acoustics – Description and Measurement of Environmental Noise"* and the measured levels have been subsequently analysed against concurrent meteorological data obtained from the Sydney Airport weather station. This analysis identified that the measurements were generally not materially affected by meteorological effects. However, where any uncertainty regarding the influence of meteorological effects, or other extraneous noise effects was observed, each of the potentially-affected 15 minute measurements were excluded from the dataset prior to the further analysis and processing.

It was observed during deployment of the loggers that background noise levels at all monitoring locations were noted to be controlled by distant vehicle movements on the local road network, in addition to the hum of cumulative industrial noise from the wider area.

4.2 Noise Monitoring Equipment

The equipment detailed in Table 4-1 was used in the noise surveys. These instruments comply with AS IEC 61672.1 – 2004 *"Electroacoustics – Sound level meters – Specifications"* and AS IEC 60942-2004: *"Electroacoustics – Sound Calibrators"* as appropriate, and have recent calibration certificates traceable to a NATA certified laboratory.

Table 4-1 Monitoring Equipment used for Noise Survey

Location / Date	Item	Make	Model	Serial No.
R13 / 10-17 June 2014	Logger	Acoustic Research Laboratories (ARL)	EL-215	194505
R38 / 10-16 June 2014	Logger	Acoustic Research Laboratories (ARL)	EL-215	194622
R117 / 10-24 June 2014	Logger	Acoustic Research Laboratories (ARL)	EL-215	194619
All	Calibrator	Bruel & Kajer (B&K)	Type 4231	Type 4231

The loggers determine L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. 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 passby of a heavy vehicle. The L_{A90} level is normally taken as the background noise level during the relevant period. 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. The L_{Aeq} is relevant for the assessment of operational noise and traffic noise. The noise descriptors are further explained in the Glossary of Acoustic Terms contained at the front of this report.

4.3 Measured Background Noise Levels

Table 4-2 summarises the background noise levels, expressed as Rating Background Levels (RBLs) for the three relevant assessment periods, namely daytime (7.00am-6.00pm), evening (6.00pm-10.00pm) and night time (10.00pm-7.00am). The RBL represents the background noise in the area, and is determined from measurement of L_{A90} noise levels. Importantly, noise from the source(s) subject to assessment must be absent to determine the RBL. The full methodology for calculating RBL values from measured L_{A90} levels is set out in the NSW *Industrial Noise Policy (INP).*

Table 4-2 Rating Background Levels

Receiver	Measured RBL (dBA)		
	Day (7am–6pm)	Evening (6pm–10pm)	Night Time (10pm–7am)
R13 (36 Baxter Road)	56	56	43
R38 (3 Wentworth Avenue)	55	51	41
R117 (59 McBurney Avenue)	53	54	46

The monitored noise levels are shown in graphical format in Appendix A. The periods of time affected by adverse meteorological conditions are indicated in the graphs (greyed out and labelled “wind” / “rain”). Meteorological data obtained from the Sydney Airport weather station was used for this purpose.

The RBLs set out in Table 4-2 form the basis of the construction noise criteria for the project, as detailed in Section 5.

5 CONSTRUCTION NOISE & VIBRATION CRITERIA

5.1 Construction Noise Criteria

5.1.1 NSW *Interim Construction Noise Guideline (ICNG)*

The noise criteria set out in the *ICNG* have been used to assess the potential impacts from construction noise. This document guides EPA in setting statutory conditions in licences or other regulatory instruments for construction noise.

Table **5-1** summarises the construction noise criteria relevant to residences, as specified in the Guideline.

Table 5-1 Construction Noise Management Levels – Residences

Time of Day	Management Level $L_{Aeq,15min}$	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of Day	Management Level $L_{Aeq,15min}$	How to Apply
Outside recommended standard hours	Noise affected RBL + 5dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 of the Guideline.

Further to this, the *ICNG* recommends Management Levels of $L_{Aeq,15min}$ 45dBA (internally) for Places of Worship, $L_{Aeq,15min}$ 70dBA (externally) for commercial premises (i.e. offices, retail outlets, etc) and $L_{Aeq,15min}$ 75dBA (externally) for industrial premises. These Management Levels apply only when the sites are in use.

5.1.2 Project-Specific Construction Noise Management Levels

For the purpose of assessment the daytime, evening and night time RBLs determined by the monitoring have been used to establish Construction Noise Management Levels for the residential receivers. In accordance with the above guideline, the following construction noise management levels are applicable during standard work hours.

Table 5-2 Project-Specific Construction Noise Management Levels for Standard Hours and Outside Standard Construction Hours

Receptor Location	Standard Construction Hours		Outside Standard Construction Hours	
	Noise Affected Level $L_{Aeq,15min}$ dB(A)	Highly Noise Affected Level $L_{Aeq,15min}$ dB(A)	Noise Affected Level $L_{Aeq,15min}$ dB(A)	Highly Noise Affected Level $L_{Aeq,15min}$ dB(A)
R1-R32	66	75	48	n/a
R33-R115	65	75	46	n/a
R116-R121	63	75	51	n/a
(Church)	45 (Internal)	n/a	45 (Internal)	n/a
C1-C26	70	n/a	70	n/a

Note: The determined residential and commercial criteria apply at the most affected point on or within the receiver property boundary. The commercial criteria only apply when the commercial premises' are occupied. The church criteria also only apply when the church is occupied and these noise management levels apply internally. Assuming the doors of the church can be closed during services, and assuming a 25-30 dB transmission loss would be achieved through the building envelope, external noise levels of up to 70-75 dBA would not be expected to generate exceedance of the internal 45 dBA criteria.

The *ICNG* does not include any criteria to assess off-site traffic noise associated with the construction. Noise from traffic associated with the proposed construction would be minimised as much as practicable by limitations on construction hours and Australian Design Rules, which apply to road-registered vehicles.

Regardless, given the existing volume of traffic on the roads within the study area, it would be expected that additional traffic movements associated with the construction would not generate a material rise in traffic noise during the construction phase. Additionally, construction traffic noise would provide a relatively minor contribution with respect to the actual construction activities.

5.1.3 Sleep Disturbance Criteria

The most recent guidelines in relation to sleep disturbance are those contained in the EPA's "*Application Notes – NSW Industrial Noise Policy*" issued in July 2006. The pertinent section of the EPA's Application Notes states the following:

> *"DEC reviewed research on sleep disturbance in the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.*
>
> *From the research, DEC recognised that current sleep disturbance criterion of an $L_{A1,(1\ minute)}$ not exceeding the $L_{A90,(15\ minute)}$ by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, DEC will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.*
>
> *The detailed analysis should cover the maximum noise level or $L_{A1,(1\ minute)}$, that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night time period. Some guidance on possible impact is contained in the review of research results in the appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:*
>
> - *how often high noise events will occur;*
> - *time of day (normally between 10pm and 7am);*
> - *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*
>
> *The $L_{A1,(1\ minute)}$ descriptor is meant to represent a maximum noise level measured under 'fast' time response. DEC will accept analysis based on either $L_{A1,(1\ minute)}$ or $L_{A(Max)}$."*

On the basis that the night time RBL in the area is in the range 41-46 dBA, the $L_{A1,1min}$ sleep disturbance screening criteria when assessed external to dwellings adopted by this assessment are set out in Table 5-3.

Table 5-3 Sleep Disturbance Screening Criteria (External to Dwellings)

Receiver	Night Time RBL (10pm–7am)	$L_{A1,1min}$ Screening Criteria (10pm-7am)
R1-R32	43	58
R33-R115	41	56
R116-R121	46	61

The "sleep disturbance" screening criteria are only applicable to night time (10.00pm to 7.00am) operations.

Further to the screening criteria identified above the EPA's *Environmental Criteria for Road Traffic Noise (ECRTN)* notes:

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

If it is assumed that the typical noise reduction through a bedroom facade with partially open windows is 10dB, then an external noise level of 60-65dBA is unlikely to cause sleep disturbance.

5.2 Construction Vibration Criteria

When assessing vibration there are two components that require consideration:

- human exposure to vibration; and
- the potential for building damage from vibration.

Construction work is generally considered an intermittent source of vibration.

5.2.1 Human Exposure to Vibration

The DECCW's *Assessing Vibration: A Technical Guideline* provides guidance for assessing human exposure to vibration. The publication is based on British Standard BS 6472:1992. Intermittent vibration is best assessed by the Vibration Dose Value (VDV) which is based on the *weighted* root mean quartic (rmq) acceleration. However, for simplicity of assessment and monitoring, a peak particle velocity (PPV) goal is preferred.

Table 5-4 sets out PPV values for continuous and impulsive vibration as specified by *Assessing Vibration: A Technical Guideline.* The impulsive vibration goals are shown in brackets.

Table 5-4 Human Comfort Vibration Goals – PPV (mm/s)

Place	Day (7.00am-10.00pm)		Night (10.00pm-7.00am)	
	Preferred	Maximum	Preferred	Maximum
Residences	0.28 (8.6)	0.56 (17.0)	0.20 (2.8)	0.40 (5.6)
Offices, Places of Worship	0.56 (18.0)	1.1 (36.0)	0.56 (18.0)	1.1 (36.0)
Workshops	1.1 (18.0)	2.2 (36.0)	1.1 (18.0)	2.2 (36.0)

Note: Impulsive goals are shown in brackets – These are most relevant to activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. The commercial/church criteria only apply when the premises' are occupied.

5.2.2 Building Damage from Vibration

There are currently no Australian Standards or guidelines to provide guidance on assessing the potential for building damage from vibration. It is common practice to derive goal levels from international standards. British Standard BS 7385:1993 and German Standard DIN 4150:1999 both provide goal levels, below which vibration is considered insufficient to cause building damage. Of these, DIN 4150 is the more stringent. Table 5-5 summarises the goal levels specified in DIN 4150.

Table 5-5 Guideline Values for Vibration Velocity to be used when Evaluating the Effects of Short-Term Vibration on Structures (DIN4150-3:1999)

Type of Structure	Guideline Values for Velocity – PPV (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under either of the other classifications and of great intrinsic value	3	3 to 8	8 to 10

With regard to these levels DIN 4150 states, *"experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible. Exceeding [these] values does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary."*

For general construction vibration, the dominant frequency of vibration is typically in the range 31.5 – 100 Hz. Because the dominant frequency of vibration cannot be determined with certainty, this assessment has adopted a conservative goal of 20mm/s for commercial and industrial buildings and 5mm/s for residential buildings.

6 CONSTRUCTION NOISE ASSESSMENT

6.1 Noise Modelling Methodology & Assumptions

Construction noise emissions from the site have been modelled using the SoundPLAN (ver 7.1) acoustic noise prediction software. Factors that are addressed in the noise modelling are:

- Equipment noise level emissions and location;
- Screening from structures;
- Receiver locations (the closest residential boundaries were considered to represent the residential receivers);
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground absorption;
- Atmospheric absorption; and
- Meteorological conditions that may influence noise levels.

6.2 Construction Stages and Noise Sources

A schedule of construction equipment based on the information provided by the CMS for each construction stage (apart from utilities relocation) is set out in Appendix B. Associated sound power levels for the identified plant are also included in Appendix B, based on the NSW Transport Construction Authority's Construction Noise Strategy and Wilkinson Murray's experience.

These sound power levels have been applied in the predictions of worst-case noise that may arise during the construction stages. The CMS is non-specific with respect to actual plant quantities. For the purpose of this assessment it has been assumed that one of each of the identified plant items would operate and all plant would operate concurrently during the 15 minute assessment period.

Noise emissions would vary as construction progresses. This assessment assumes worst-case scenarios whereby all sources are operational simultaneously for a full 15-minute period. This scenario would be unlikely to occur often and so noise levels at receivers would typically be lower than identified. The predicted $L_{Aeq,15min}$ construction noise levels are provided for each construction activity in the following sections. Exceedances of the standard hours and out-of-hours criteria are identified, where they are predicted, and exceedances of the highly affected noise management level are shown in **bold font**.

6.3 Noise Predictions – Activity 1 – Utilities Relocation

The utilities relocation works are regarded as linear works - that is, the works will progress along a line and will not be stationary for an extended period of time. Therefore, the noise exposure to the nearest residences will be limited. Any noise impact on individual receivers during these works would not be continuous and would be expected to occur for no more than approximately one week.

The CMS does not indicate what construction equipment would be used during the utilities relocation. The equipment assumed to be used for the utilities relocation works is presented in Table 6-1. It is expected that the equipment details would be revised once the construction programme develops.

Table 6-1 Summary of Assumed Plant for the Utilities Relocation Works

Activity	Noise Source	Qty
Utilities Relocation Works	Shearing	1
	Oxycutter	1
	Excavator	1
	Truck	1

Table 6-2 shows the range of noise levels that may be expected from the different plant. These levels are predicted at 15, 25 metres and 35 metres in order to represent the worst-case scenarios.

Table 6-2 Predicted Noise Levels from Utilities Relocation Activities

Activity	Worst-Case Predicted Level ($L_{Aeq,15min}$ dBA)
Shearing	63 (at 15m)
	59 (at 25m)
	56 (at 35m)
Oxycutter	66 (at 15m)
	62 (at 25m)
	59 (at 35m)
Excavator	71 (at 15m)
	67 (at 25m)
	64 (at 35m)
Truck	66 (at 15m)
	62 (at 25m)
	59 (at 35m)
Total (Worst-Case)	75 (at 15m)
	71 (at 25m)
	68 (at 35m)

Table 6-2 shows that the utilities relocation works are likely to exceed the construction noise management levels at the closest residential receivers (where the works are undertaken within approximately 35 m of receivers). It is important to note, however, that the works would move along the works corridor reasonably quickly therefore the noise impact would not be continuous or for an extended period. Notwithstanding this, as noise management levels are exceeded it is recommended that the contractor conducting the works be required to develop a Noise Management Plan that considers all reasonable and feasible mitigation. Section 9 of this report outlines reasonable and feasible noise mitigation methods recommended to be considered in the Noise Management Plan.

6.4 Noise Predictions – Activity 2 – General Holmes Widening

The worst-case noise levels during Stage 1 of the General Holmes widening works are compared against the standard-hours criteria and out-of-hours criteria in Appendix C1. These are typical worst-case levels that may be expected to arise during activities involving rock breaking with pneumatic hammers. During the other Activity 2 stages, the worst-case levels would be expected to be typically between 1-5 dB lower than shown in the table.

Appendix D1 includes exceedance maps identifying the approximate extent of the exceedances.

6.4.1 Residential Impacts Within Standard Construction Hours

As shown in Appendix C1, during standard construction hours it is predicted that the General Holmes Drive widening works may be undertaken in compliance with standard hours criteria for the majority of the receivers considered.

Marginal exceedances may, however, be anticipated at some of the closest and/or most exposed properties to the works (R34-R38, R65-R67 and R120-R121) during standard construction hours.

No exceedances of the 75 dBA highly affected management level are predicted during Activity 2 works.

6.4.2 Residential Impacts Outside Standard Construction Hours

Should the General Holmes widening works be undertaken out-of-hours, appreciable exceedances of the out-of-hours criteria may be expected.

The out-of-hours noise management level may be expected to be exceeded by >10 dB the majority of receivers considered. The greatest exceedances of up to 23 dB are predicted at R33-R38.

Section 9 of this report addresses mitigation measures that should be considered, particularly for the receivers identified.

6.4.3 Impacts at Non-Residential Receivers

The General Holmes widening works would not be expected to generate exceedances of criteria at the church on Botany Road or at any commercial receivers.

6.5 Noise Predictions – Activity 3 – Joyce Drive Widening

The worst-case noise levels during the widening of Joyce Drive would be expected to arise during Stage 2 of the works, given the closer proximity of the Stage 2 works area to the closest receivers located on Baxter Road. The worst-case predicted noise levels for this stage are compared against the standard-hours criteria and out-of-hours criteria in Appendix C2.

Appendix D2 includes exceedance maps identifying the approximate extent of the exceedances.

6.5.1 Residential Impacts Within Standard Construction Hours

As shown in Appendix C2, during standard construction hours it is predicted that the Joyce Drive widening works may be undertaken in compliance with standard hours criteria for the majority of the receivers considered.

Marginal exceedances may, however, be anticipated at some of the closest and/or most exposed properties to the works (R7-R13, R20-R27 and R34-R38) during standard construction hours.

No exceedances of the highly affected management level are predicted during Activity 3 works.

6.5.2 Residential Impacts Outside Standard Construction Hours

Should the Joyce Drive widening works be undertaken out-of-hours, appreciable exceedances of the out-of-hours criteria may be expected.

The out-of-hours noise management level may be expected to be exceeded by >10 dB the majority of receivers considered, apart from those located around McBurney Avenue.

The most notable exceedances of up to 23 dB are predicted at R7-R13, R35-R38, and R20-R27 during these out-of-hours works.

Section 9 of this report addresses mitigation measures that should be considered, particularly for the receivers identified.

6.5.3 Impacts at Non-Residential Receivers

The Joyce Drive widening works would not be expected to generate exceedances of criteria at the church on Botany Road. Marginal exceedances of up to 4 dB may be expected at the commercial receivers on located on Baxter Street during the works.

6.6 Noise Predictions – Activity 4 – New Rail Bridges

The worst-case noise levels during construction of the rail bridges would be expected during Stages 1-3 of the eastern bridge construction. These stages include piling works. Predicted levels during the Stage 2 works are compared against the standard-hours criteria and out-of-hours criteria in Appendix C3. These are typical worst-case levels that may be expected to arise during Activity 4 piling works. For the other stages not including piling, predicted noise levels may be expected to be approximately 4-10 dB lower than shown in the table.

Appendix D3 includes exceedance maps identifying the approximate extent of the exceedances.

6.6.1 Residential Impacts Within Standard Construction Hours

As shown in Appendix C3, during standard construction hours it is predicted that the Bridgeworks may be undertaken in compliance with standard hours criteria for the majority of the receivers considered.

Marginal exceedances may be expected at some of the closest properties to the works (R34-R39 and R68) during standard construction hours.

No exceedances of the highly affected management level are predicted during Activity 4 works.

6.6.2 Residential Impacts Outside Standard Construction Hours

Should the Bridgeworks be undertaken out-of-hours, appreciable exceedances of the out-of-hours criteria may be expected. The following exceedances have been predicted:

- >30 dB at R37;
- >20 dB at R34-R36 and R38-R39; and
- 10-20 dB at R1, R10-R13, R33, R40-R45, R59-R67, R69-R76, R81, R105-R115.

Section 9 of this report addresses mitigation measures that should be considered, particularly for the receivers identified.

6.6.3 Impacts at Non-Residential Receivers

The Bridgeworks may be expected to generate a marginal exceedance of criteria at the church on Botany Road. Marginal exceedances are also predicted at C16, C17 and C21.

6.7 Noise Predictions – Activity 5 – Intersection Upgrade

The greatest noise impacts associated with the intersection works would be expected to arise during the Stage 1 to Stage 3 works, as these works areas are located adjacent to the receivers located on Botany Road and Wentworth Avenue. The worst-case noise levels during Stage 1 are compared against the standard-hours criteria and out-of-hours criteria in Appendix C4.

Appendix D4 includes exceedance maps identifying the approximate extent of the exceedances.

6.7.1 Residential Impacts Within Standard Construction Hours

As shown in Appendix C4, during standard construction hours it is predicted that the Intersection Upgrade works may be undertaken in compliance with standard hours criteria for many of the receivers considered. Notable exceedances of the standard criteria by up to 14 dB have, however, been predicted at the closest receivers, R37-R38 and R67 during these works. Further to this exceedances of up to 10 dB may be expected at R33-R36, R39-R42, R51-R79, R110-R114 and R116-R121.

Receivers R37, R38, R39 and R67 may be expected to be highly affected during the Activity 5 works.

Section 9 of this report addresses mitigation measures that should be considered, particularly for these receivers.

6.7.2 Residential Impacts Outside Standard Construction Hours

Out-of-hours intersection works would be expected to generate appreciable exceedances of the out-of-hours criteria. The following exceedances have been predicted:

- >30 dB at R37 and R38;
- 20-30 dB at R33-R36, R39-R42, R52-R79 and R110-R114; and
- 10-20 dB at R1, R2, R12-R29, R43-R51, R80-R109 and R115-R121.

Section 9 of this report addresses mitigation measures that should be considered, particularly for the receivers identified.

6.7.3 Impacts at Non-Residential Receivers

The Intersection Upgrade works would also be expected to generate an appreciable exceedance of criteria at the church on Botany Road. Marginal exceedances are also predicted at C16, C17, C20, C21 C23, C25 and C26.

6.8 Noise Predictions – Activity 6 – Finalisation Works

The predicted worst-case noise levels during the finalisation works are compared against the standard-hours criteria and out-of-hours criteria in Appendix C5.

Appendix D5 includes exceedance maps identifying the approximate extent of the exceedances.

6.8.1 Residential Impacts Within Standard Construction Hours

As shown in Appendix C5, during standard construction hours it is predicted that the Finalisation works may be undertaken in compliance with standard hours criteria for most of the receivers considered. Marginal exceedances of the standard criteria have, however, been predicted at the closest and/or most exposed receivers, R11-R13, R33-R38, R57-R67 and R116-R121 during these works.

The highly affected criteria would not be expected to be exceeded during the Activity 6 finalisation works.

6.8.2 Residential Impacts Outside Standard Construction Hours

Out-of-hours intersection works would be expected to generate appreciable exceedances of the out-of-hours criteria. The following exceedances have been predicted:

- >20 dB at R11-R13, R33-R38, R57-R67; and
- 10-20 dB at R1, R8-R10, R14-R32, R39-R56 and R68-R121.

Section 9 of this report addresses mitigation measures that should be considered, particularly for the receivers identified.

6.8.3 Impacts at Non-Residential Receivers

The Finalisation works would not be expected to generate exceedances of criteria at the church on Botany Road. Marginal exceedances of up to 1 dB may be expected commercial receivers C13-C15 on Botany Road.

7 SLEEP DISTURBANCE ASSESSMENT

The CMS notes that a large portion of the works during the General Holmes Drive Widening may need to be undertaken during East West Runway closures at night. Additionally, it is understood that the a significant proportion of the finalisation works and Botany Road / Wentworth Avenue intersection works may generally be undertaken at night to minimise impacts on traffic.

Further development of the programme would be undertaken once some of the stages (such as utilities relocation early works) and constraints (such as East West Runway closures) are confirmed.

For the purpose of this assessment, potential $L_{A1,1min}$ noise levels have been calculated for all construction stages and compared with the sleep disturbance screening criteria, set out in Table 5-3. The results are set out in Appendix C6.

As shown, the screening procedure identifies that all receivers may be potentially affected throughout the works. The noise levels exceeding sleep disturbance screening criteria are shown in bold.

The $L_{A1,1min}$ noise levels should be revaluated during detailed design, once the construction methodology and equipment requirements are more certain.

Section 9 of this report identifies appropriate mitigation strategies to assist in the management of sleep disturbance impacts during the construction. These should be incorporated in a Noise Management Plan prepared by the contractor conducting the works.

8 CONSTRUCTION VIBRATION ASSESSMENT

Activities undertaken during construction may generate ground vibration. With respect to the construction plant identified in Appendix B, the highest levels of vibration would be expected to occur during construction phases using vibratory rollers during the intersection upgrade. Somewhat lower levels of vibration may also arise with the use of an excavator mounted hydraulic hammers and piling rigs.

Results from vibration monitoring trials of various plant operating, as previously undertaken by WM are set out in Table 8-1. These levels were measured at various sites throughout NSW and provide a guide to the levels that may occur due to similar activities undertaken on the subject site. It should be noted however, that actual levels would depend on the specific site geological conditions.

Table 8-1 Measured Vibration Levels from Various Construction Plant

Source	PPV Vibration Level (mms^{-1}) at Distance					
	5m	10m	20m	30m	40m	50m
Large Vibratory Roller (20t)	7	4.5	3	2.3	2	1.7
Medium Vibratory Roller (10t)	-	3.6	2	1.5	1	-
Compactor (7t)	-	6	2.5	0.3	-	-
Heavy Hydraulic Hammer (1500kg hammer on 30t exc)	4.5	2.5	0.5	0.2	0.12	<0.1
Light Hydraulic Hammer (300kg on 5t Excavator)	0.2	0.1	<0.1	-	-	-
Jack Hammer				-	-	-
Air Track Drill	4.5	1.5	0.6	-	0.1	<0.1
Small Rock drill (estimate)	-	0.5	0.2	0.1	<0.1	
Down the Hole Hammer	0.9	0.2	<0.1			
Ripping (measured in Sydney sandstone)	0.7	0.15	0.03	-	-	-
Impact Piling	11	3.5	1.0	0.5	0.2	<0.1
Vibratory Piling	10	5	-	0.5	0.2	-
Rock Sawing	1.2	0.5	0.3	-	-	-
Bored Piling	-	0.2	<0.1	-	-	-

As shown in Table 8-1, vibration levels reduce substantially with distance. The separation distances between the closest receivers and the General Holmes and Joyce Drive widening works sites are sufficient to ensure that these activities would not generate any material vibration impacts.

The Botany Road / Wentworth Avenue Intersection Upgrade works would works require a significant increase to the footprint of the existing intersection and a realignment of Wentworth Avenue and the final surface levels will be up to 2 metres lower than existing surface levels. These works would be undertaken within approximately 10 metres of the closest residential receivers. The works would involve the use of excavator mounted pneumatic hammers and 10-16t vibratory rollers. It is also possible that some piling may be required.

With consideration to the measured levels (at 10 metres from the source) set out in Table 8-1, no material risk of structural damage is anticipated.

Potential for exceedance of the human comfort criteria would, however, be anticipated.

On this basis it is recommended that pre-construction vibration trials are undertaken on site to confirm that the use of vibratory rollers can comply with the maximum level of 0.56 mm/s at the closest dwellings. This testing should consider the recommendations of *Assessing Vibration: A Technical Guideline*, giving due consideration to the vibration dose method described by the guideline.

It is considered that the trial monitoring would likely confirm that compliance may be achieved by limiting either:

- the size of the roller;
- the rollers vibratory settings;
- periods of continuous operation; or
- any combination of the above.

Should trials indicate that maximum level for human comfort cannot be practicably achieved, it would be recommended to negotiate an acceptable limit with the affected receivers or consider relocating the impacted receivers during the compacting and piling works.

9 MITIGATION MEASURES

During construction works it is recommended that best practice management strategies are implemented to minimise any potential noise and vibration impacts.

Reduction of construction noise for night time road works is sometimes 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 proposal. Often it is appropriate to mitigate impacts in consultation with residents most affected by the noise.

Detailed mitigation measures should be set out in a construction noise and vibration management plan (CNVMP) prepared by the contractor, once more certainty surrounding the construction methods and programme exists.

WM recommends that the following matters are addressed within the CNVMP:

- Construction hours;
- Noise and vibration monitoring on site and at sensitive receivers;
- Training and awareness of contractors;
- Communication;
- Incident and emergency response;
- Non-conformance, preventative and corrective action;
- Notification and negotiation procedures for receivers where noise impact cannot be mitigated to meet the criteria;
- Procedure assessing audibility at any sensitive receiver outside normal construction hours;
- 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.

WM recommends that the following noise management strategies are considered during the preparation of the CNVMP, which would reduce the potential for noise and vibration issues during construction:

- Mitigation of specific noise sources may be possible by using portable temporary screens. Such screening could be set up during daytime for night work;
- Respite periods from noise from impact piling and ground works;
- Respite periods from all noisy activities;
- Relocation for receivers exposed to high noise levels;
- 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;
- Avoid dropping materials from a height;
- 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 cranes, graders, excavators and trucks;
- Selecting plant and equipment based on noise emission levels;
- Using alternative construction methods;
- Using spotters, closed circuit television monitors, “smart” reversing alarms, or “squawker” type reversing alarms in place of traditional reversing alarms;
- Appointing a community liaison officer and consulting with local residents/businesses about scheduling activities to minimise noise impact;
- Community consultation with local residents/businesses to assist in the alleviation of community concerns. Previous experience on similar projects has demonstrated that affected noise sensitive receptors may be willing to endure higher construction noise levels for a shorter duration if they have been provided with sufficient warning in the place of intermittent but extended periods of construction noise at lower levels;
- Provide details of noisy works to residents/businesses prior to commencement including letterbox drops;
- Providing alternative arrangements with affected residents such as temporary relocation;
- Maintaining a suitable complaints register. Should noise complaints be received, they should be immediately investigated and where appropriate, noise monitoring should be undertaken at the locations concerned to determine compliance with the determined construction noise limits. Reasonable and feasible measures would then need to be implemented to reduce any noise impacts; and
- It is recommended that pre-construction vibration trials are considered before the use of vibratory rolling or piling within 20 metres of dwellings, as discussed in Section 8.

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 proposal;
- 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; and

- Turning off machinery when not in use.

The potential noise reduction that can be achieved by noise mitigation measures are shown in Table 9-1.

Table 9-1 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
Undertake community consultation and respond to complaints 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 reasonably practicable 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

10 CONCLUSION

RMS is planning to upgrade roads east of Sydney airport and remove the General Holmes Drive rail level crossing in order to improve traffic flow and access to the airport, Port Botany and, in the future, the WestConnex motorway.

Wilkinson Murray has undertaken a construction noise and vibration assessment for the Project based on the proposed works staging and equipment detailed in the Construction Method Statement (CMS), prepared by MIE.

The CMS breaks the works into six activity stages, namely:

- Utilities Relocation;
- General Holmes Drive Widening, Utility Protection Slab & Bridge Over Stormwater Canal;
- Joyce Drive Widening;
- New Rail Bridges (Western, followed by Eastern, followed by Decline Construction);
- Botany Road / Wentworth Avenue Intersection Upgrade; and
- Finalisation Works.

These activity stages are each broken into several sub-stages, by the CMS, totalling a total of 44 sub-stages. Given the number of sub-stages to be considered, this assessment has focussed on the typical worst-case noise scenarios within each of the primary activity stages.

Based on the details provided in the CMS, noise predictions have been undertaken to determine the potential for exceedance of the construction noise criteria, established in-line with the provisions of the NSW Interim Construction Noise Guideline. Results have been reported for residential receivers generally deemed representative of the potentially most impacted receivers surrounding the proposed works. The results should be regarded as indicative only and may be updated during detailed design, once comprehensive details of the construction methodology and plant are available.

This construction noise and vibration impact statement has identified that there is potential for exceedances of the established construction noise criteria throughout the stages, particularly if the construction has to be undertaken during the night time period. Additionally there would be potential for sleep disturbance impacts for works undertaken during the night time.

The greatest potential noise impacts may arise during the Botany Road / Wentworth Avenue Intersection Upgrade works which would be undertaken in close vicinity of sensitive receivers. The highly affected noise management level has potential to be exceeded during these works at a number of receivers.

Provided the works are undertaken with the expected care and diligence it is considered that there would be no material risk of structural damage to properties surrounding the works due to vibration. Potential for exceedance of the human comfort vibration criteria has, however, been noted at the receivers closest to the intersection upgrade.

A number of mitigation measures have been identified that, if employed, would be expected to effectively reduce the level of impacts to the most practicable extent. It is recommended that these measures are incorporated within a Construction Noise and Vibration Management Plan (CNVMP) prepared by the contractor, once more certainty surrounding the construction methods and programme exists.

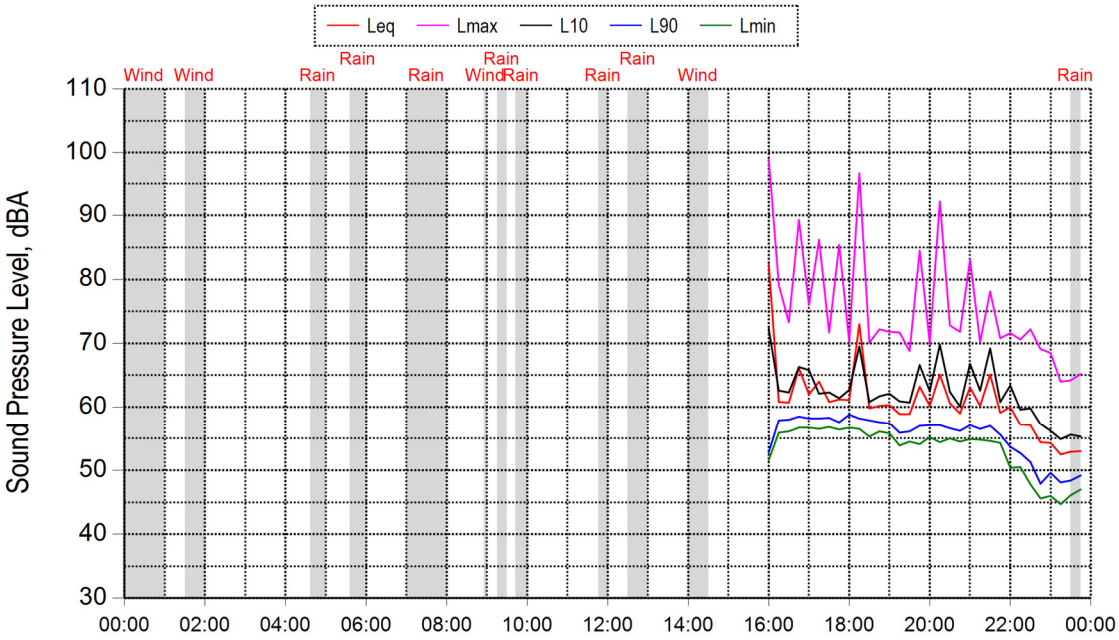
A revised construction and noise and vibration impact assessment may be undertaken at this time, which would consider concurrent activities and particularly the extent of works that may be undertaken within the most sensitive night time period.

APPENDIX A

NOISE MEASUREMENT RESULTS

Noise Monitorng Results – 36 Baxter Road

Tuesday 10 June 2014



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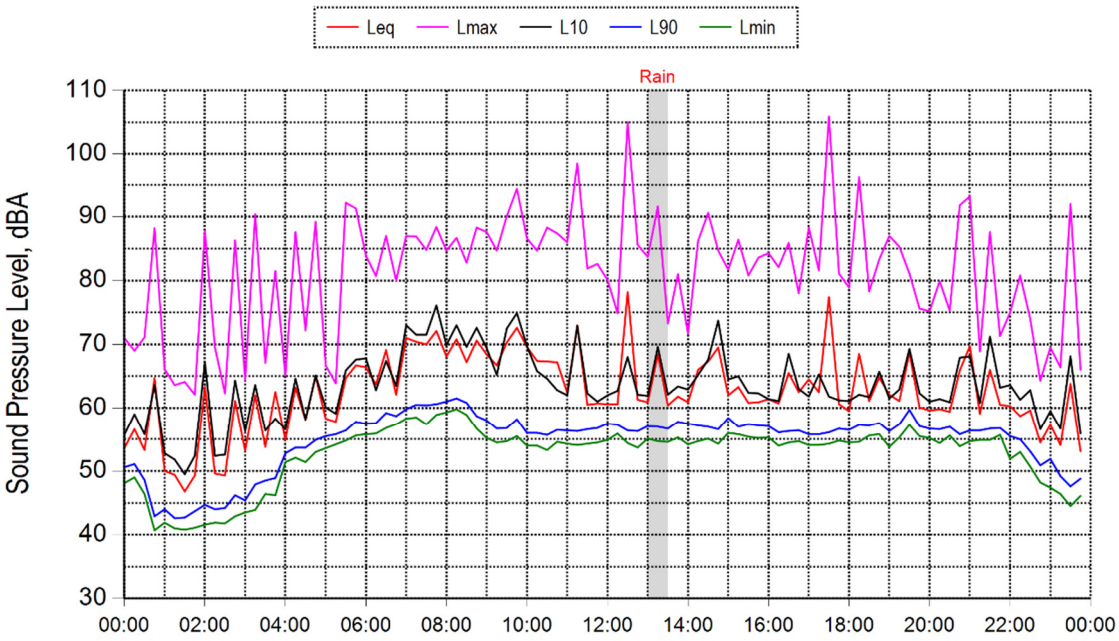

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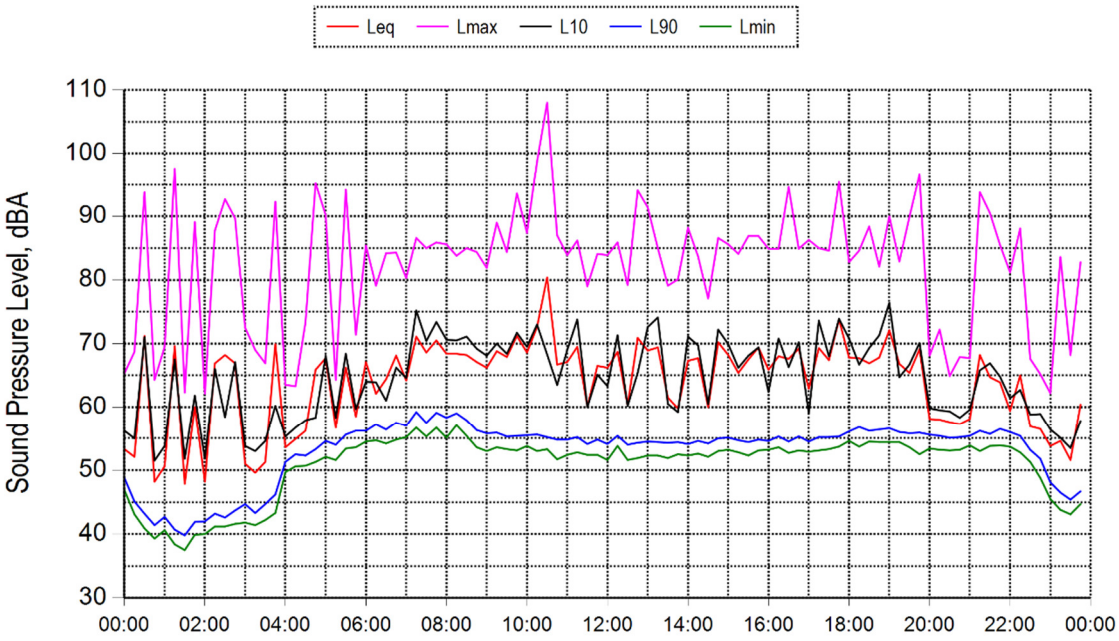

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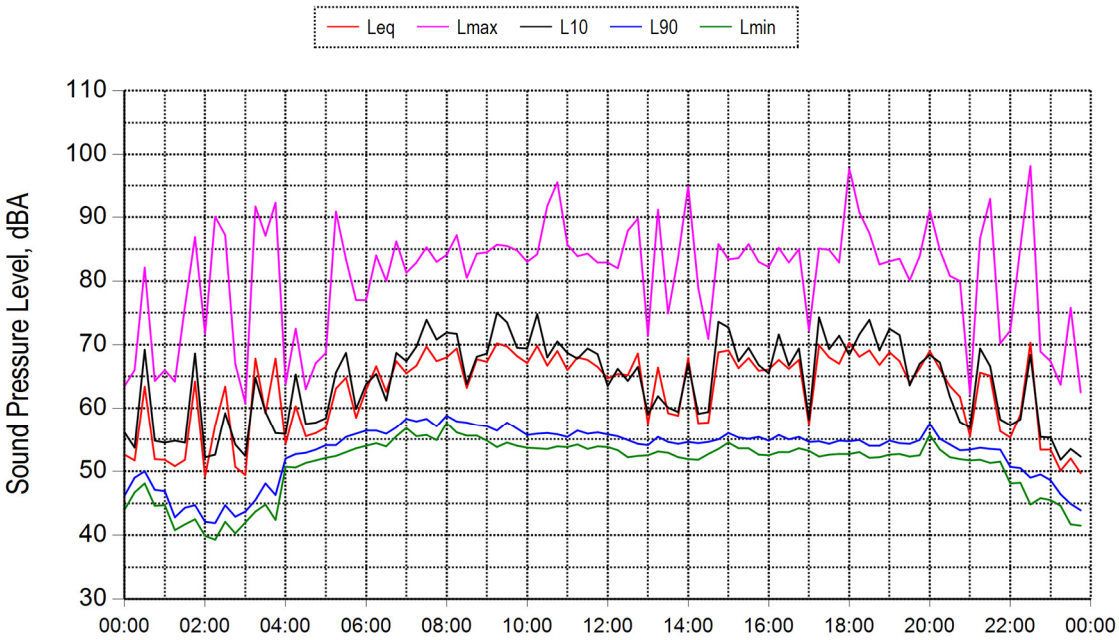
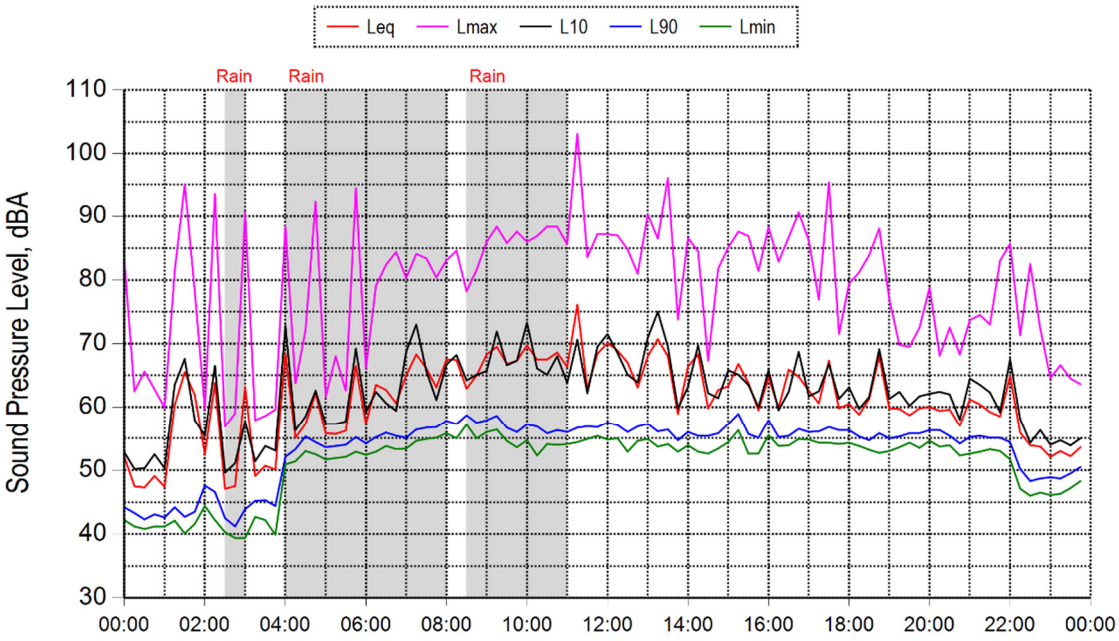


Saturday 14 June 2014



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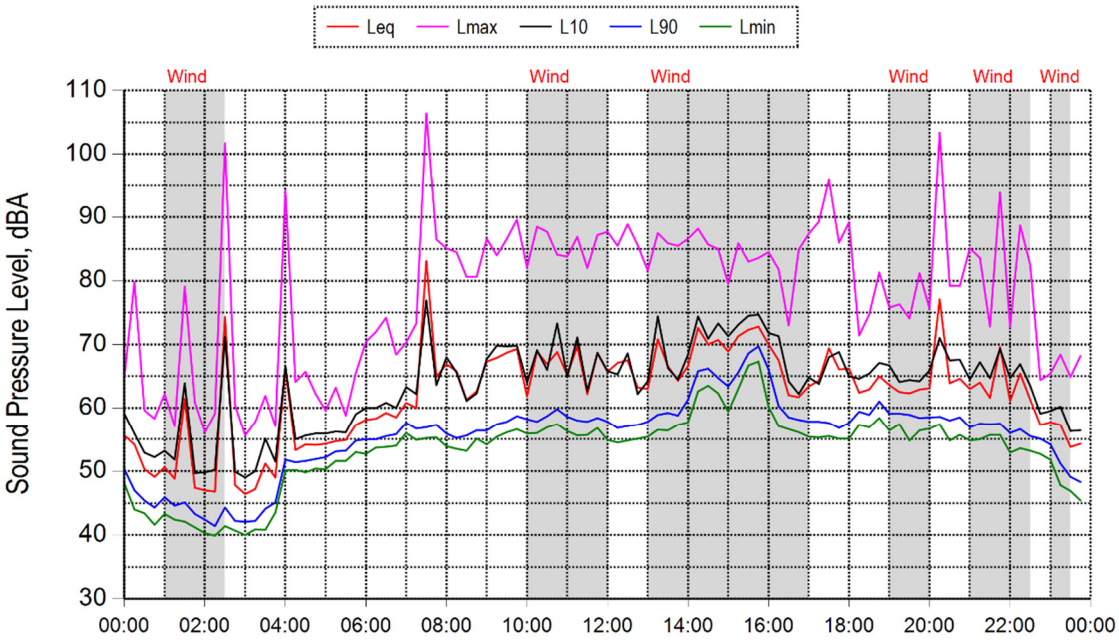

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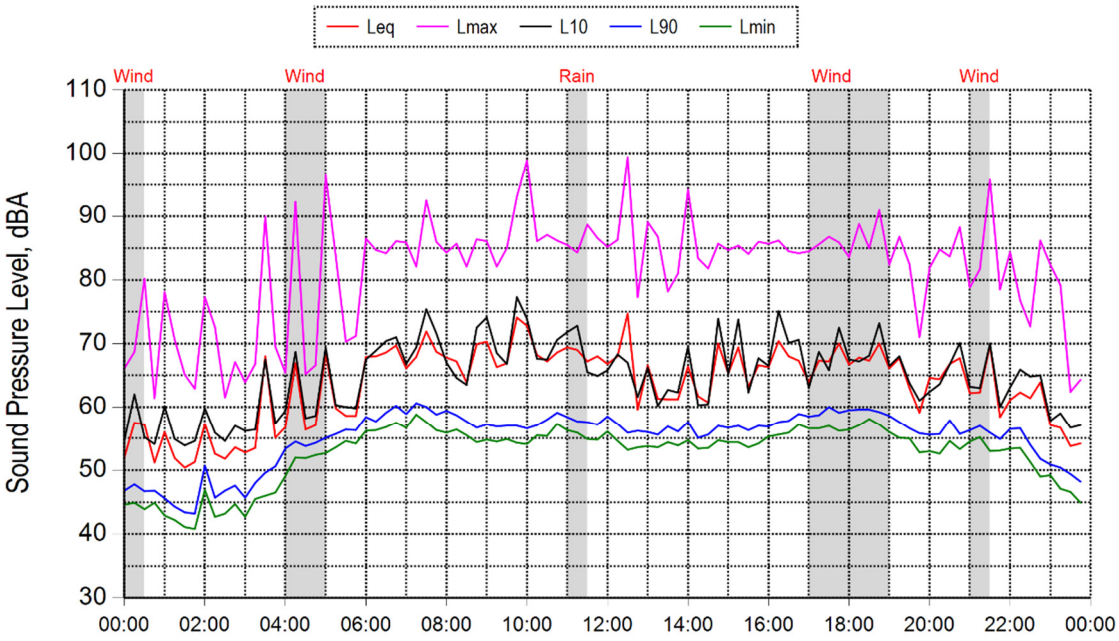

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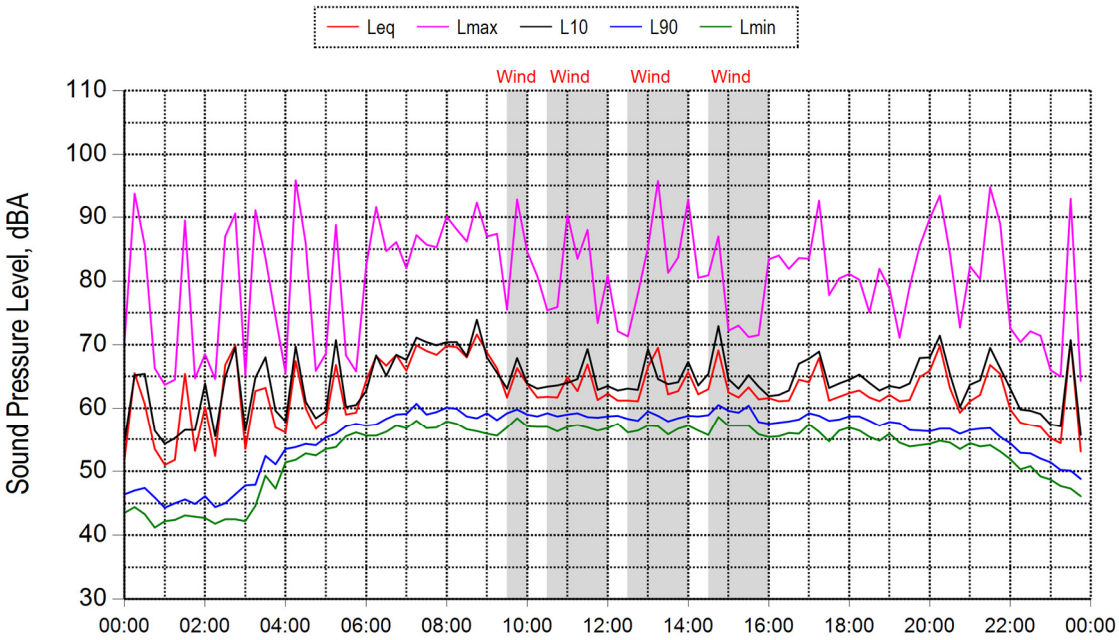

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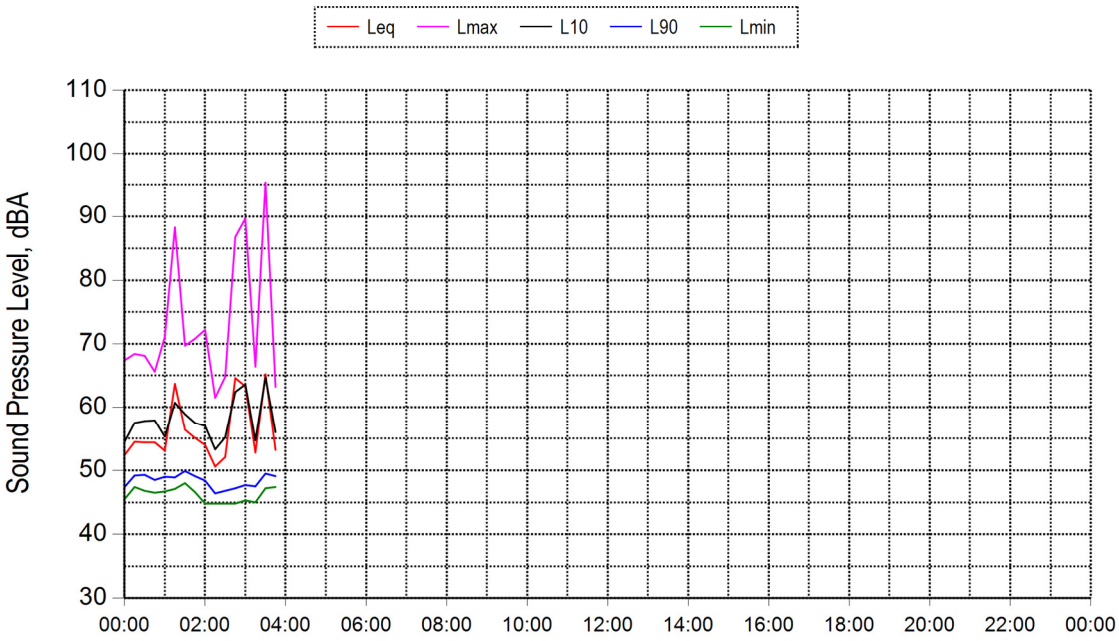

Noise Monitorng Results – 3 Wentworth Avenue

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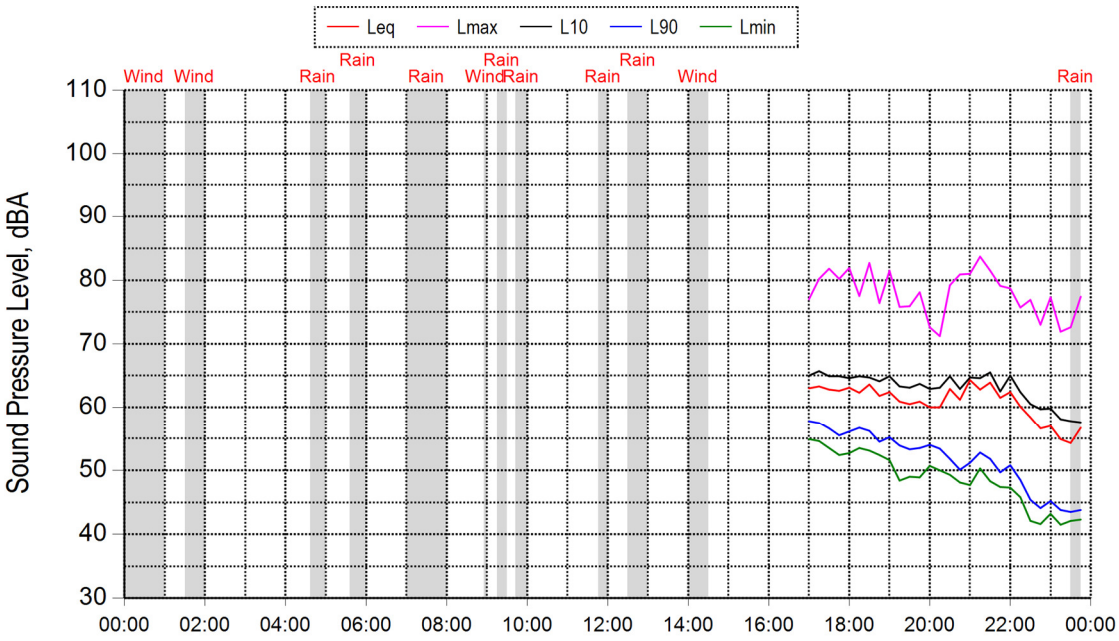

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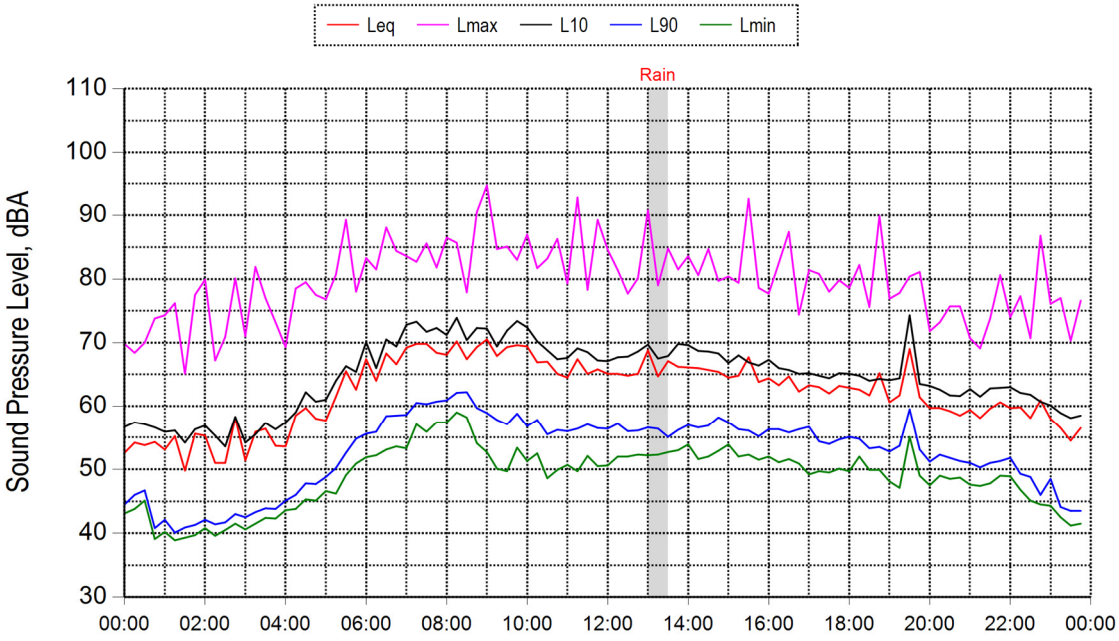

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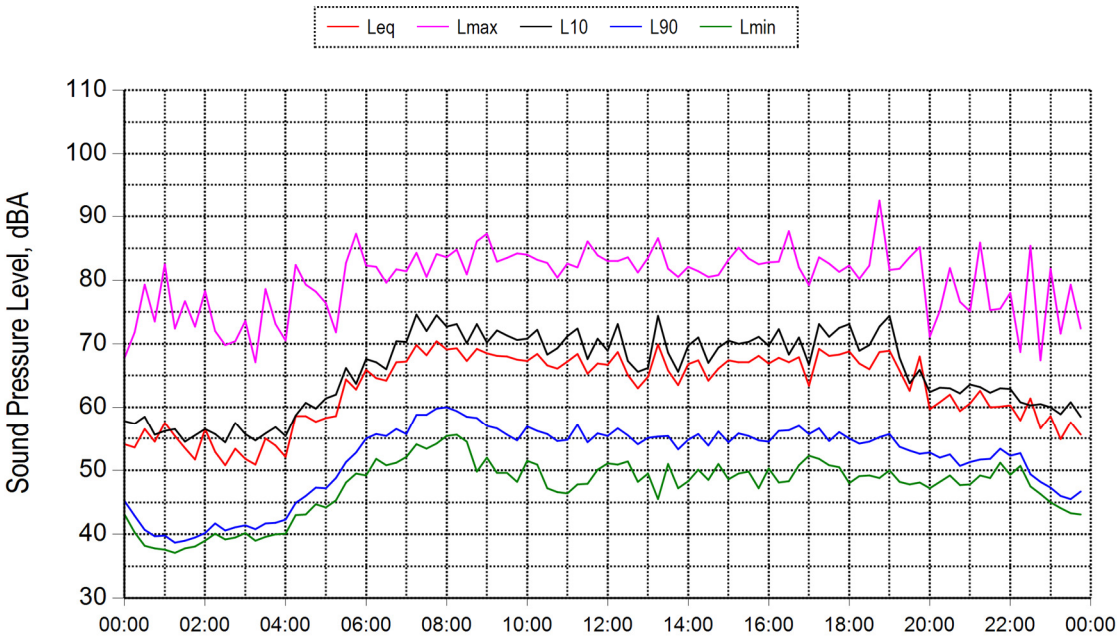

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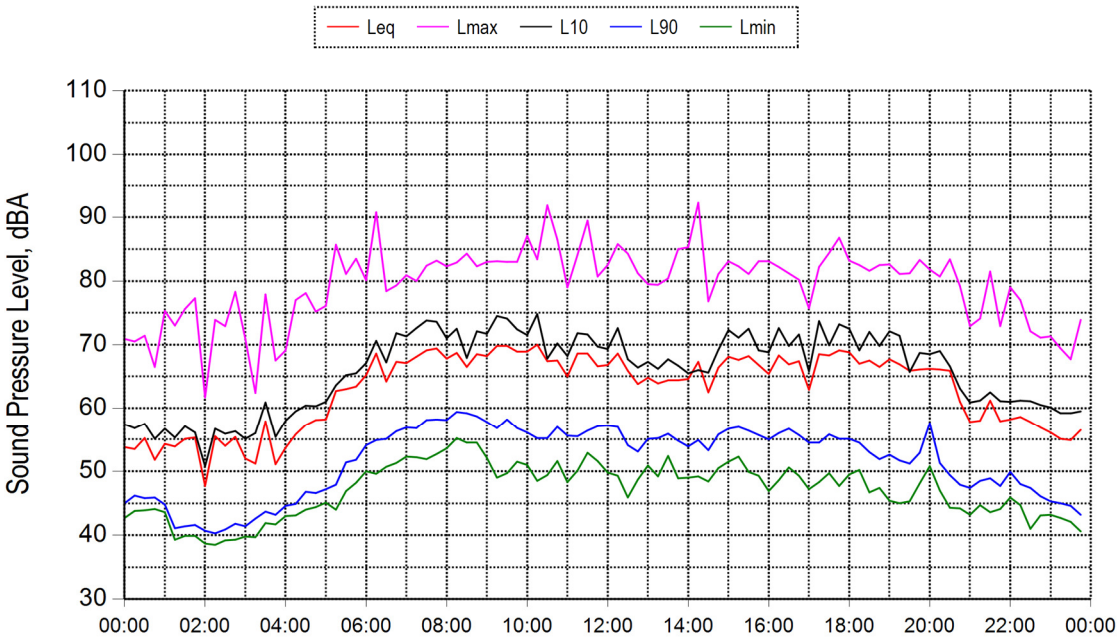

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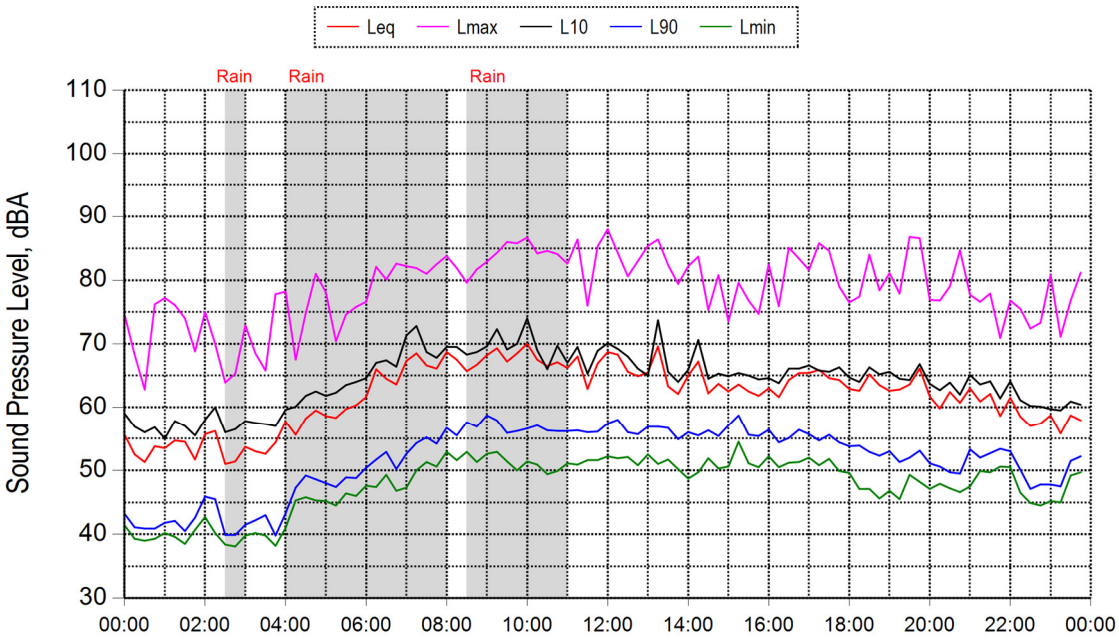

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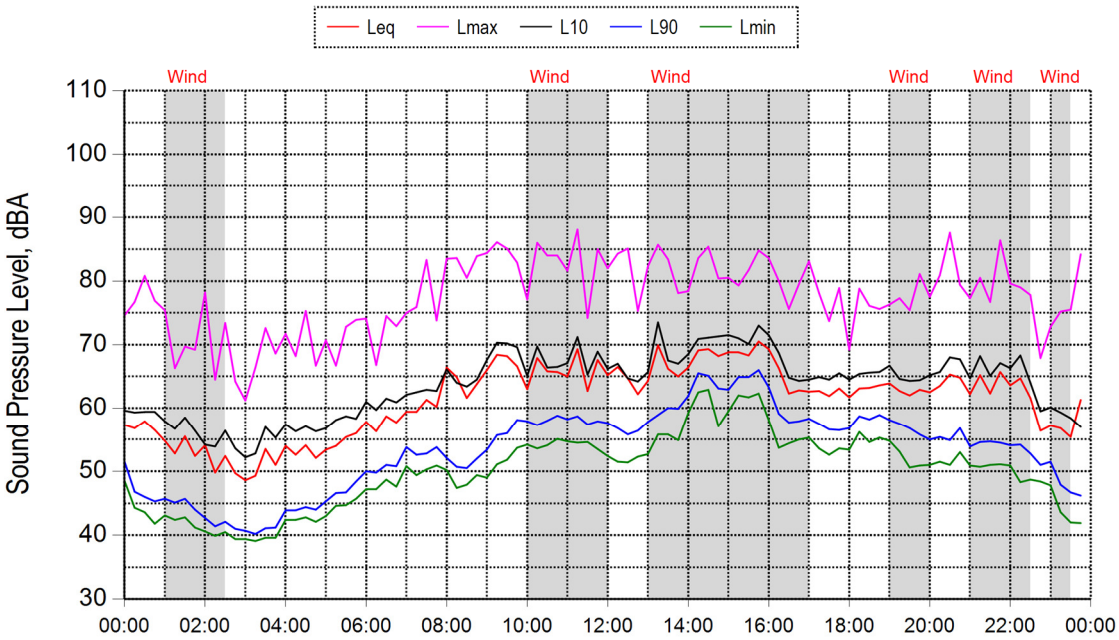
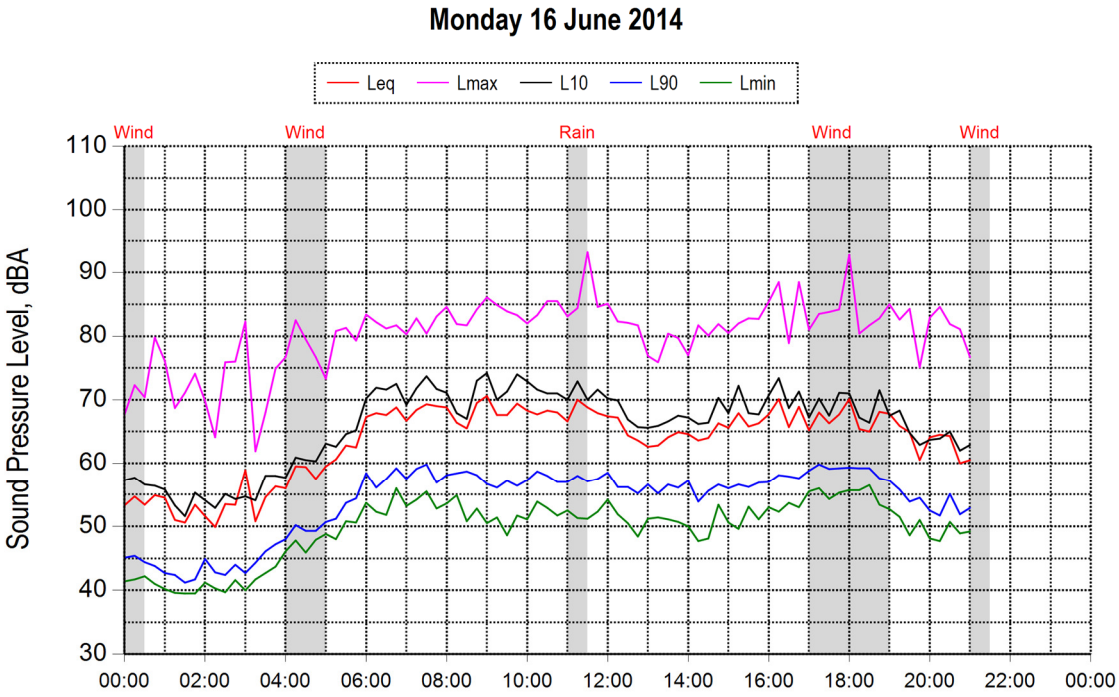
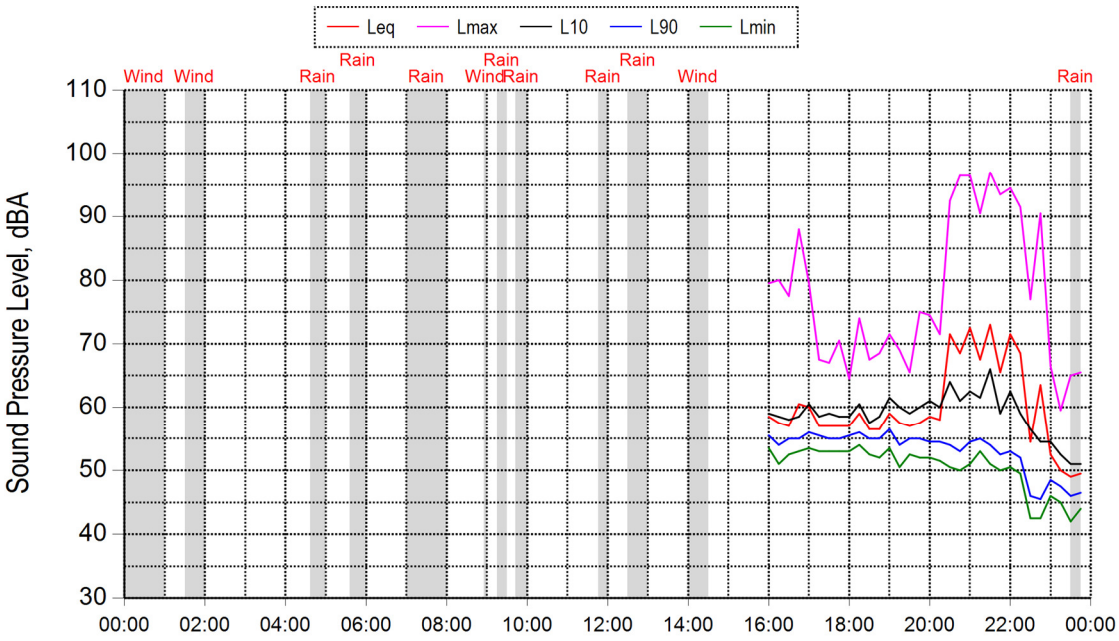



Monday 16 June 2014
Leq
Lmax
L10
L90
Lmin
Wind
Wind
Rain
Wind
Wind
Sound Pressure Level, dBA
110
100
90
80
70
60
50
40
30
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

Noise Monitorng Results – 59 McBurney Avenue

Tuesday 10 June 2014



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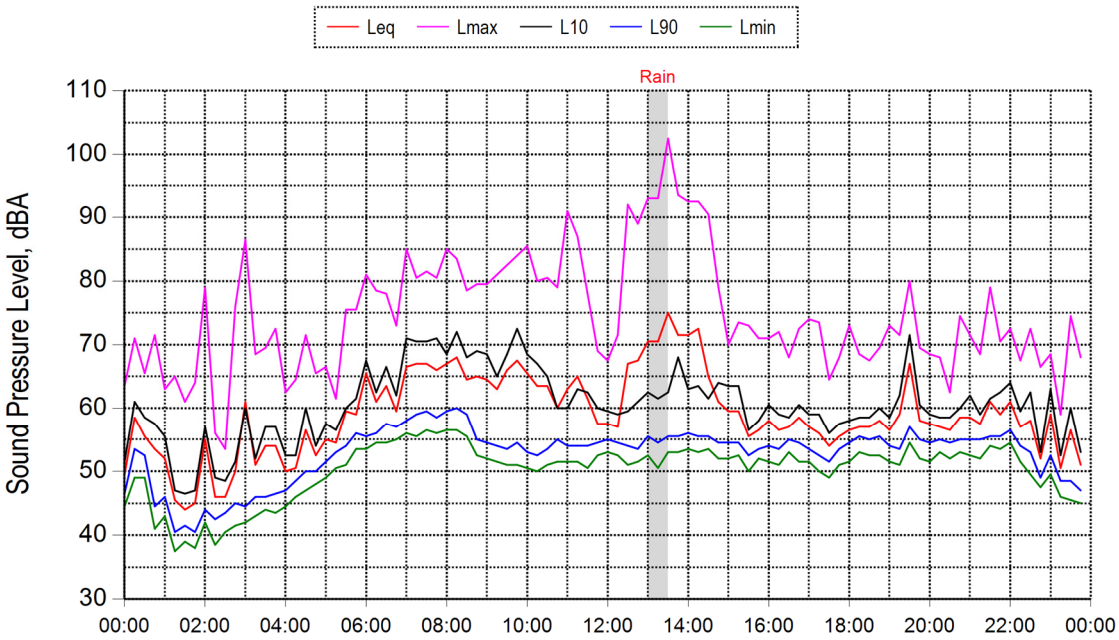

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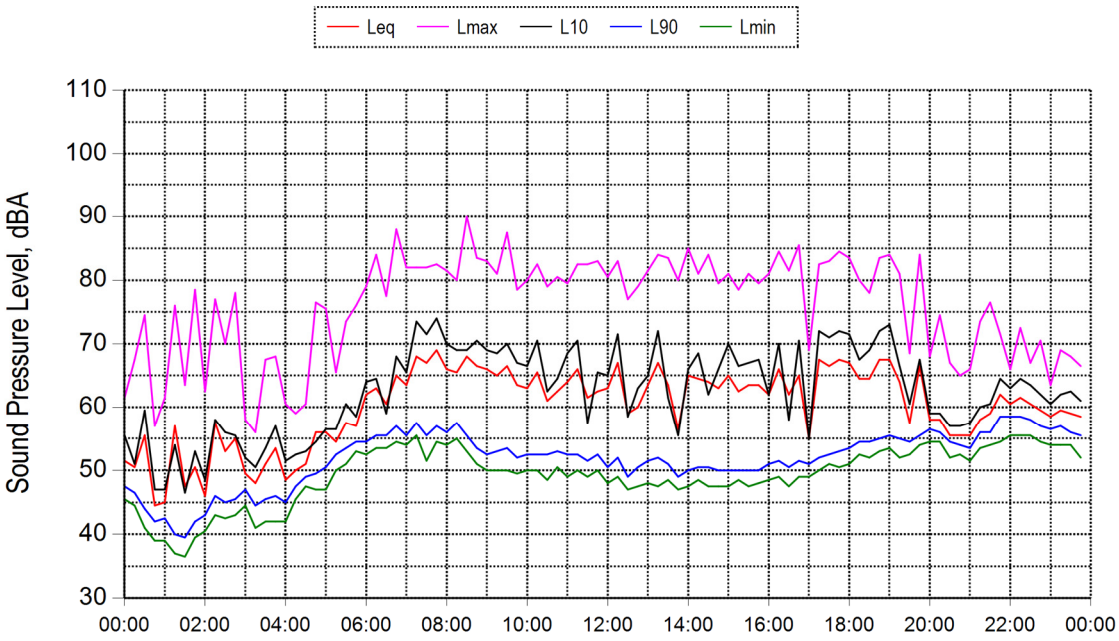

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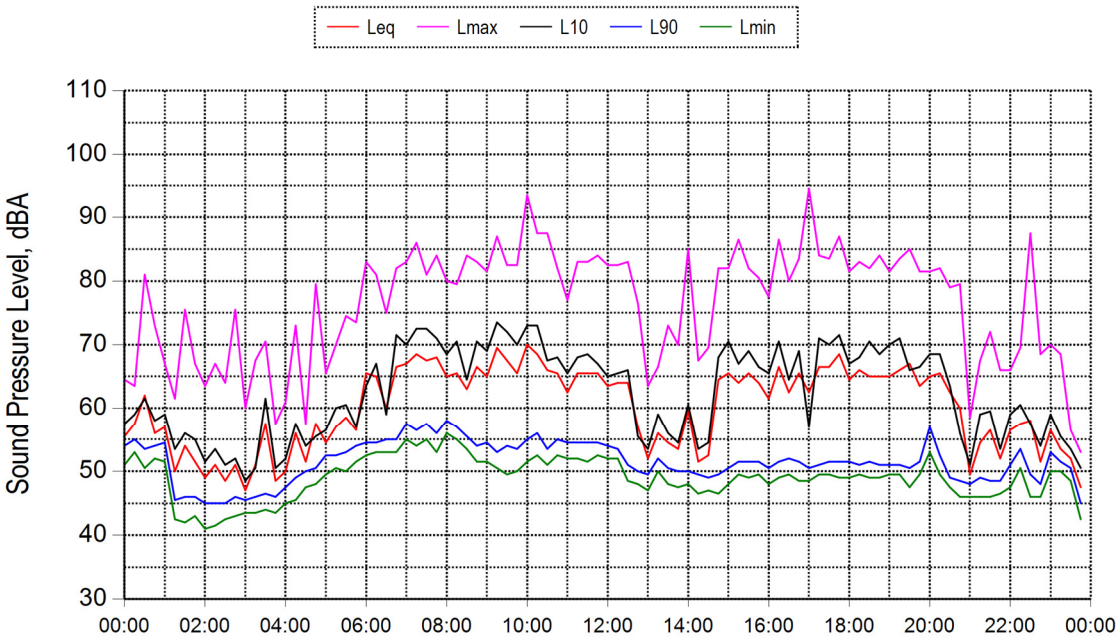

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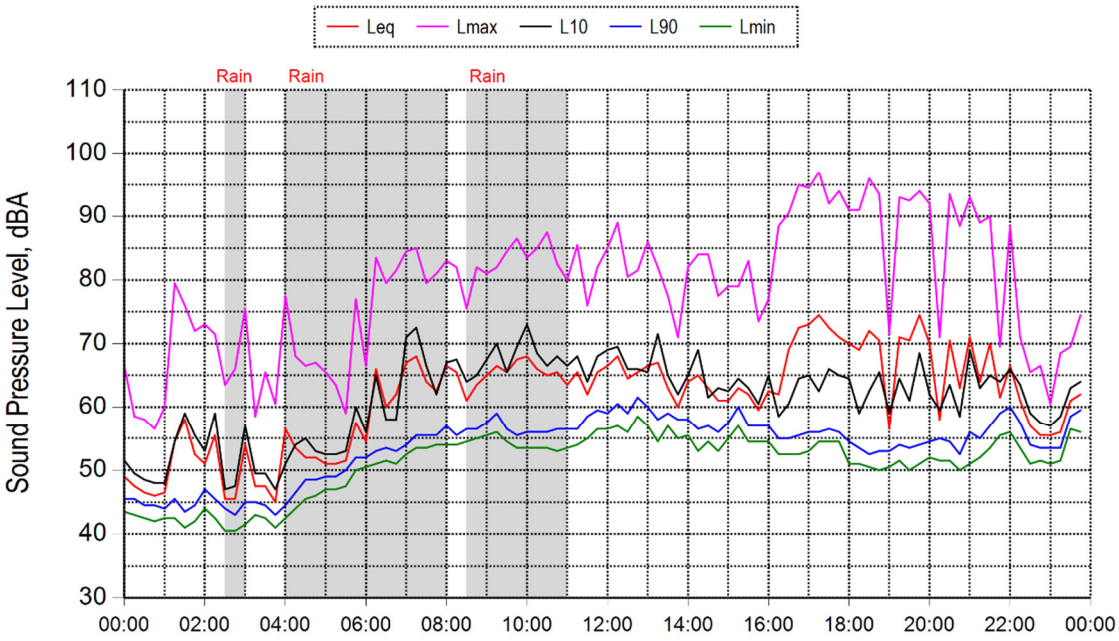

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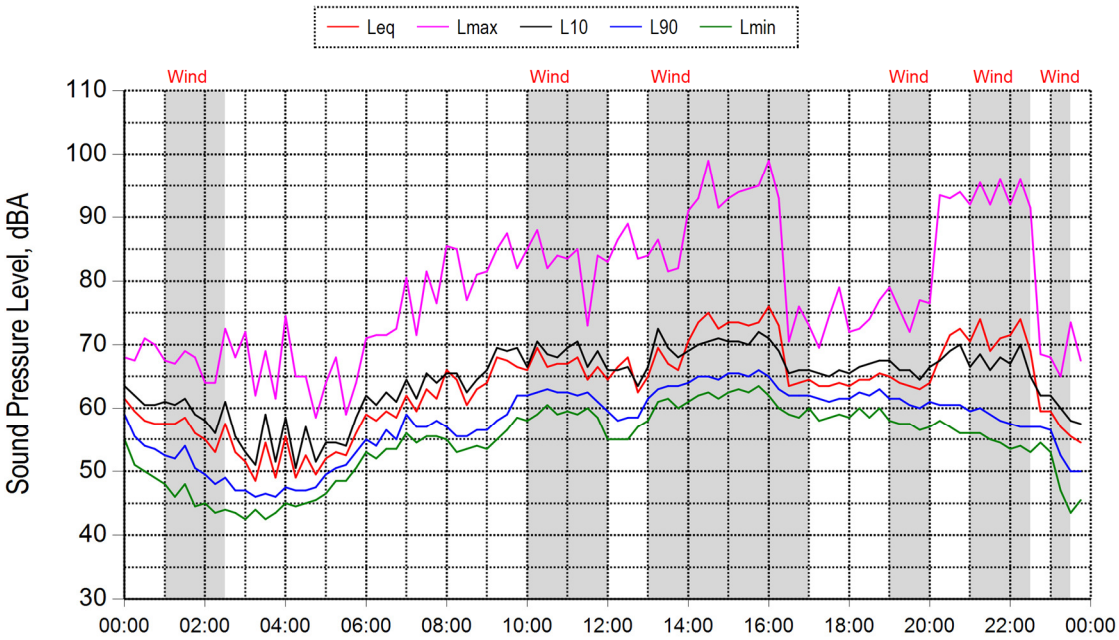

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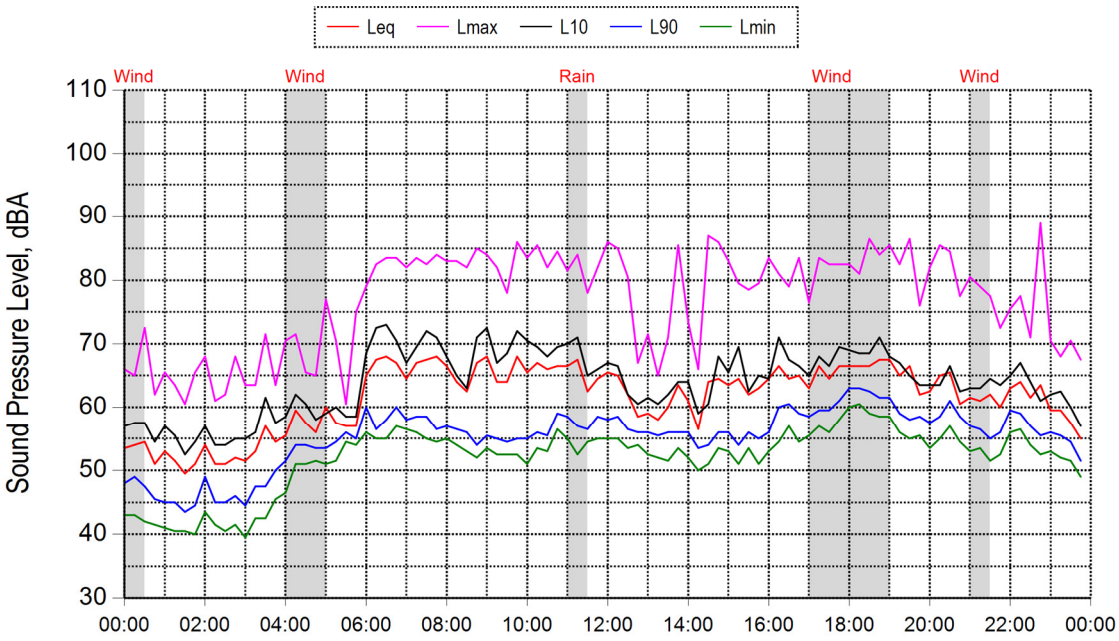

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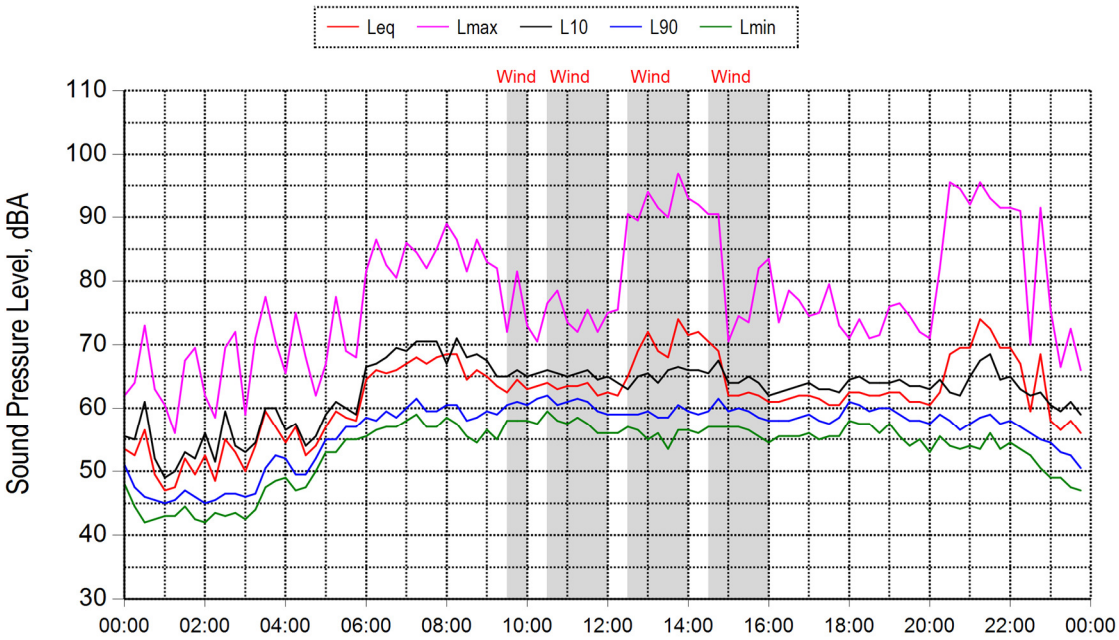

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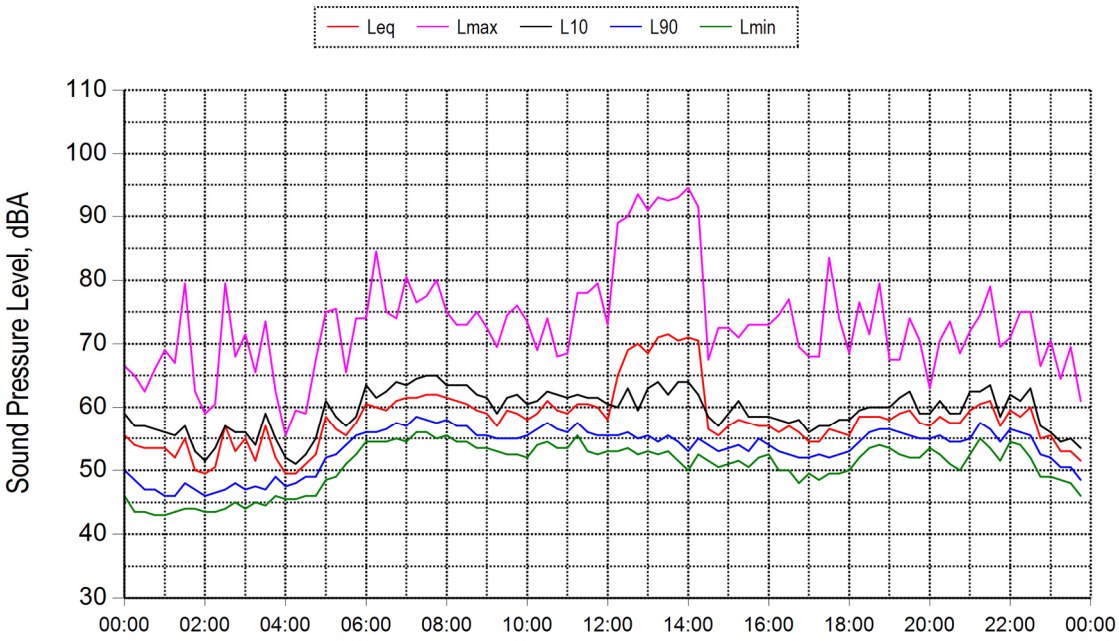

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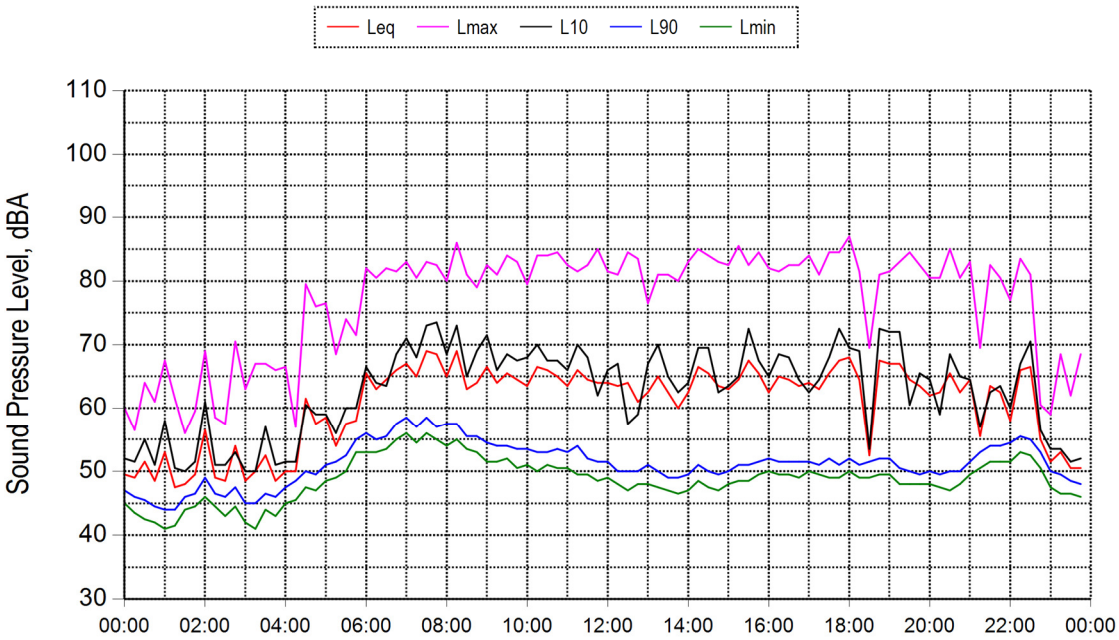

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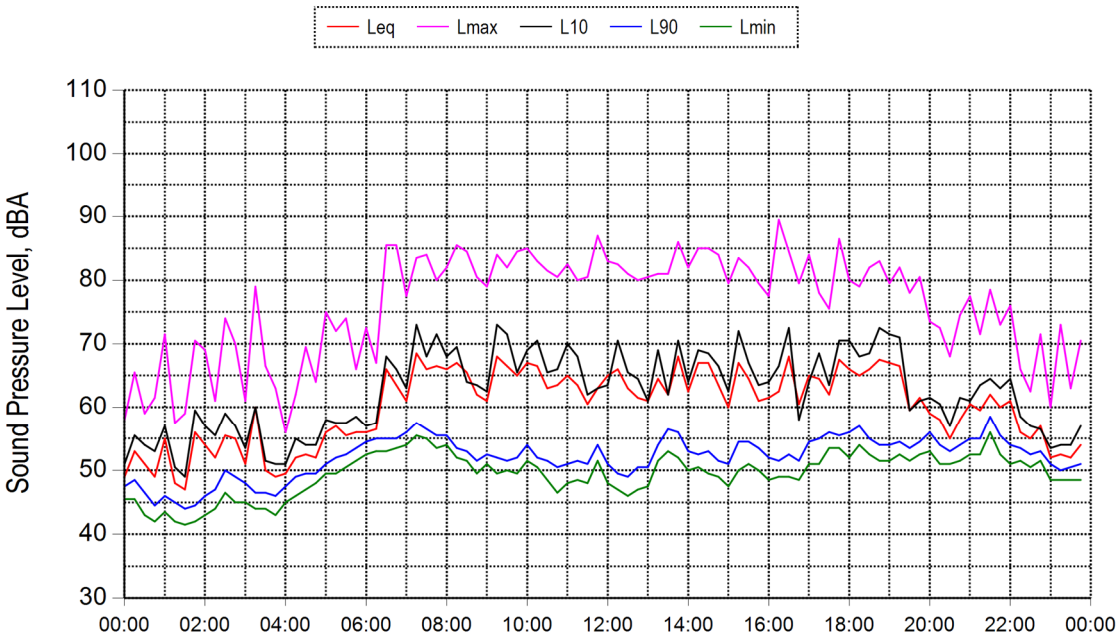

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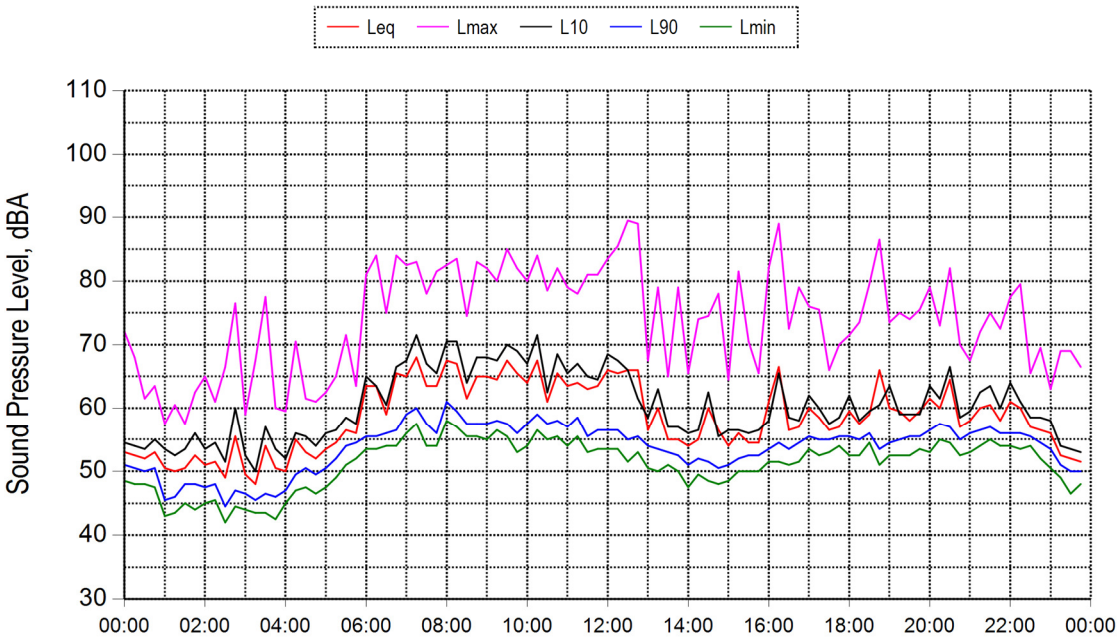

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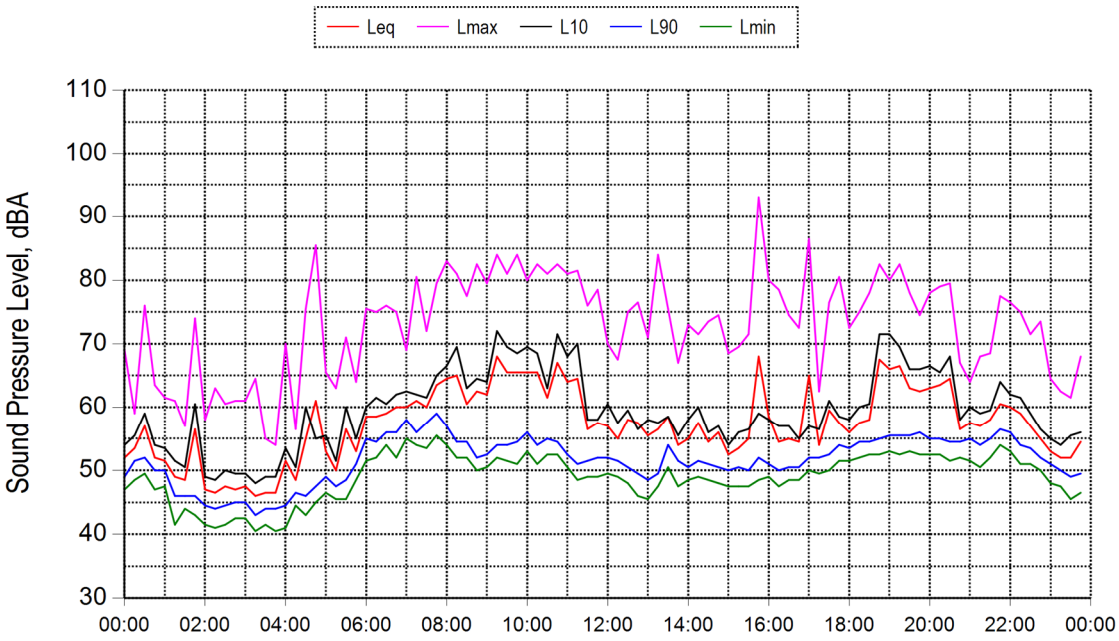

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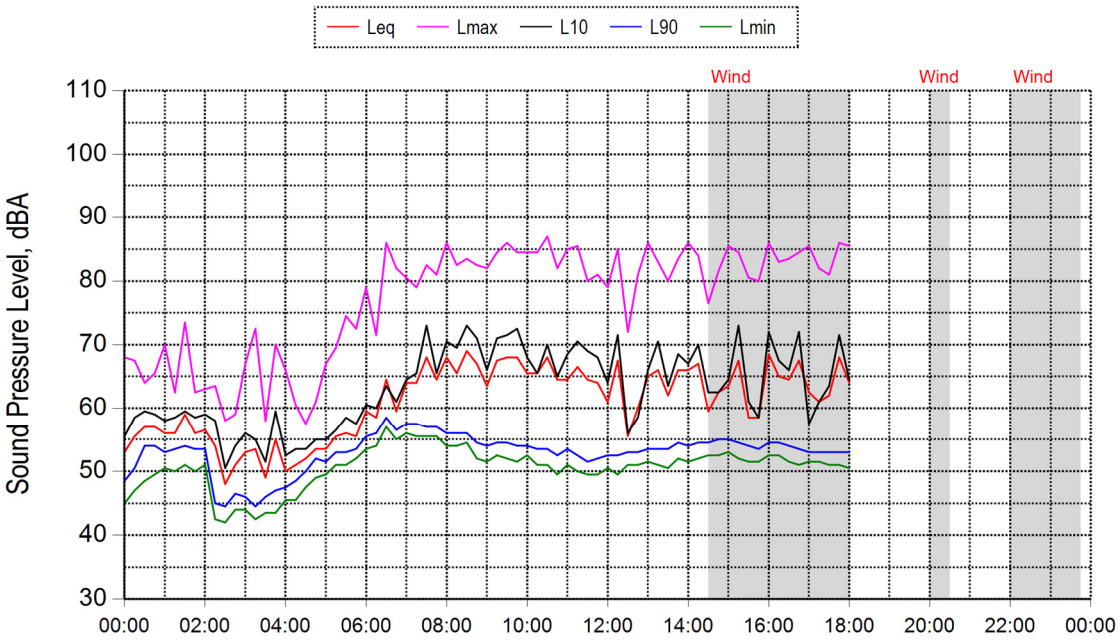


APPENDIX B

DRAFT SCHEDULE OF CONSTRUCTION EQUIPMENT & ASSOCIATED SOUND POWER LEVELS

Activity	Stage	Estimated Timeframe	Equipment	Sound Power Level per Item $L_{Aeq,15min}$ dB(A)
General Holmes Drive Widening	1	X Weeks	Vacuum sucker truck	107
			Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw 9	118
			Tipper trucks	108
			Franna Cranes	110
			Semi-trailers	100
			Grader (12H)	110
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
General Holmes Drive Widening	2	X Weeks	Vacuum sucker truck	107
			Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Semi-trailers	100
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
General Holmes Drive Widening	3	X Weeks	Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Semi-trailers	100
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
			Crane (40 – 80t)	110
General Holmes Drive Widening	4	X Weeks	Vacuum sucker truck	107
			Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122

			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Semi-trailers	100
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Daymaker Portable Lights	80
General Holmes Drive Widening	5	X Weeks	Excavators (20 – 30t)	110
			Tipper trucks	108
			Franna Cranes	110
			Piling Rig (Mait HR150)	120
			Mobile crane (40t)	110
			Skidsteer loader	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
			Small compaction equipment	100
General Holmes Drive Widening	6	X Weeks	Excavators (20 – 30t)	110
			Tipper trucks	108
			Franna Cranes	110
			Piling Rig (Mait HR150)	120
			Bentonite slurry plant/tanks	100
			Mobile crane (40t)	110
			Skidsteer loader	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
			Small compaction equipment	100
General Holmes Drive Widening	7	X Weeks	Vacuum sucker truck	107
			Excavators (20 – 30t)	110
			Tipper trucks	108
			Franna Cranes	110
			Piling Rig (Mait HR150)	120
			Bentonite slurry plant/tanks	100
			Mobile crane (40t)	110
			Skidsteer loader	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100

			Daymaker Portable Lights	80
			Small compaction equipment	100
General Holmes Drive Widening	8	X Weeks	Vacuum sucker truck	107
			Excavators (20 – 30t)	110
			Tipper trucks	108
			Franna Cranes	110
			Piling Rig (Mait HR150)	120
			Mobile crane (40t)	110
			Skidsteer loader	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
			Small compaction equipment	100
General Holmes Drive Widening	9	X Weeks	Excavators (20 – 30t)	110
			Tipper trucks	108
			Franna Cranes	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
			Small compaction equipment	100
General Holmes Drive Widening	10	X Weeks	Excavators (20 – 30t)	110
			Tipper trucks	108
			Concrete saw	118
			Franna Cranes	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
			Small compaction equipment	100
General Holmes Drive Widening	11	X Weeks	Vacuum sucker truck	107
			Excavators (20 – 30t)	110
			Rollers (10 - 16t)	114
			Tipper trucks	108
			Mobile Crane (Grove GMK 6220-L)	110
			Franna Cranes	110
			Semi-trailers	100
			Concrete pump	109
			Concrete agitator trucks	112
			Air compressor/pneumatic hammer/air pipe	100

			Daymaker Portable Lights	80
Joyce Drive Widening	1	X Weeks	Vacuum sucker truck	107
			Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Semi-trailers	100
			Grader (12H)	110
			Rollers (10 - 16t)	114
			Asphalt paver	114
			Daymaker Portable Lights	80
Joyce Drive Widening	2	X Weeks	Vacuum sucker truck	107
			Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Semi-trailers	100
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
Joyce Drive Widening	3	X Weeks	Vacuum sucker truck	107
			Tipper trucks	108
			Franna Cranes	110
			Concrete agitator trucks	112
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	1	X Weeks	Vacuum sucker truck	107
			Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Tipper trucks	108
			Franna Cranes	110
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	2	X Weeks	Vacuum sucker truck	107
			Backhoes	111
			Excavators (20 – 30t)	110
			Excavator Mouted Sheet Piling Rig	121

			Grader (12H)	110
			Rollers (10 - 16t)	114
			Tipper trucks	108
			Franna Cranes	110
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	3	X Weeks	Welding equipment/generator set	100
			Mobile crane (40t)	110
			Franna Cranes	110
			Bentonite tanks/pumps	100
			Piling Rig (Bauer BG40)	120
			Skidsteer loader	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	4	X Weeks	Piling Rig (Mait HR130)	120
			Franna Cranes	110
			Skidsteer loader	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	5	X Weeks	Franna Cranes	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	6	X Weeks	Franna Cranes	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	7	X Weeks	Franna Cranes	110
			Concrete Boom Pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Post stressing jacks, hydraulic pumps and tendon coil frames	100
			Daymaker Portable Lights	80

New Rail Bridges (Western Bridge)	8	X Weeks	Excavators (20t)	110
			Tipper trucks	108
			Rollers (16t)	114
			Concrete agitator trucks	112
			Concrete pump	109
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	9	X Weeks	Excavators (30t)	110
			Tipper trucks	108
			Semi-trailers	100
			Franna Cranes	110
			Daymaker Portable Lights	80
New Rail Bridges (Western Bridge)	10	X Weeks	Excavators (20 – 30t)	110
			Track tamping machinery (on track)	108
			Daymaker Portable Lights	80
New Rail Bridges (Eastern Bridge)	1	X Weeks	Vacuum sucker truck	107
			Excavators (20 – 30t)	110
			Excavator Mouted Sheet Piling Rig	121
			Rollers (10 - 16t)	114
			Tipper trucks	108
			Franna Cranes	110
			Daymaker Portable Lights	80
New Rail Bridges (Eastern Bridge)	2	X Weeks	Welding equipment/generator set	100
			Mobile crane (40t)	110
			Franna Cranes	110
			Bentonite tanks/pumps	100
			Piling Rig (Bauer BG40)	120
			Skidsteer loader	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Eastern Bridge)	3	X Weeks	Piling Rig (Mait HR130)	120
			Franna Cranes	110
			Skidsteer loader	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Daymaker Portable Lights	80
New Rail Bridges (Eastern	4	X Weeks	Franna Cranes	110
			Concrete pump	109

Bridge)			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Eastern Bridge)	5	X Weeks	Franna Cranes	110
			Concrete pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Eastern Bridge)	6	X Weeks	Franna Cranes	110
			Concrete Boom Pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Post stressing jacks, hydraulic pumps and tendon coil frames	100 80
			Daymaker Portable Lights	
New Rail Bridges (Eastern Bridge)	7	X Weeks	Excavators (20t)	110
			Tipper trucks	108
			Rollers (16t)	114
			Concrete agitator trucks	112
			Concrete pump	109
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Daymaker Portable Lights	80
New Rail Bridges (Eastern Bridge)	8	X Weeks	Excavators (30t)	110
			Tipper trucks	108
			Semi-trailers	100
			Franna Cranes	110
			Daymaker Portable Lights	80
New Rail Bridges (Eastern Bridge)	9	X Weeks	Excavators (30t)	110
			Track tamping machinery (on track)	108
			Daymaker Portable Lights	80
New Rail Bridges (Decline Construction)	1	X Weeks	Excavators (30t)	110
			Tipper trucks	108
			Concrete pump	109
			Air compressor and shotcrete spray unit	100
			Concrete agitator trucks	112
			Franna Cranes	110
New Rail Bridges (Decline Construction)	2	X Weeks	Excavators (30t)	110
			Tipper trucks	108
			Semi-trailers	100
			Franna Cranes	110

			Dewatering pumps and equipment	100
New Rail Bridges (Decline Construction)	3	X Weeks	Excavators (20t)	110
			Franna Cranes	110
			Concrete Boom Pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
			Dewatering pumps and equipment	100
New Rail Bridges (Decline Construction)	4	X Weeks	Franna Cranes	110
			Concrete Boom Pump	109
			Concrete agitator trucks	112
			Semi-trailers	100
			Air compressor/pneumatic hammer/air pipe	100
Botany Road / Wentworth Avenue Intersection Upgrade	1	X Weeks	Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Vacuum sucker truck	107
			Semi-trailers	100
			Grader (12H)	110
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
Botany Road / Wentworth Avenue Intersection Upgrade	2	X Weeks	Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Vacuum sucker truck	107
			Semi-trailers	100
			Grader (12H)	110
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
Botany Road / Wentworth Avenue Intersection Upgrade	3	X Weeks	Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108

			Franna Cranes	110
			Vacuum sucker truck	107
			Semi-trailers	100
			Grader (12H)	110
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
Botany Road / Wentworth Avenue Intersection Upgrade	4	X Weeks	Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Vacuum sucker truck	107
			Semi-trailers	100
			Grader (12H)	110
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
Botany Road / Wentworth Avenue Intersection Upgrade	5	X Weeks	Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Vacuum sucker truck	107
			Semi-trailers	100
			Grader (12H)	110
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
Botany Road / Wentworth Avenue Intersection Upgrade	6	X Weeks	Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Vacuum sucker truck	107
			Semi-trailers	100
			Grader (12H)	110
			Rollers (10 - 16t)	114

			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80
Finalisation Works	1	X Weeks	Backhoes	111
			Excavators (20 – 30t)	110
			Pneumatic hammer (excavator mounted)	122
			Concrete saw	118
			Tipper trucks	108
			Franna Cranes	110
			Vacuum sucker truck	107
			Semi-trailers	100
			Rollers (10 - 16t)	114
			Pavement profiler	113
			Asphalt paver	114
			Daymaker Portable Lights	80

APPENDIX C

PREDICTED CONSTRUCTION NOISE LEVELS

APPENDIX C-1

Worst-Case Predicted $L_{Aeq,15min}$ Construction Noise Levels During Activity 2 – General Holmes Widening

Note:

Worst-case construction noise levels, based on all the identified sources operating simultaneously and continuously, are presented in the following table. Additionally, where predicted noise levels vary due to the spatial distribution of the construction noise sources throughout the site, the upper range predictions are presented. Exceedances of the highly affected noise management level are shown in bold. It should be noted that typically lower noise levels than presented would be expected for most of the time. No local barrier effects have been considered in the predictions as barrier details have not been provided by the CMS. Where barriers are to be installed around works sites, provided they are formed of a material with sufficient surface mass (i.e. >10kg/m2), are contiguous (with no gaps) and are situated such that they break the acoustic line of sight between the construction noise source(s) and the receiver(s), a reduction of the reported levels by up to approximately 10 dB may be expected.

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R1	66	48	55	Nil	7
R2	66	48	53	Nil	5
R3	66	48	53	Nil	5
R4	66	48	52	Nil	4
R5	66	48	52	Nil	4
R6	66	48	52	Nil	4
R7	66	48	53	Nil	5
R8	66	48	61	Nil	13
R9	66	48	65	Nil	17
R10	66	48	65	Nil	17
R11	66	48	65	Nil	17
R12	66	48	65	Nil	17
R13	66	48	65	Nil	17
R14	66	48	59	Nil	11
R15	66	48	59	Nil	11
R16	66	48	59	Nil	11
R17	66	48	58	Nil	10
R18	66	48	58	Nil	10
R19	66	48	58	Nil	10
R20	66	48	58	Nil	10
R21	66	48	58	Nil	10
R22	66	48	61	Nil	13
R23	66	48	64	Nil	16
R24	66	48	64	Nil	16
R25	66	48	64	Nil	16
R26	66	48	63	Nil	15
R27	66	48	63	Nil	15
R28	66	48	63	Nil	15
R29	66	48	63	Nil	15
R30	66	48	59	Nil	11
R31	66	48	59	Nil	11
R32	66	48	59	Nil	11
R33	65	46	65	Nil	19
R34	65	46	68	3	22
R35	65	46	68	3	22
R36	65	46	69	4	23
R37	65	46	69	4	23
R38	65	46	66	1	20

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R39	65	46	65	Nil	19
R40	65	46	63	Nil	17
R41	65	46	61	Nil	15
R42	65	46	60	Nil	14
R43	65	46	60	Nil	14
R44	65	46	59	Nil	13
R45	65	46	58	Nil	12
R46	65	46	57	Nil	11
R47	65	46	56	Nil	10
R48	65	46	62	Nil	16
R49	65	46	62	Nil	16
R50	65	46	62	Nil	16
R51	65	46	62	Nil	16
R52	65	46	62	Nil	16
R53	65	46	63	Nil	17
R54	65	46	63	Nil	17
R55	65	46	63	Nil	17
R56	65	46	63	Nil	17
R57	65	46	64	Nil	18
R58	65	46	64	Nil	18
R59	65	46	64	Nil	18
R60	65	46	64	Nil	18
R61	65	46	65	Nil	19
R62	65	46	65	Nil	19
R63	65	46	65	Nil	19
R64	65	46	65	Nil	19
R65	65	46	66	1	20
R66	65	46	66	1	20
R67	65	46	66	1	20
R68	65	46	65	Nil	19
R69	65	46	64	Nil	18
R70	65	46	64	Nil	18
R71	65	46	64	Nil	18
R72	65	46	63	Nil	17
R73	65	46	63	Nil	17
R74	65	46	63	Nil	17
R75	65	46	63	Nil	17
R76	65	46	61	Nil	15

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R77	65	46	61	Nil	15
R78	65	46	61	Nil	15
R79	65	46	61	Nil	15
R80	65	46	60	Nil	14
R81	65	46	60	Nil	14
R82	65	46	60	Nil	14
R83	65	46	59	Nil	13
R84	65	46	59	Nil	13
R85	65	46	59	Nil	13
R86	65	46	59	Nil	13
R87	65	46	58	Nil	12
R88	65	46	58	Nil	12
R89	65	46	58	Nil	12
R90	65	46	58	Nil	12
R91	65	46	57	Nil	11
R92	65	46	57	Nil	11
R93	65	46	57	Nil	11
R94	65	46	57	Nil	11
R95	65	46	56	Nil	10
R96	65	46	56	Nil	10
R97	65	46	56	Nil	10
R98	65	46	56	Nil	10
R99	65	46	56	Nil	10
R100	65	46	56	Nil	10
R101	65	46	57	Nil	11
R102	65	46	57	Nil	11
R103	65	46	58	Nil	12
R104	65	46	58	Nil	12
R105	65	46	59	Nil	13
R106	65	46	59	Nil	13
R107	65	46	59	Nil	13
R108	65	46	59	Nil	13
R109	65	46	60	Nil	14
R110	65	46	60	Nil	14
R111	65	46	61	Nil	15
R112	65	46	61	Nil	15
R113	65	46	61	Nil	15
R114	65	46	61	Nil	15

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R115	65	46	59	Nil	13
R116	63	51	62	Nil	11
R117	63	51	63	Nil	12
R118	63	51	63	Nil	12
R119	63	51	63	Nil	12
R120	63	51	64	1	13
R121	63	51	64	1	13
Church	70	70	67	Nil	Nil
C1	70	70	63	Nil	Nil
C2	70	70	63	Nil	Nil
C3	70	70	60	Nil	Nil
C4	70	70	60	Nil	Nil
C5	70	70	59	Nil	Nil
C6	70	70	58	Nil	Nil
C7	70	70	57	Nil	Nil
C8	70	70	57	Nil	Nil
C9	70	70	62	Nil	Nil
C10	70	70	63	Nil	Nil
C11	70	70	63	Nil	Nil
C12	70	70	64	Nil	Nil
C13	70	70	65	Nil	Nil
C14	70	70	66	Nil	Nil
C15	70	70	67	Nil	Nil
C16	70	70	67	Nil	Nil
C17	70	70	66	Nil	Nil
C18	70	70	65	Nil	Nil
C19	70	70	65	Nil	Nil
C20	70	70	65	Nil	Nil
C21	70	70	66	Nil	Nil
C22	70	70	63	Nil	Nil
C23	70	70	64	Nil	Nil
C24	70	70	63	Nil	Nil
C25	70	70	65	Nil	Nil
C26	70	70	64	Nil	Nil

APPENDIX C-2

Worst-Case Predicted $L_{Aeq,15min}$ Construction Noise Levels During Activity 3 – Joyce Drive Widening

Note:

Worst-case construction noise levels, based on all the identified sources operating simultaneously and continuously, are presented in the following table. Additionally, where predicted noise levels vary due to the spatial distribution of the construction noise sources throughout the site, the upper range predictions are presented. Exceedances of the highly affected noise management level are shown in bold. It should be noted that typically lower noise levels than presented would be expected for most of the time. No local barrier effects have been considered in the predictions as barrier details have not been provided by the CMS. Where barriers are to be installed around works sites, provided they are formed of a material with sufficient surface mass (i.e. >10kg/m2), are contiguous (with no gaps) and are situated such that they break the acoustic line of sight between the construction noise source(s) and the receiver(s), a reduction of the reported levels by up to approximately 10 dB may be expected.

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R1	66	48	63	Nil	15
R2	66	48	64	Nil	16
R3	66	48	64	Nil	16
R4	66	48	65	Nil	17
R5	66	48	65	Nil	17
R6	66	48	66	Nil	18
R7	66	48	68	2	20
R8	66	48	71	5	23
R9	66	48	71	5	23
R10	66	48	71	5	23
R11	66	48	71	5	23
R12	66	48	71	5	23
R13	66	48	71	5	23
R14	66	48	63	Nil	15
R15	66	48	64	Nil	16
R16	66	48	64	Nil	16
R17	66	48	64	Nil	16
R18	66	48	64	Nil	16
R19	66	48	65	Nil	17
R20	66	48	68	2	20
R21	66	48	68	2	20
R22	66	48	68	2	20
R23	66	48	68	2	20
R24	66	48	68	2	20
R25	66	48	69	3	21
R26	66	48	68	2	20
R27	66	48	69	3	21
R28	66	48	63	Nil	15
R29	66	48	63	Nil	15
R30	66	48	59	Nil	11
R31	66	48	59	Nil	11
R32	66	48	59	Nil	11
R33	65	46	65	Nil	19
R34	65	46	68	3	22
R35	65	46	68	3	22
R36	65	46	69	4	23
R37	65	46	69	4	23
R38	65	46	66	1	20

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R39	65	46	62	Nil	16
R40	65	46	61	Nil	15
R41	65	46	60	Nil	14
R42	65	46	59	Nil	13
R43	65	46	58	Nil	12
R44	65	46	57	Nil	11
R45	65	46	57	Nil	11
R46	65	46	56	Nil	10
R47	65	46	55	Nil	9
R48	65	46	60	Nil	14
R49	65	46	60	Nil	14
R50	65	46	60	Nil	14
R51	65	46	60	Nil	14
R52	65	46	60	Nil	14
R53	65	46	60	Nil	14
R54	65	46	61	Nil	15
R55	65	46	62	Nil	16
R56	65	46	64	Nil	18
R57	65	46	64	Nil	18
R58	65	46	64	Nil	18
R59	65	46	64	Nil	18
R60	65	46	64	Nil	18
R61	65	46	64	Nil	18
R62	65	46	64	Nil	18
R63	65	46	64	Nil	18
R64	65	46	64	Nil	18
R65	65	46	64	Nil	18
R66	65	46	64	Nil	18
R67	65	46	65	Nil	19
R68	65	46	63	Nil	17
R69	65	46	63	Nil	17
R70	65	46	63	Nil	17
R71	65	46	63	Nil	17
R72	65	46	61	Nil	15
R73	65	46	61	Nil	15
R74	65	46	61	Nil	15
R75	65	46	61	Nil	15
R76	65	46	60	Nil	14

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R77	65	46	60	Nil	14
R78	65	46	60	Nil	14
R79	65	46	60	Nil	14
R80	65	46	59	Nil	13
R81	65	46	59	Nil	13
R82	65	46	59	Nil	13
R83	65	46	58	Nil	12
R84	65	46	58	Nil	12
R85	65	46	58	Nil	12
R86	65	46	58	Nil	12
R87	65	46	57	Nil	11
R88	65	46	56	Nil	10
R89	65	46	57	Nil	11
R90	65	46	57	Nil	11
R91	65	46	56	Nil	10
R92	65	46	56	Nil	10
R93	65	46	56	Nil	10
R94	65	46	56	Nil	10
R95	65	46	55	Nil	9
R96	65	46	55	Nil	9
R97	65	46	55	Nil	9
R98	65	46	55	Nil	9
R99	65	46	55	Nil	9
R100	65	46	55	Nil	9
R101	65	46	55	Nil	9
R102	65	46	55	Nil	9
R103	65	46	56	Nil	10
R104	65	46	57	Nil	11
R105	65	46	57	Nil	11
R106	65	46	57	Nil	11
R107	65	46	57	Nil	11
R108	65	46	57	Nil	11
R109	65	46	58	Nil	12
R110	65	46	58	Nil	12
R111	65	46	59	Nil	13
R112	65	46	59	Nil	13
R113	65	46	59	Nil	13
R114	65	46	59	Nil	13

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R115	65	46	57	Nil	11
R116	63	51	58	Nil	7
R117	63	51	57	Nil	6
R118	63	51	57	Nil	6
R119	63	51	57	Nil	6
R120	63	51	58	Nil	7
R121	63	51	58	Nil	7
Church	70	70	63	Nil	Nil
C1	70	70	71	1	1
C2	70	70	73	3	3
C3	70	70	72	2	2
C4	70	70	70	Nil	Nil
C5	70	70	72	2	2
C6	70	70	73	3	3
C7	70	70	74	4	4
C8	70	70	71	1	1
C9	70	70	61	Nil	Nil
C10	70	70	61	Nil	Nil
C11	70	70	61	Nil	Nil
C12	70	70	61	Nil	Nil
C13	70	70	66	Nil	Nil
C14	70	70	67	Nil	Nil
C15	70	70	67	Nil	Nil
C16	70	70	63	Nil	Nil
C17	70	70	62	Nil	Nil
C18	70	70	60	Nil	Nil
C19	70	70	59	Nil	Nil
C20	70	70	61	Nil	Nil
C21	70	70	62	Nil	Nil
C22	70	70	59	Nil	Nil
C23	70	70	61	Nil	Nil
C24	70	70	59	Nil	Nil
C25	70	70	62	Nil	Nil
C26	70	70	61	Nil	Nil

APPENDIX C-3

Worst-Case Predicted $L_{Aeq,15min}$ Construction Noise Levels During Activity 4 – New Rail Bridges

Note:

Worst-case construction noise levels, based on all the identified sources operating simultaneously and continuously, are presented in the following table. Additionally, where predicted noise levels vary due to the spatial distribution of the construction noise sources throughout the site, the upper range predictions are presented. Exceedances of the highly affected noise management level are shown in bold. It should be noted that typically lower noise levels than presented would be expected for most of the time. No local barrier effects have been considered in the predictions as barrier details have not been provided by the CMS. Where barriers are to be installed around works sites, provided they are formed of a material with sufficient surface mass (i.e. >10kg/m2), are contiguous (with no gaps) and are situated such that they break the acoustic line of sight between the construction noise source(s) and the receiver(s), a reduction of the reported levels by up to approximately 10 dB may be expected.

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R1	66	48	61	Nil	13
R2	66	48	58	Nil	10
R3	66	48	54	Nil	6
R4	66	48	58	Nil	10
R5	66	48	54	Nil	6
R6	66	48	54	Nil	6
R7	66	48	54	Nil	6
R8	66	48	51	Nil	3
R9	66	48	53	Nil	5
R10	66	48	59	Nil	11
R11	66	48	59	Nil	11
R12	66	48	62	Nil	14
R13	66	48	59	Nil	11
R14	66	48	58	Nil	10
R15	66	48	56	Nil	8
R16	66	48	55	Nil	7
R17	66	48	55	Nil	7
R18	66	48	55	Nil	7
R19	66	48	53	Nil	5
R20	66	48	55	Nil	7
R21	66	48	53	Nil	5
R22	66	48	54	Nil	6
R23	66	48	54	Nil	6
R24	66	48	53	Nil	5
R25	66	48	56	Nil	8
R26	66	48	53	Nil	5
R27	66	48	57	Nil	9
R28	66	48	55	Nil	7
R29	66	48	58	Nil	10
R30	66	48	53	Nil	5
R31	66	48	52	Nil	4
R32	66	48	51	Nil	3
R33	65	46	57	Nil	11
R34	65	46	69	4	23
R35	65	46	69	4	23
R36	65	46	70	5	24
R37	65	46	76	11	30
R38	65	46	68	3	22

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R39	65	46	67	2	21
R40	65	46	63	Nil	17
R41	65	46	61	Nil	15
R42	65	46	60	Nil	14
R43	65	46	59	Nil	13
R44	65	46	59	Nil	13
R45	65	46	57	Nil	11
R46	65	46	56	Nil	10
R47	65	46	54	Nil	8
R48	65	46	51	Nil	5
R49	65	46	50	Nil	4
R50	65	46	49	Nil	3
R51	65	46	49	Nil	3
R52	65	46	47	Nil	1
R53	65	46	50	Nil	4
R54	65	46	51	Nil	5
R55	65	46	53	Nil	7
R56	65	46	53	Nil	7
R57	65	46	50	Nil	4
R58	65	46	51	Nil	5
R59	65	46	58	Nil	12
R60	65	46	59	Nil	13
R61	65	46	58	Nil	12
R62	65	46	58	Nil	12
R63	65	46	58	Nil	12
R64	65	46	61	Nil	15
R65	65	46	60	Nil	14
R66	65	46	62	Nil	16
R67	65	46	64	Nil	18
R68	65	46	66	1	20
R69	65	46	63	Nil	17
R70	65	46	62	Nil	16
R71	65	46	61	Nil	15
R72	65	46	62	Nil	16
R73	65	46	58	Nil	12
R74	65	46	60	Nil	14
R75	65	46	59	Nil	13
R76	65	46	59	Nil	13

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R77	65	46	54	Nil	8
R78	65	46	53	Nil	7
R79	65	46	54	Nil	8
R80	65	46	56	Nil	10
R81	65	46	57	Nil	11
R82	65	46	56	Nil	10
R83	65	46	54	Nil	8
R84	65	46	54	Nil	8
R85	65	46	52	Nil	6
R86	65	46	49	Nil	3
R87	65	46	49	Nil	3
R88	65	46	54	Nil	8
R89	65	46	53	Nil	7
R90	65	46	49	Nil	3
R91	65	46	53	Nil	7
R92	65	46	49	Nil	3
R93	65	46	49	Nil	3
R94	65	46	49	Nil	3
R95	65	46	52	Nil	6
R96	65	46	52	Nil	6
R97	65	46	49	Nil	3
R98	65	46	56	Nil	10
R99	65	46	53	Nil	7
R100	65	46	51	Nil	5
R101	65	46	55	Nil	9
R102	65	46	55	Nil	9
R103	65	46	47	Nil	1
R104	65	46	45	Nil	Nil
R105	65	46	57	Nil	11
R106	65	46	59	Nil	13
R107	65	46	60	Nil	14
R108	65	46	59	Nil	13
R109	65	46	58	Nil	12
R110	65	46	58	Nil	12
R111	65	46	57	Nil	11
R112	65	46	60	Nil	14
R113	65	46	61	Nil	15
R114	65	46	60	Nil	14

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R115	65	46	58	Nil	12
R116	63	51	59	Nil	8
R117	63	51	60	Nil	9
R118	63	51	60	Nil	9
R119	63	51	60	Nil	9
R120	63	51	60	Nil	9
R121	63	51	60	Nil	9
Church	70	70	77	7	7
C1	70	70	55	Nil	Nil
C2	70	70	55	Nil	Nil
C3	70	70	54	Nil	Nil
C4	70	70	53	Nil	Nil
C5	70	70	52	Nil	Nil
C6	70	70	52	Nil	Nil
C7	70	70	51	Nil	Nil
C8	70	70	49	Nil	Nil
C9	70	70	58	Nil	Nil
C10	70	70	59	Nil	Nil
C11	70	70	60	Nil	Nil
C12	70	70	60	Nil	Nil
C13	70	70	62	Nil	Nil
C14	70	70	64	Nil	Nil
C15	70	70	64	Nil	Nil
C16	70	70	78	8	8
C17	70	70	73	3	3
C18	70	70	67	Nil	Nil
C19	70	70	64	Nil	Nil
C20	70	70	70	Nil	Nil
C21	70	70	71	1	1
C22	70	70	63	Nil	Nil
C23	70	70	67	Nil	Nil
C24	70	70	62	Nil	Nil
C25	70	70	66	Nil	Nil
C26	70	70	64	Nil	Nil

APPENDIX C-4

Worst-Case Predicted $L_{Aeq,15min}$ Construction Noise Levels During Activity 5 – Botany Road / Wentworth Avenue Intersection Upgrade

Note:

Worst-case construction noise levels, based on all the identified sources operating simultaneously and continuously, are presented in the following table. Additionally, where predicted noise levels vary due to the spatial distribution of the construction noise sources throughout the site, the upper range predictions are presented. Exceedances of the highly affected noise management level are shown in bold. It should be noted that typically lower noise levels than presented would be expected for most of the time. No local barrier effects have been considered in the predictions as barrier details have not been provided by the CMS. Where barriers are to be installed around works sites, provided they are formed of a material with sufficient surface mass (i.e. >10kg/m2), are contiguous (with no gaps) and are situated such that they break the acoustic line of sight between the construction noise source(s) and the receiver(s), a reduction of the reported levels by up to approximately 10 dB may be expected.

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R1	66	48	65	Nil	17
R2	66	48	60	Nil	12
R3	66	48	55	Nil	7
R4	66	48	53	Nil	5
R5	66	48	53	Nil	5
R6	66	48	53	Nil	5
R7	66	48	52	Nil	4
R8	66	48	54	Nil	6
R9	66	48	54	Nil	6
R10	66	48	56	Nil	8
R11	66	48	58	Nil	10
R12	66	48	62	Nil	14
R13	66	48	62	Nil	14
R14	66	48	64	Nil	16
R15	66	48	64	Nil	16
R16	66	48	63	Nil	15
R17	66	48	63	Nil	15
R18	66	48	62	Nil	14
R19	66	48	60	Nil	12
R20	66	48	59	Nil	11
R21	66	48	59	Nil	11
R22	66	48	59	Nil	11
R23	66	48	59	Nil	11
R24	66	48	59	Nil	11
R25	66	48	58	Nil	10
R26	66	48	59	Nil	11
R27	66	48	60	Nil	12
R28	66	48	61	Nil	13
R29	66	48	61	Nil	13
R30	66	48	57	Nil	9
R31	66	48	57	Nil	9
R32	66	48	57	Nil	9
R33	65	46	67	2	21
R34	65	46	72	7	26
R35	65	46	73	8	27
R36	65	46	74	9	28
R37	65	46	79	14	33
R38	65	46	78	13	32

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R39	65	46	75	10	29
R40	65	46	71	6	25
R41	65	46	68	3	22
R42	65	46	66	1	20
R43	65	46	65	Nil	19
R44	65	46	63	Nil	17
R45	65	46	62	Nil	16
R46	65	46	61	Nil	15
R47	65	46	59	Nil	13
R48	65	46	64	Nil	18
R49	65	46	65	Nil	19
R50	65	46	65	Nil	19
R51	65	46	65	Nil	19
R52	65	46	66	1	20
R53	65	46	66	1	20
R54	65	46	66	1	20
R55	65	46	67	2	21
R56	65	46	67	2	21
R57	65	46	68	3	22
R58	65	46	68	3	22
R59	65	46	69	4	23
R60	65	46	69	4	23
R61	65	46	70	5	24
R62	65	46	71	6	25
R63	65	46	72	7	26
R64	65	46	72	7	26
R65	65	46	73	8	27
R66	65	46	74	9	28
R67	65	46	76	11	30
R68	65	46	75	10	29
R69	65	46	74	9	28
R70	65	46	73	8	27
R71	65	46	72	7	26
R72	65	46	70	5	24
R73	65	46	70	5	24
R74	65	46	69	4	23
R75	65	46	69	4	23
R76	65	46	68	3	22

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R77	65	46	67	2	21
R78	65	46	67	2	21
R79	65	46	66	1	20
R80	65	46	65	Nil	19
R81	65	46	65	Nil	19
R82	65	46	65	Nil	19
R83	65	46	63	Nil	17
R84	65	46	63	Nil	17
R85	65	46	63	Nil	17
R86	65	46	63	Nil	17
R87	65	46	62	Nil	16
R88	65	46	61	Nil	15
R89	65	46	61	Nil	15
R90	65	46	61	Nil	15
R91	65	46	61	Nil	15
R92	65	46	60	Nil	14
R93	65	46	60	Nil	14
R94	65	46	60	Nil	14
R95	65	46	59	Nil	13
R96	65	46	59	Nil	13
R97	65	46	59	Nil	13
R98	65	46	59	Nil	13
R99	65	46	60	Nil	14
R100	65	46	60	Nil	14
R101	65	46	60	Nil	14
R102	65	46	60	Nil	14
R103	65	46	62	Nil	16
R104	65	46	62	Nil	16
R105	65	46	63	Nil	17
R106	65	46	63	Nil	17
R107	65	46	63	Nil	17
R108	65	46	64	Nil	18
R109	65	46	65	Nil	19
R110	65	46	66	1	20
R111	65	46	66	1	20
R112	65	46	67	2	21
R113	65	46	67	2	21
R114	65	46	66	1	20

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R115	65	46	64	Nil	18
R116	63	51	64	1	13
R117	63	51	64	1	13
R118	63	51	64	1	13
R119	63	51	64	1	13
R120	63	51	66	3	15
R121	63	51	65	2	14
Church	70	70	84	14	14
C1	70	70	61	Nil	Nil
C2	70	70	61	Nil	Nil
C3	70	70	58	Nil	Nil
C4	70	70	57	Nil	Nil
C5	70	70	56	Nil	Nil
C6	70	70	56	Nil	Nil
C7	70	70	55	Nil	Nil
C8	70	70	54	Nil	Nil
C9	70	70	63	Nil	Nil
C10	70	70	64	Nil	Nil
C11	70	70	65	Nil	Nil
C12	70	70	66	Nil	Nil
C13	70	70	68	Nil	Nil
C14	70	70	69	Nil	Nil
C15	70	70	70	Nil	Nil
C16	70	70	79	9	9
C17	70	70	74	4	4
C18	70	70	70	Nil	Nil
C19	70	70	68	Nil	Nil
C20	70	70	76	6	6
C21	70	70	81	11	11
C22	70	70	69	Nil	Nil
C23	70	70	74	4	4
C24	70	70	69	Nil	Nil
C25	70	70	76	6	6
C26	70	70	73	3	3

APPENDIX C-5

Worst-Case Predicted $L_{Aeq,15min}$ Construction Noise Levels During Activity 6 – Finalisation Works

Note:

Worst-case construction noise levels, based on all the identified sources operating simultaneously and continuously, are presented in the following table. Additionally, where predicted noise levels vary due to the spatial distribution of the construction noise sources throughout the site, the upper range predictions are presented. Exceedances of the highly affected noise management level are shown in bold. It should be noted that typically lower noise levels than presented would be expected for most of the time. No local barrier effects have been considered in the predictions as barrier details have not been provided by the CMS. Where barriers are to be installed around works sites, provided they are formed of a material with sufficient surface mass (i.e. >10kg/m2), are contiguous (with no gaps) and are situated such that they break the acoustic line of sight between the construction noise source(s) and the receiver(s), a reduction of the reported levels by up to approximately 10 dB may be expected.

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R1	66	48	59	Nil	11
R2	66	48	57	Nil	9
R3	66	48	57	Nil	9
R4	66	48	56	Nil	8
R5	66	48	57	Nil	9
R6	66	48	57	Nil	9
R7	66	48	57	Nil	9
R8	66	48	58	Nil	10
R9	66	48	61	Nil	13
R10	66	48	66	Nil	18
R11	66	48	69	3	21
R12	66	48	69	3	21
R13	66	48	68	2	20
R14	66	48	59	Nil	11
R15	66	48	59	Nil	11
R16	66	48	59	Nil	11
R17	66	48	59	Nil	11
R18	66	48	59	Nil	11
R19	66	48	59	Nil	11
R20	66	48	59	Nil	11
R21	66	48	59	Nil	11
R22	66	48	59	Nil	11
R23	66	48	59	Nil	11
R24	66	48	60	Nil	12
R25	66	48	61	Nil	13
R26	66	48	64	Nil	16
R27	66	48	66	Nil	18
R28	66	48	66	Nil	18
R29	66	48	65	Nil	17
R30	66	48	58	Nil	10
R31	66	48	58	Nil	10
R32	66	48	58	Nil	10
R33	65	46	69	4	23
R34	65	46	70	5	24
R35	65	46	70	5	24
R36	65	46	70	5	24
R37	65	46	68	3	22
R38	65	46	66	1	20

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R39	65	46	64	Nil	18
R40	65	46	63	Nil	17
R41	65	46	62	Nil	16
R42	65	46	61	Nil	15
R43	65	46	60	Nil	14
R44	65	46	59	Nil	13
R45	65	46	58	Nil	12
R46	65	46	58	Nil	12
R47	65	46	57	Nil	11
R48	65	46	64	Nil	18
R49	65	46	64	Nil	18
R50	65	46	64	Nil	18
R51	65	46	64	Nil	18
R52	65	46	65	Nil	19
R53	65	46	65	Nil	19
R54	65	46	65	Nil	19
R55	65	46	65	Nil	19
R56	65	46	65	Nil	19
R57	65	46	66	1	20
R58	65	46	66	1	20
R59	65	46	66	1	20
R60	65	46	66	1	20
R61	65	46	67	2	21
R62	65	46	67	2	21
R63	65	46	67	2	21
R64	65	46	66	1	20
R65	65	46	66	1	20
R66	65	46	66	1	20
R67	65	46	66	1	20
R68	65	46	65	Nil	19
R69	65	46	65	Nil	19
R70	65	46	65	Nil	19
R71	65	46	65	Nil	19
R72	65	46	63	Nil	17
R73	65	46	63	Nil	17
R74	65	46	63	Nil	17
R75	65	46	63	Nil	17
R76	65	46	62	Nil	16

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R77	65	46	62	Nil	16
R78	65	46	62	Nil	16
R79	65	46	61	Nil	15
R80	65	46	61	Nil	15
R81	65	46	60	Nil	14
R82	65	46	60	Nil	14
R83	65	46	59	Nil	13
R84	65	46	59	Nil	13
R85	65	46	59	Nil	13
R86	65	46	59	Nil	13
R87	65	46	58	Nil	12
R88	65	46	58	Nil	12
R89	65	46	58	Nil	12
R90	65	46	58	Nil	12
R91	65	46	58	Nil	12
R92	65	46	57	Nil	11
R93	65	46	57	Nil	11
R94	65	46	57	Nil	11
R95	65	46	57	Nil	11
R96	65	46	57	Nil	11
R97	65	46	56	Nil	10
R98	65	46	57	Nil	11
R99	65	46	57	Nil	11
R100	65	46	57	Nil	11
R101	65	46	57	Nil	11
R102	65	46	57	Nil	11
R103	65	46	58	Nil	12
R104	65	46	59	Nil	13
R105	65	46	59	Nil	13
R106	65	46	59	Nil	13
R107	65	46	59	Nil	13
R108	65	46	59	Nil	13
R109	65	46	60	Nil	14
R110	65	46	60	Nil	14
R111	65	46	61	Nil	15
R112	65	46	61	Nil	15
R113	65	46	61	Nil	15
R114	65	46	60	Nil	14

Receiver	Noise Management Level During Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Noise Management Level Outside Standard Construction Hours ($L_{Aeq,15min}$ dBA)	Worst Case Predicted Level ($L_{Aeq,15min}$ dBA)	Exceedance During Standard Construction Hours (dB)	Exceedance Outside Standard Construction Hours (dB)
R115	65	46	60	Nil	14
R116	63	51	65	2	14
R117	63	51	65	2	14
R118	63	51	65	2	14
R119	63	51	65	2	14
R120	63	51	64	1	13
R121	63	51	64	1	13
Church	70	70	65	Nil	Nil
C1	70	70	65	Nil	Nil
C2	70	70	64	Nil	Nil
C3	70	70	60	Nil	Nil
C4	70	70	59	Nil	Nil
C5	70	70	58	Nil	Nil
C6	70	70	57	Nil	Nil
C7	70	70	56	Nil	Nil
C8	70	70	55	Nil	Nil
C9	70	70	58	Nil	Nil
C10	70	70	63	Nil	Nil
C11	70	70	67	Nil	Nil
C12	70	70	68	Nil	Nil
C13	70	70	70	Nil	Nil
C14	70	70	71	1	1
C15	70	70	71	1	1
C16	70	70	65	Nil	Nil
C17	70	70	65	Nil	Nil
C18	70	70	66	Nil	Nil
C19	70	70	64	Nil	Nil
C20	70	70	64	Nil	Nil
C21	70	70	64	Nil	Nil
C22	70	70	63	Nil	Nil
C23	70	70	63	Nil	Nil
C24	70	70	62	Nil	Nil
C25	70	70	64	Nil	Nil
C26	70	70	63	Nil	Nil

APPENDIX C-6

Worst-Case Predicted $L_{A1,1min}$ Construction Noise Levels During Activities 1-6

Note:

Worst-case construction noise levels, based on all the identified sources operating simultaneously and continuously, are presented in the following table. Additionally, where predicted noise levels vary due to the spatial distribution of the construction noise sources throughout the site, the upper range predictions are presented. Exceedances of the sleep disturbance screening criteria are shown in bold. It should be noted that typically lower noise levels than presented would be expected for most of the time. No local barrier effects have been considered in the predictions as barrier details have not been provided by the CMS. Where barriers are to be installed around works sites, provided they are formed of a material with sufficient surface mass (i.e. >10kg/m2), are contiguous (with no gaps) and are situated such that they break the acoustic line of sight between the construction noise source(s) and the receiver(s), a reduction of the reported levels by up to approximately 10 dB may be expected.

Receiver	Sleep Disturbance Screening Criterion ($L_{A1,1min}$ dBA)	Activity 1 ($L_{A1,1min}$ dBA)	Activity 2 ($L_{A1,1min}$ dBA)	Activity 3 ($L_{A1,1min}$ dBA)	Activity 4 ($L_{A1,1min}$ dBA)	Activity 5 ($L_{A1,1min}$ dBA)	Activity 6 ($L_{A1,1min}$ dBA)
R1	58	80*	60	68	66	70	64
R2	58	80*	58	69	63	65	62
R3	58	80*	58	69	59	60	62
R4	58	80*	57	70	63	58	61
R5	58	80*	57	70	59	58	62
R6	58	80*	57	71	59	58	62
R7	58	80*	58	73	59	57	62
R8	58	80*	66	76	56	59	63
R9	58	80*	70	76	58	59	66
R10	58	80*	70	76	64	61	71
R11	58	80*	70	76	64	63	74
R12	58	80*	70	76	67	67	74
R13	58	80*	70	76	64	67	73
R14	58	80*	64	68	63	69	64
R15	58	80*	64	69	61	69	64
R16	58	80*	64	69	60	68	64
R17	58	80*	63	69	60	68	64
R18	58	80*	63	69	60	67	64
R19	58	80*	63	70	58	65	64
R20	58	80*	63	73	60	64	64
R21	58	80*	63	73	58	64	64
R22	58	80*	66	73	59	64	64
R23	58	80*	69	73	59	64	64
R24	58	80*	69	73	58	64	65
R25	58	80*	69	74	61	63	66
R26	58	80*	68	73	58	64	69
R27	58	80*	68	74	62	65	71
R28	58	80*	68	68	60	66	71
R29	58	80*	68	68	63	66	70
R30	58	80*	64	64	58	62	63
R31	58	80*	64	64	57	62	63
R32	58	80*	64	64	56	62	63
R33	56	80*	70	70	62	72	74
R34	56	80*	73	73	74	77	75
R35	56	80*	73	73	74	78	75
R36	56	80*	74	74	75	79	75
R37	56	80*	74	74	81	84	73
R38	56	80*	71	71	73	83	71
R39	56	80*	70	67	72	80	69

Receiver	Sleep Disturbance Screening Criterion ($L_{A1,1min}$ dBA)	Activity 1 ($L_{A1,1min}$ dBA)	Activity 2 ($L_{A1,1min}$ dBA)	Activity 3 ($L_{A1,1min}$ dBA)	Activity 4 ($L_{A1,1min}$ dBA)	Activity 5 ($L_{A1,1min}$ dBA)	Activity 6 ($L_{A1,1min}$ dBA)
R40	56	80*	68	66	68	76	68
R41	56	80*	66	65	66	73	67
R42	56	80*	65	64	65	71	66
R43	56	80*	65	63	64	70	65
R44	56	80*	64	62	64	68	64
R45	56	80*	63	62	62	67	63
R46	56	80*	62	61	61	66	63
R47	56	80*	61	60	59	64	62
R48	56	80*	67	65	56	69	69
R49	56	80*	67	65	55	70	69
R50	56	80*	67	65	54	70	69
R51	56	80*	67	65	54	70	69
R52	56	80*	67	65	52	71	70
R53	56	80*	68	65	55	71	70
R54	56	80*	68	66	56	71	70
R55	56	80*	68	67	58	72	70
R56	56	80*	68	69	58	72	70
R57	56	80*	69	69	55	73	71
R58	56	80*	69	69	56	73	71
R59	56	80*	69	69	63	74	71
R60	56	80*	69	69	64	74	71
R61	56	80*	70	69	63	75	72
R62	56	80*	70	69	63	76	72
R63	56	80*	70	69	63	77	72
R64	56	80*	70	69	66	77	71
R65	56	80*	71	69	65	78	71
R66	56	80*	70	69	67	79	71
R67	56	80*	71	70	69	81	71
R68	56	80*	70	68	71	80	70
R69	56	80*	69	68	68	79	70
R70	56	80*	69	68	67	78	70
R71	56	80*	69	68	66	77	70
R72	56	80*	68	66	67	75	68
R73	56	80*	68	66	63	75	68
R74	56	80*	68	66	65	74	68
R75	56	80*	68	66	64	74	68
R76	56	80*	66	65	64	73	67
R77	56	80*	66	65	59	72	67
R78	56	80*	66	65	58	72	67

Receiver	Sleep Disturbance Screening Criterion ($L_{A1,1min}$ dBA)	Activity 1 ($L_{A1,1min}$ dBA)	Activity 2 ($L_{A1,1min}$ dBA)	Activity 3 ($L_{A1,1min}$ dBA)	Activity 4 ($L_{A1,1min}$ dBA)	Activity 5 ($L_{A1,1min}$ dBA)	Activity 6 ($L_{A1,1min}$ dBA)
R79	56	80*	66	65	59	71	66
R80	56	80*	65	64	61	70	66
R81	56	80*	65	64	62	70	65
R82	56	80*	65	64	61	70	65
R83	56	80*	64	63	59	68	64
R84	56	80*	64	63	59	68	64
R85	56	80*	64	63	57	68	64
R86	56	80*	64	63	54	68	64
R87	56	80*	63	62	54	67	63
R88	56	80*	63	61	59	66	63
R89	56	80*	63	62	58	66	63
R90	56	80*	63	62	54	66	63
R91	56	80*	62	61	58	66	63
R92	56	80*	62	61	54	65	62
R93	56	80*	62	61	54	65	62
R94	56	80*	62	61	54	65	62
R95	56	80*	61	60	57	64	62
R96	56	80*	61	60	57	64	62
R97	56	80*	61	60	54	64	61
R98	56	80*	61	60	61	64	62
R99	56	80*	61	60	58	65	62
R100	56	80*	61	60	56	65	62
R101	56	80*	62	60	60	65	62
R102	56	80*	62	60	60	65	62
R103	56	80*	63	61	52	67	63
R104	56	80*	63	62	50	67	64
R105	56	80*	64	62	62	68	64
R106	56	80*	64	62	64	68	64
R107	56	80*	64	62	65	68	64
R108	56	80*	64	62	64	69	64
R109	56	80*	65	63	63	70	65
R110	56	80*	65	63	63	71	65
R111	56	80*	66	64	56	71	66
R112	56	80*	66	64	65	72	66
R113	56	80*	66	64	66	72	66
R114	56	80*	66	64	65	71	65
R115	56	80*	64	62	63	69	65
R116	61	80*	67	63	64	69	70
R117	61	80*	68	62	65	69	70

Receiver	Sleep Disturbance Screening Criterion ($L_{A1,1min}$ dBA)	Activity 1 ($L_{A1,1min}$ dBA)	Activity 2 ($L_{A1,1min}$ dBA)	Activity 3 ($L_{A1,1min}$ dBA)	Activity 4 ($L_{A1,1min}$ dBA)	Activity 5 ($L_{A1,1min}$ dBA)	Activity 6 ($L_{A1,1min}$ dBA)
R118	61	80*	68	62	65	69	70
R119	61	80*	68	62	65	69	70
R120	61	80*	69	63	65	71	69
R121	61	80*	69	63	65	70	69

* Note that the predicted $L_{A1,1min}$ levels during Activity 1 assume the receiver is within 15 m of the works. It is expected that these levels are substantially overstated for most receivers. The $L_{A1,1min}$ noise levels should be revaluated during detailed design, once the construction methodology and equipment requirements are more certain.

APPENDIX D

PREDICTED CONSTRUCTION NOISE EXCEEDANCE MAPS

APPENDIX D-1

Predicted Standard Hours NML Exceedances During Activity 2 – General Holmes Widening

Predicted Out-of-Hours NML Exceedances During Activity 2 – General Holmes Widening

APPENDIX D-2

Predicted Standard Hours NML Exceedances During Activity 3 – Joyce Drive Widening

Predicted Out-of-Hours Hours NML Exceedances During Activity 3 – Joyce Drive Widening

APPENDIX D-3

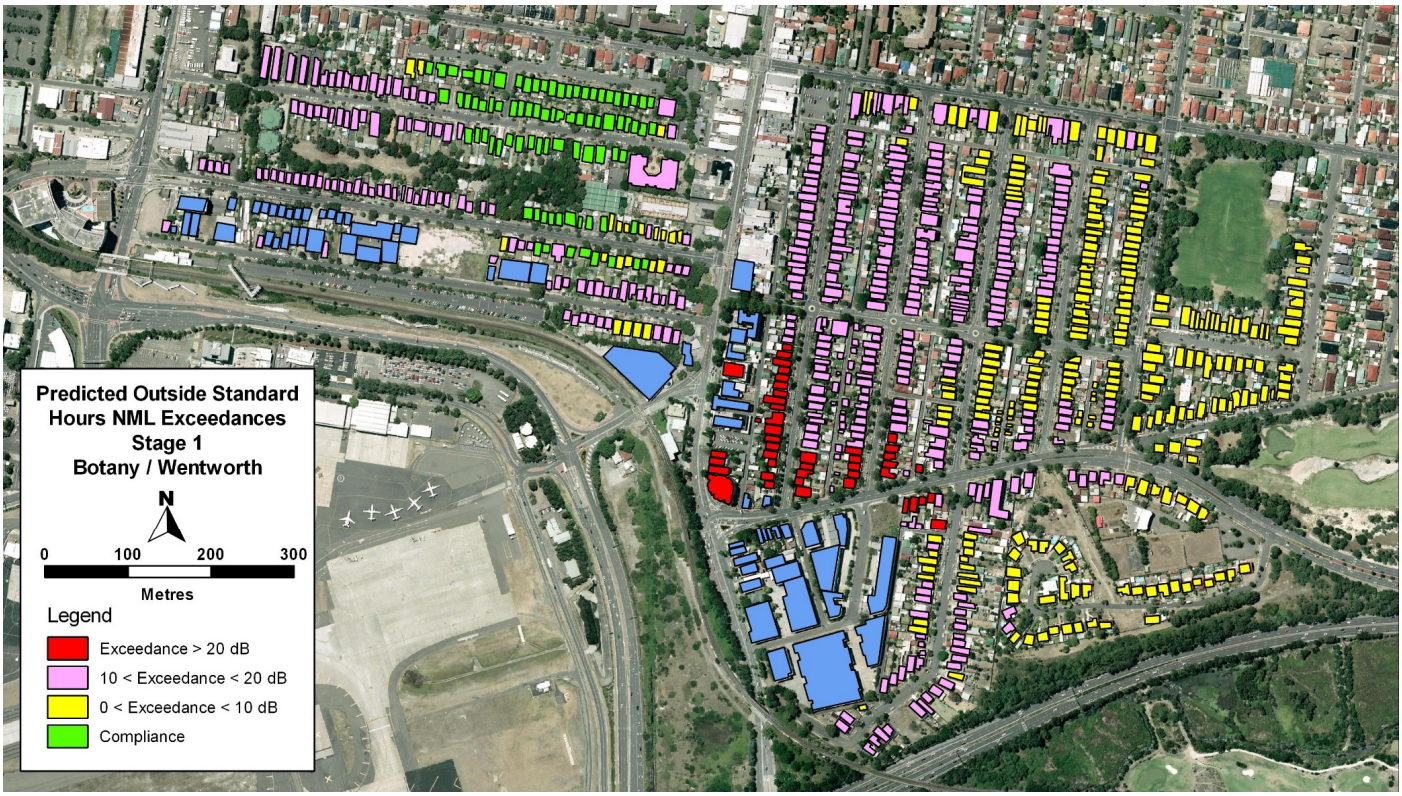
Predicted Standard Hours NML Exceedances During Activity 4 – New Rail Bridges

Predicted Out-of-Hours NML Exceedances During Activity 4 – New Rail Bridges

APPENDIX D-4

Predicted Standard Hours NML Exceedances During Activity 5 – Intersection Upgrade

Predicted Out-of-Hours NML Exceedances During Activity 5 – Intersection Upgrade



APPENDIX D-5

Predicted Standard Hours NML Exceedances During Activity 6 – Finalisation Works

Predicted Out-of-Hours NML Exceedances During Activity 6 – Finalisation Works

Appendix H3: Operational noise impact assessment

ACOUSTICS AND AIR

WESTCONNEX ENABLING WORKS (AIRPORT EAST)

OPERATIONAL NOISE IMPACT STATEMENT

REPORT NO. 14174
VERSION B

JANUARY 2015

PREPARED FOR

ROADS AND MARITIME SERVICES
27 ARGYLE STREET
PARRAMATTA NSW 2150

WILKINSON MURRAY

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
B	Final	6 January 2015	Sean Flaherty	-
A	Final	29 October 2014	Sean Flaherty	John Wassermann
A	Draft	25 August 2014	Sean Flaherty	John Wassermann

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APPENDIX B – Noise Measurement Results

GLOSSARY OF ACOUSTIC TERMS

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 below, 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.

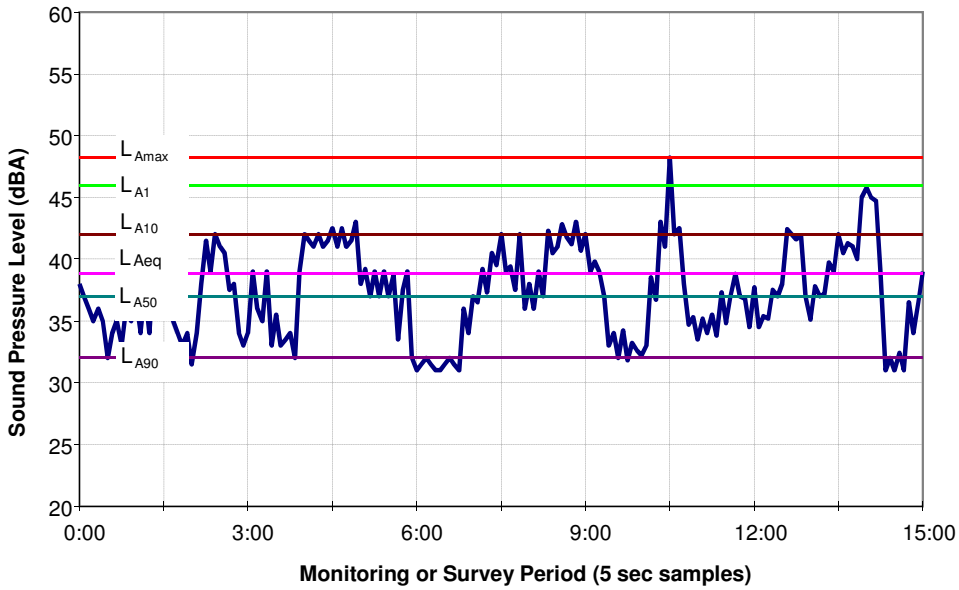
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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.

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.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

Roads and Maritime Services (RMS) is planning to upgrade roads east of Sydney airport and remove the General Holmes Drive rail level crossing. This will improve traffic flow and access to the airport, Port Botany and, in the future, the WestConnex motorway.

On behalf of RMS, Jacobs SKM has undertaken a traffic study for the WestConnex Enabling Works – Airport East Precinct Project (the Project).

Wilkinson Murray has been engaged by RMS to undertake an operational noise assessment for the Project, based on the findings of the traffic study and the road design details provided by RMS.

Potential noise impacts have been assessed in accordance with the requirements of the Professional Services Brief provided by RMS *(Westconnex Enabling works – Airport East, Environmental Assessment Standard Brief, Noise and Vibration Assessment, dated May 2014]* – referred to herein as the *Professional Services Brief*.

Consistent with the requirements of the *Professional Services Brief*, potential noise impacts have been assessed against road traffic noise criteria recommended by the NSW Government's *Road Noise Policy (RNP)* and mitigation requirements have been guided by the *RTA Environmental Noise Management Manual (ENMM)*.

2 PROPOSAL DESCRIPTION

The WestConnex enabling works, airport east precinct is located in Mascot, about eight kilometres south of the Sydney central business district and adjacent to Sydney Airport. It is located within the City of Botany Bay local government area.

The study area includes:

- General Holmes Drive, from just south of Mill Pond Road to the Botany Road intersection;
- Botany Road between Mill Pond Road and King Street;
- Joyce Drive between General Holmes Drive and just east of the O'Riordan Street intersection;
- Wentworth Avenue between Botany Road and Sutherland Street; and
- Mill Pond Road.

A general arrangement plan of the preferred Option (Option 4 7E) is included in Figure 2-1.

The Project Map extracted from the RMS Community Update *WestConnex Enabling Works – Airport East Precinct November 2013* is additionally included below, in Figure 2-2.

The primary objectives of the proposal are to reduce current levels of congestion, improve the flow of road and rail traffic and provide as a minimum, a light vehicle standard rail underpass to replace the General Holmes Drive level crossing.

Figure 2-1 General Arrangement Plan of Option 4 7E (Extracted from Project Construction Method Statement)

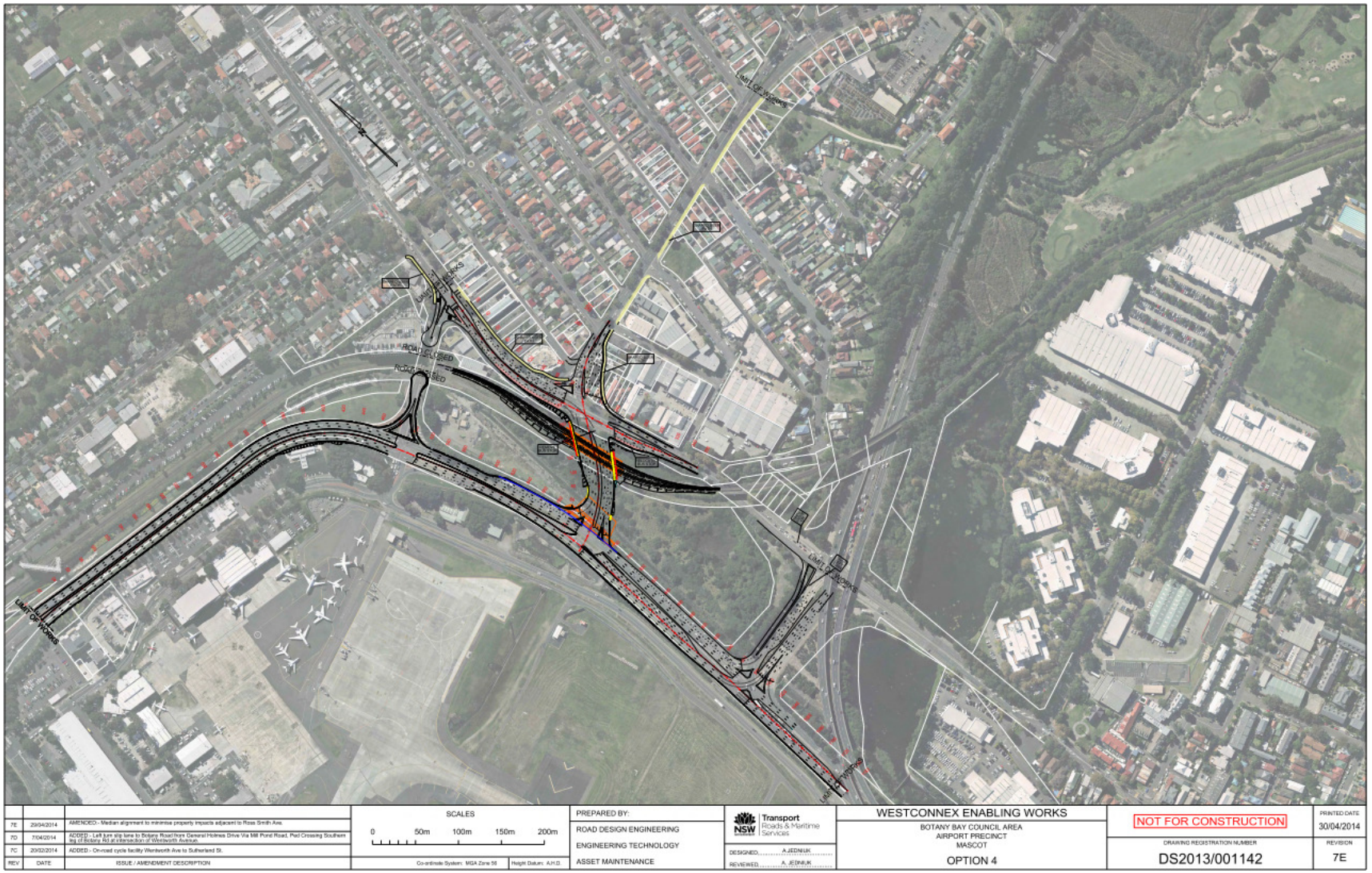
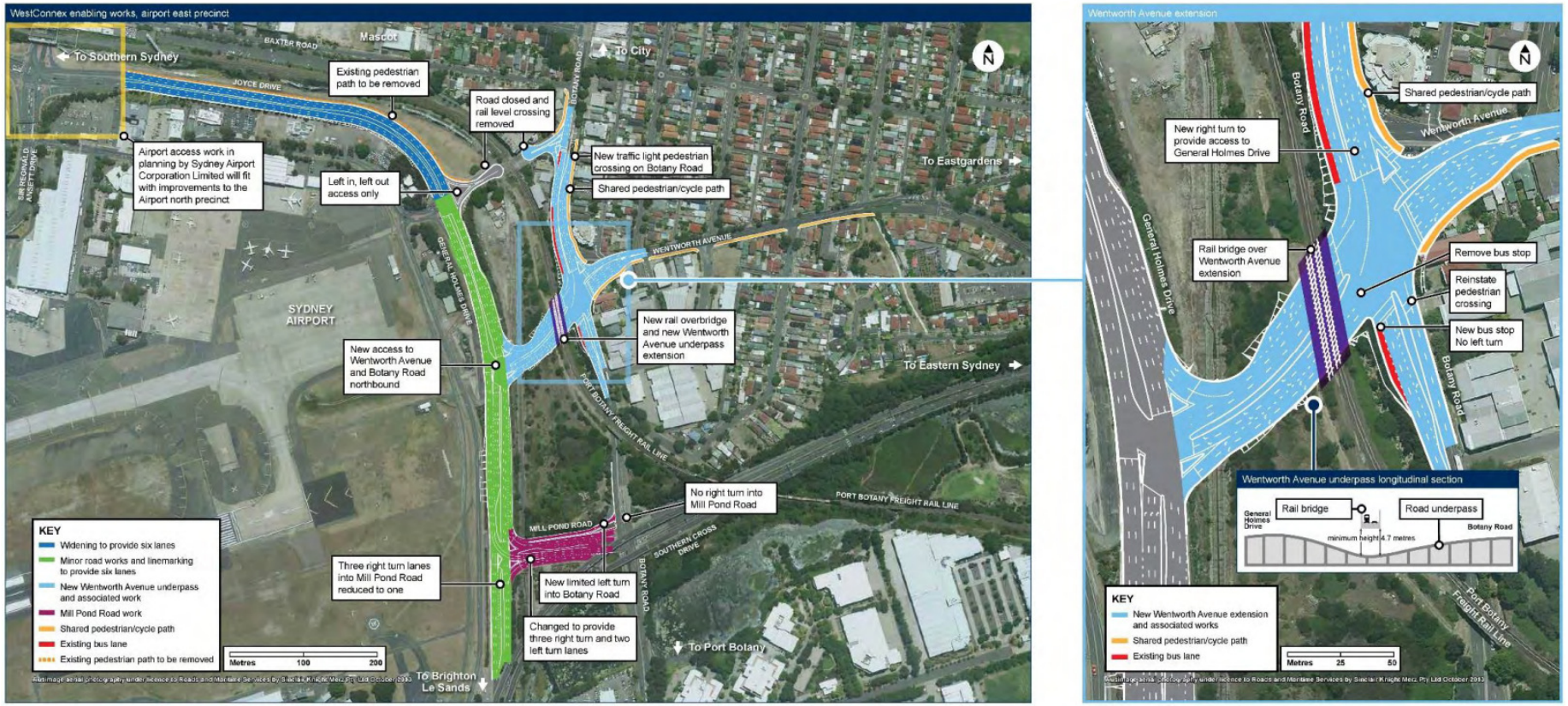


Figure 2-2 Project Map Extracted from RMS Community Update WestConnex Enabling Works – Airport East Precinct November 2013



3 POLICY ADVICE PROVIDED BY RMS ENVIRONMENT BRANCH

Email correspondence with RMS environment section has provided some policy advice relevant to this project only. This is due to the unique set of circumstances which are present for this project. A brief summary of the content is provided below.

"The airport precinct may contain a number of other projects which will be constructed at different times. As the scheduled program of works is not determined the other projects will not be analysed as part of this noise study. i.e. this project will be analysed as stand-alone works. In highly urban situations a boundary width of 600m may include other significant roads with noise levels that dominate receivers. As a guide the boundary width of the study area may be reduced to where noise levels from the project contribute slightly less than half of the total noise level. The boundary should be adjusted to close-by landmarks to provide a logical boundary. This should be determined with liaison with an RMS noise specialist.

The primary driver of the project is to maintain existing network capacity as traffic volumes increase. A new, more realistic traffic modelling approach has been used which analyses the effect over the entire network. If the roads in the network are not upgraded, the result is that vehicles are locked out before they can enter the project area, which implies that volumes will drop. However, broader network capacity constraints are expected to constrain traffic entering the study area. The works proposed as part of the project increase the capacity of the network and hence reduce the apparent drop in vehicle volumes. From this, the assumption is made that the 'no build' option in any future year does not accurately reflect the situation as it will give a heavily reduced noise impact due to the reduction in vehicle volumes.

As the broader network is expected to have reached capacity by 2018, traffic projections to ten years after project opening are considered to be anomalous. This suggests that for comparison purposes the most applicable years of study would be the current year levels and the levels at the completion of construction (2018). Since the future 'no build' options and the ten after project opening 'build', are not valid, they can be discarded from the analysis. Therefore for this assessment, taking account of this more realistic new traffic modelling approach, the community will better understand the impact by comparing the 2013 existing to 2018 build scenario".

4 SUMMARY OF TRAFFIC NOISE CRITERIA

4.1 Relevant Traffic Noise Criteria

Consistent with the requirements of the *Professional Services Brief*, Table 4-1 sets out the applicable road traffic noise base criteria for residential uses recommended by the NSW Environmental Protection Agency (EPA) *Road Noise Policy* (*RNP*, 2011) for new and redeveloped roads. It is noted all criteria relate to façade locations and assessment has been undertaken on this basis.

Table 4-1 Road Traffic Noise Base Criteria for Residential Land Uses

Road Category	Type of Proposal / Land Use	Noise Criteria	
		Day 7am – 10pm	Night Time 10pm - 7am
Freeway / Arterial / Sub-Arterial Roads	Existing Residences affected by noise from new freeway / arterial / sub-arterial road corridors	$L_{Aeq,15\ hour}$ 55 dBA	$L_{Aeq,9\ hour}$ 50 dBA
	Existing Residences affected by noise from redevelopment of existing freeway / arterial / sub-arterial roads	$L_{Aeq,15\ hour}$ 60 dBA	$L_{Aeq,9\ hour}$ 55 dBA

The upgraded roads sections within the study area and the Wentworth Road extension would be regarded as redeveloped roads in the context of the RNP and ENMM and therefore the $L_{Aeq,15\ hour}$ 60 dBA and $L_{Aeq,9\ hour}$ 55 dBA criteria apply.

Additionally, the *ENMM* identifies receivers exposed to traffic noise levels greater than or equal to $L_{Aeq,15\ hour}$ 65 dBA and $L_{Aeq,9\ hour}$ 60 dBA as 'acutely affected'. The *ENMM* identifies the requirement for a detailed assessment of noise mitigation for acutely affected receivers. This is reiterated in the RTA Environmental Direction No. 24 - *Noise Assessment for Acute Levels of Noise – Redevelopment of Existing Roads*, which states:

"*The RTA's policy recognises the increased importance of reducing noise levels where existing or predicted road traffic noise impacts are acute (see ENMM p98). In practice this means that where the design year noise levels for the road project are predicted to be acute (ie 65dB(A) day or 60dB(A) night) then an assessment of mitigation measures should be made to identify whether it is feasible and reasonable to provide noise mitigation in the form of noise barriers, architectural treatment and quieter pavement for noise sensitive receivers*".

An existing church is located in the study area, the relevant criteria that apply to places of worship are set out in Table 4-2. These apply internally.

Table 4-2 Road Traffic Noise Base Criteria for Non-Residential Land Uses

Existing Sensitive Land Use	Noise Criteria	
	Day 7am – 10pm	Night Time 10pm - 7am
Places of Worship	$L_{Aeq,1\ hour}$ 40 dBA (Internal)	$L_{Aeq,1\ hour}$ 40 dBA (Internal)

The RNP does not nominate internal noise levels for commercial premises. It is expected that existing commercial premises within the study area would have been constructed to ensure the relevant internal design levels recommended by *Australian Standard 2107:2000 (Standards Australia 2000)* would be met and therefore commercial premises are not considered any further by this assessment.

A summary of the criteria considered for this assessment is provided in Table 4-3.

Table 4-3 Summary of Relevant Criteria

Land Use	Daytime Noise Criteria $L_{Aeq,15\ hour}$ (7am – 10pm)		Night Time Noise Criteria $L_{Aeq,9\ hour}$ (10pm – 7am)	
	Base Criterion	Acute Criterion	Base Criterion	Acute Criterion
Existing Residences	60 dBA	65 dBA	55 dBA	60 dBA
Church on Botany Road	40 dBA (Internal)	-	40 dBA (Internal)	-

For the purpose of this assessment, with consideration to the points discussed in Section 3, the criteria set out above principally apply to the 2018 design year.

Practice Note (IV) of the *ENMM* provides further discussion of situations where provision of additional traffic noise mitigation would be considered "feasible and reasonable". The practice note states that 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 'existing' noise levels by more than 2 dB; and
- will not be 'acute' (i.e. do not exceed 65 dBA $L_{Aeq,15h}$ and 60 dBA $L_{Aeq,9h}$)

4.2 Guidelines for Assessing Maximum Noise Levels

The potential for sleep disturbance varies between studies, however, it is largely recognised that the maximum noise level of an event, in addition to the number of occurrences and duration of the events, as well as the emergence above background or ambient noise levels are key factors. Not all people are affected to the same degree or by the same noise exposure. Findings from studies of sleep disturbance measured by an awakening, change in sleep state or awakening-effects reflect the considerable variation in the population's response to noise.

In relation to assessing maximum traffic noise levels, Practice Note (III) of the *ENMM* notes the following:

- *Maximum internal noise levels below 50–55 dB(A) are unlikely to cause awakening reactions*
- *One or two noise events per night with maximum internal noise levels of 65–70 dB(A) are not likely to significantly affect health and well-being*
- *At locations where road traffic is continuous rather than intermittent, the Leq(9hr) (night) target noise levels should sufficiently account for sleep disturbance impacts*
- *Where the emergence of Lmax over the ambient Leq is equal to or greater than 15 dB(A), the Leq(9hr) criteria may not sufficiently account for sleep disturbance impacts.*

With consideration to the above, for the purpose of this assessment the following guidelines have been adopted:

- Maximum noise levels external to dwellings should not exceed L_{Amax} 65 dB(A) (i.e. internal levels of L_{Amax} 50-55 considering the 10-15 dB attenuation that is typically achieved through windows partially open for ventilation); and
- Maximum noise levels external to dwellings should not exceed the $L_{Aeq,9Hr}$ (or $L_{Aeq,1Hr}$) noise level by >15 dB.

5 SENSITIVE RECEIVERS

This assessment considers potential traffic noise impacts on a number of existing residential receivers located within the study area. Additionally an existing church located at 1293-1295 Botany Rd has been considered. No material impacts on existing commercial premises would be expected and therefore this assessment has not considered existing commercial receivers.

Table 5-1 provides a summary of the potentially most impacted receivers with the study area. These are shown graphically in Figure 5-1. Further close-in view figures clearly identifying all receivers are additionally provided in Appendix A.

It should be noted that the addresses identified in Table 5-1 have been interpreted from review of *Googlemaps* aerial imagery and *Googlemaps Streetview* and have not been confirmed by ground-truthing. On this basis the identified addresses should be considered approximate only.

A number of properties would need to be acquired to accommodate the Botany Road / Wentworth Avenue intersection and therefore these have not been considered as sensitive to operational traffic noise. These properties would be acquired during the construction phase. They are shown in Figure 5-2 (and highlighted in blue in Figure 5-1).

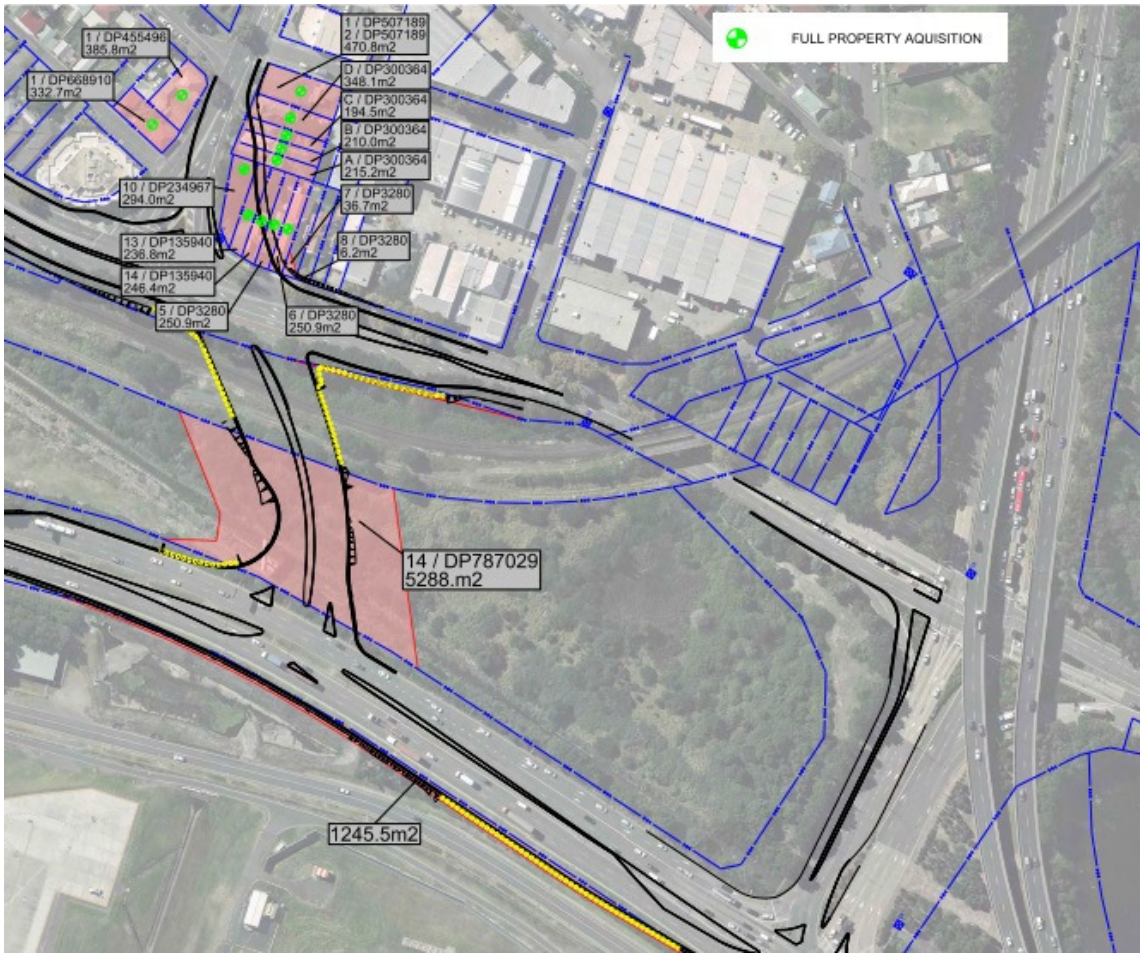
Table 5-1 Sensitive Receivers Considered by this Assessment

ID	Address	ID	Address	ID	Address	ID	Address	ID	Address
R1	2 Baxter Rd	R26	25 Baxter Rd	R51	50 Hardie St	R76	67 Johnson St	R101	62 Wentworth Ave
R2	4 Baxter Rd	R27	29 Baxter Rd	R52	52 Hardie St	R77	65 Johnson St	R102	60 Wentworth Ave
R3	6-8 Baxter Rd	R28	31 Baxter Rd	R53	54 Hardie St	R78	63 Johnson St	R103	56 Wentworth Ave
R4	10-12 Baxter Rd	R29	33 Baxter Rd	R54	56 Hardie St	R79	61 Johnson St	R104	54 Wentworth Ave
R5	14-16 Baxter Rd	R30	93 Baxter Rd	R55	58 Hardie St	R80	78 Alfred St	R105	52 Wentworth Ave
R6	18-20 Baxter Rd	R31	105 Baxter Rd	R56	60 Hardie St	R81	74 Alfred St	R106	50 Wentworth Ave
R7	22-24 Baxter Rd	R32	133 Baxter Rd	R57	62 Hardie St	R82	70 Alfred St	R107	48 Wentworth Ave
R8	26 Baxter Rd	R33	1247 Botany Rd	R58	64 Hardie St	R83	75A Alfred St	R108	46 Wentworth Ave
R9	28 Baxter Rd	R34	1273 Botany Rd	R59	66 Hardie St	R84	75 Alfred St	R109	44 Wentworth Ave
R10	30 Baxter Rd	R35	1275 Botany Rd	R60	68 Hardie St	R85	73 Alfred St	R110	42 Wentworth Ave
R11	32 Baxter Rd	R36	1277 Botany Rd	R61	70 Hardie St	R86	71 Alfred St	R111	40 Wentworth Ave
R12	34 Baxter Rd	R37	1285 Botany Rd	R62	72 Hardie St	R87	69 Frogmore St	R112	38 Wentworth Ave
R13	36 Baxter Rd	R38	86 Hardie St	R63	74 Hardie St	R88	67 Frogmore St	R113	36 Wentworth Ave
R14	1 Baxter Rd	R39	87 Hardie St	R64	76 Hardie St	R89	65 Frogmore St	R114	44B Wentworth Ave
R15	3 Baxter Rd	R40	90 Johnson St	R65	80 Hardie St	R90	63 Frogmore St	R115	1 McBurney Ave
R16	5 Baxter Rd	R41	69 Johnson St	R66	82 Hardie St	R91	64 Frogmore St	R116	57 McBurney Ave
R17	7 Baxter Rd	R42	5 Johnson Ln	R67	84 Hardie St	R92	62 Frogmore St	R117	59 McBurney Ave
R18	9 Baxter Rd	R43	80 Alfred St	R68	85 Hardie St	R93	60 Frogmore St	R118	61 McBurney Ave
R19	11 Baxter Rd	R44	77 Alfred St	R69	85 Hardie St	R94	58 Frogmore St	R119	63 McBurney Ave
R20	13 Baxter Rd	R45	71 Frogmore St	R70	83 Hardie St	R95	182 Sutherland St	R120	40 McBurney Ave
R21	15 Baxter Rd	R46	66 Frogmore St	R71	81 Hardie St	R96	180 Sutherland St	R121	42 McBurney Ave
R22	17 Baxter Rd	R47	184 Sutherland St	R72	88 Johnson St	R97	178 Sutherland St	Church	1293-1295 Botany Road
R23	19 Baxter Rd	R48	44 Hardie St	R73	86 Johnson St	R98	68 Wentworth Ave		
R24	21 Baxter Rd	R49	46 Hardie St	R74	84 Johnson St	R99	66 Wentworth Ave		
R25	23 Baxter Rd	R50	48 Hardie St	R75	82 Johnson St	R100	64 Wentworth Ave		

Note: The addresses identified have been interpreted from review of *Googlemaps* aerial imagery and *Googlemaps Streetview* and have not been confirmed by ground-truthing. The identified addresses should be consider approximate only

Figure 5-1 Sensitive Receivers Considered by this Assessment

Figure 5-2 Properties Identified for Acquisition



6 EXISTING NOISE ENVIRONMENT

In accordance with the requirements of the brief, WM has undertaken noise monitoring within the project study area to broadly characterise the existing noise environment and to verify the traffic noise model (as discussed in Section 7).

Monitoring locations were selected at 54 Wentworth Avenue and 36 Baxter Road. The data collected at Baxter Road was, however, subsequently found to be highly contaminated by extraneous non-traffic noise sources including frequent aircraft and rail movements (and other unidentifiable sources). Despite efforts to filter the data at this location to remove the influence from these sources, the monitoring data was found to be unusable for validation purposes.

The monitoring at 54 Wentworth Avenue was conducted between 18 and 25 June 2014, whilst fully classified traffic count data were collected concurrently. Figure 6-1 identifies the unattended noise monitoring location.

Figure 6-1 Noise Monitoring Location – 54 Wentworth Avenue

Note: Traffic counting undertaken nearby on Wentworth Avenue between Alfred Street and Frogmore Street - Counters were installed far enough away from the noise monitoring location to ensure the noise of vehicles passing over counter tubes did not influence the measured noise levels.

The logger was located at 1 m from the residential façade and placed in a position with more than 140 degrees view of the road.

Observations made during the site survey confirmed the primary noise source at the monitoring location was road traffic on Wentworth Avenue. The noise monitoring data has been screened to remove the influence of non-road traffic sources to the best practicable extent, as discussed in Section 6.2.

6.1 Noise Monitoring Equipment

An ARL-Ngara environmental noise logger was used in the survey. This was set to A-weighted, fast response and set to continuously monitoring each 15-minute period. These instruments are capable of monitoring and storing various noise level descriptors for later detailed analysis. The loggers determine 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 per cent, 10 per cent and 90 per cent of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional passby 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. While 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 in NSW.

6.2 Noise Monitoring Results

All data considered to be affected by adverse weather conditions (i.e. wind speed > 5m/s or rain affected) were excluded from the results. Data concurrently collected from the Sydney Airport weather station was reviewed for this purpose. Additionally the data was reviewed to exclude the influence of non-road traffic sources (principally aircraft movements). These sources are not always clearly identifiable, however, discrete 15 minute measurements for which the L_{Aeq} level is significantly higher than the L_{A10} level, with an unusually high maximum level are unlikely to be controlled by 'normal' traffic noise. These measurements have therefore been excluded from the statistical analysis of the data. The noise results are presented in graphical form in Appendix B and summarised below in Table 6-1.

Table 6-1 Summary of Measured Noise Levels (18-25 June 2014)

Site	Approx. Setback Distance to the Nearside Carriageway (metres)	Daytime $L_{Aeq,15hr}$ (dBA)	Night Time $L_{Aeq,9hr}$ (dBA)	Rating Background Level (RBL) (dBA)		
				Day	Evening	Night
R104 (54 Wentworth Ave)	7	71	66	58	50	41

7 ROAD TRAFFIC NOISE MODELLING

7.1 Methodology of Assessing Traffic Noise Impact

In accordance with the *Professional Services Brief* detailed noise calculations have been carried out for the 'no-build' (2013) and 'build' (2018) scenarios. All calculations and modelling are based on forecast traffic volumes provided by RMS. The following factors have been considered during the assessment process:

- Traffic volume and percentage of heavy vehicles for daytime and night time;
- Vehicle speeds based on posted speed limits;
- Road surface types;
- Road gradient;
- Different vehicle noise emission levels and source heights;
- Location of the noise sources on the road network;
- Topographical information along and surrounding the entire project corridor;
- Shielding from landforms and buildings;
- Land use (types of noise sensitive receivers) surrounding the project; and
- Receiver locations.

A review of the study area has identified that for the most part residential boundary fencing appeared to lack substantial noise control efficacy, with consideration to fencing heights and contiguousness, available line of sight to the nearby roads and general state of repair. On this basis, any shielding effects from residential boundary fencing has been disregarded for the purpose of this assessment. It would be anticipated that local screening effects are considered further during detailed design.

7.2 Noise Modelling Procedures

Noise levels from the proposed road designs were calculated using procedures based on the *CoRTN (Calculation of Road Traffic Noise)* (UK Department of Transport, 1988) prediction algorithms. The standard prediction procedures were modified in the following ways, in accordance with the *Professional Services Brief*:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the *CoRTN* algorithms using the well-validated approximation $L_{Aeq,1hour} = L_{A10,1hr} - 3$ (NSW RTA, 2001). It is worth noting the predicted $L_{Aeq,1hr}$ is equivalent to the $L_{Aeq,period}$ as required by the noise criteria since the input is the "average" traffic flow over the given daytime and night time periods
- Noise source heights were set at 0.5 m for cars, 1.5 m for heavy vehicle engines and 3.6 m for heavy vehicle exhausts, representative of typical values for Australian vehicles (*Road Traffic Noise: Interim Traffic Noise Policy*, 1992)
- Noise from heavy vehicle exhausts have been set 8 dB lower than the (steady continuous) noise from the engine

- Previous research in Australia has established a negative correction to the *CoRTN* predictions of -1.7 dB for façade-corrected levels (Samuels and Saunders, 1982). Corrections for Australian conditions have been included in noise modelling for this project
- Dense grade asphalt road surface has been applied throughout the model and relevant surface correction applied to all light and heavy vehicle sources in the 3 source height model

The model was implemented using the Cadna-A environmental noise prediction software (Version 6.4), based on the alignment data supplied by RMS on 14 July 2014 and projected vehicle volumes provided by RMS on 14 August 2014.

Table 7-1 summarises other variables used in the noise model.

Table 7-1 Variables Used for Noise Modelling

Parameter	Comment
Traffic Speed	For the existing road: Weighted average (validation) and 85th percentile data (supplied by Austraffic); For the upgraded road: Posted speed limits (i.e. 60 km/h on Botany Road, Mill Pond Road and Wentworth Avenue and 70 km/h on General Holmes Drive and Joyce Drive).
Road Surface	0 dB correction for dense grade asphalt (DGA).
Façade Correction	+2.5 dB in accordance with *CoRTN; and* -1.7 dB for ARRB's Australian condition correction at 1 m from façade conditions and -0.7 dB for free-field conditions.
Traffic Volume	Traffic counting data provided by Austraffic for the existing road (model validation); and Volume predictions provided by RMS for the upgraded road.
Calculation Settings	Grid space of 20 m; height above ground = 1.5 m; grid interpretation field size = 9 x 9; grid interpretation min/max = 2 dB; grid interpretation difference = 0.1 dB; angle increment = 1 degree; reflection depth = 0; number of reflections = 0; and maximal search radius = 7000 m.
Receivers	1.5 m above existing ground level for single and storey premises; and 1.5 m above existing ground level (plus 3 m for each additional storey) for multiple storey premises.
Buildings	4.5 m and 6 m above maximum terrain height of building footprint for single and double storey premises respectively.
Ground Absorption	Percentage of absorbent ground cover was set to 60 per cent throughout the study area.

7.3 Modelling Scenarios

The following scenarios were modelled under both daytime and night time conditions.

- Existing Network Validation – Current noise levels were calculated based on traffic counts obtained during the traffic survey undertaken concurrently with noise monitoring (supplied by Austraffic). This was used to validate the noise model by comparing predicted levels with those measured at the corresponding noise logger location
- Year of Opening (2013) 'No Build Option' – Noise levels were predicted based on forecast traffic counts that would be expected to occur due to general traffic growth assuming the project does not proceed (supplied by RMS)
- Design Year (2018) 'Build Option' – Noise levels were predicted based on forecast traffic counts (supplied by RMS). Results are compared with existing results and baseline criteria

7.4 Traffic Data

Traffic inputs were provided by Austraffic (for validation model) and RMS (for the 2013 and 2018 models).

Traffic volumes and 85th percentile speeds based on the fully classified traffic counting data collected concurrently with the noise measurements are shown in Table 7-2 below.

Table 7-2 Existing Traffic - Daily Average Counts between 18-25 June 2014

Location	Direction	Day (7am to 10pm)		Night (10pm to 7am)		85th Percentile Speed	
		Light	Heavy	Light	Heavy	Day	Night
Wentworth Avenue (Between Alfred Street and Frogmore Street)	Eastbound	12060	840	1623	142	59	65
	Westbound	11207	754	1422	95	62	66

This traffic count data is discussed in Section 7.5, which addresses calibration of the noise model.

The traffic volumes provided by RMS for the existing (2013, "No Build") and future (2018, "Build") scenarios are summarised below in Table 7-3 and Table 7-4.

Table 7-3 Predicted Traffic Volumes – No Build Option Year 2013

Year 2016	Direction	Day, 15hr		Night, 9hr	
		Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Main Carriageways					
General Holmes Drive – Between	NB/EB	15829	1525	3143	303
Mill Pond Rd and Southern Cross Dr	SB/WB	19370	1714	2624	232
Botany Road – Between Mill Pond	NB/EB	10196	859	939	79
Rd and Lord St	SB/WB	10537	871	1723	142
Southern Cross Drive – Off Ramp to	NB/EB	-	-	-	-
Mill Pond Rd	SB/WB	14248	394	4178	116
General Holmes Drive – Between	NB/EB	19922	1455	5099	372
Joyce Dr and Mill Pond Rd	SB/WB	22920	1512	3116	205
Botany Road – Between Wentworth	NB/EB	14099	974	1956	135
Ave and Southern Cross Dr	SB/WB	12428	934	1621	122
Wentworth Avenue – Between	NB/EB	10285	578	1507	85
Botany Rd and Sutherland St	SB/WB	10884	841	1421	110
Botany Road – Between General	NB/EB	10052	1242	1470	182
Holmes Dr and Wentworth Ave	SB/WB	10076	1136	1541	174
General Holmes Drive – Between	NB/EB	3687	218	675	40
Joyce Dr and Botany Rd	SB/WB	5809	455	944	74
Botany Road – Between Robey St	NB/EB	12973	1328	1800	184
and General Holmes Dr	SB/WB	13266	1301	1942	191
Joyce Drive – Between O'Riordan St	NB/EB	16154	1162	2335	168
and General Holmes Dr	SB/WB	15161	1382	3336	304
Mill Pond Road – Between Botany	NB/EB	22632	923	3357	137
Rd and General Holmes Dr	SB/WB	21816	900	4657	192

Table 7-4 Predicted traffic volumes – Build Option Year 2018

Year 2016	Direction	Day, 15hr		Night, 9hr	
		Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Main Carriageways					
General Holmes Drive – Between	NB/EB	11907	1147	2491	240
Mill Pond Rd and Southern Cross Dr	SB/WB	16776	1485	2353	208
Botany Road – Between Mill Pond	NB/EB	10490	883	1135	96
Rd and Lord St	SB/WB	9074	750	1371	113
Southern Cross Drive – Off Ramp to	NB/EB	-	-	-	-
Mill Pond Rd	SB/WB	12936	358	13294	4195
General Holmes Drive – Between	NB/EB	23550	1720	5750	420
Joyce Dr and Mill Pond Rd	SB/WB	25200	1657	2740	180
Botany Road – Between Wentworth	NB/EB	8317	574	917	63
Ave and Southern Cross Dr	SB/WB	8979	675	812	61
Wentworth Avenue – Between	NB/EB	12211	686	1320	74
Botany Rd and Sutherland St	SB/WB	11939	923	1147	89
Botany Road – Between General	NB/EB	12804	1582	1934	239
Holmes Dr and Wentworth Ave	SB/WB	13104	1477	1682	190
General Holmes Drive – Between	NB/EB	-	-	-	-
Joyce Dr and Botany Rd	SB/WB	-	-	-	-
Botany Road – Between Robey St	NB/EB	12852	1316	1936	198
and General Holmes Dr	SB/WB	14664	1439	1886	185
Joyce Drive – Between O'Riordan St	NB/EB	19441	1399	2579	186
and General Holmes Dr	SB/WB	17883	1630	4403	401
Mill Pond Road – Between Botany	NB/EB	31806	1297	2857	116
Rd and General Holmes Dr	SB/WB	30387	1254	5521	228
Wentworth Avenue Extension					
Wentworth Avenue Extension	NB/EB	15504	866	2067	116
	SB/WB	15737	1216	1806	140

7.5 Noise Model Validation & Calibration Adjustments

To provide validation of the noise model to be used for the 2013 and 2018 scenarios, a model for the existing road was prepared based on the traffic counts and average weighted vehicle speeds recorded by Austraffic. As discussed in Section 7.4, the counts were undertaken contemporaneously with the noise monitoring between 18-25 June 2014.

Measured results are compared with model predictions at the identified noise monitoring location in Table 7-5.

Table 7-5 Predicted and Measured Results (Unattended Monitoring)

Location	Daytime $L_{Aeq,15hr}$			Night Time $L_{Aeq,9hr}$		
	Measured	Predicted	Difference	Measured	Predicted	Difference
R104	71.0	70.0	-1.0	65.7	64.0	-1.7

As shown in Table 7-5, the measured and predicted levels are within 2 dB for both the daytime and night time. Agreement to within 2 dB is generally considered acceptable given the expected accuracy of standard noise modelling procedures, and also variability in traffic speeds and road surface across the routes. On this basis, the model is considered to predict traffic noise to within an acceptable degree of accuracy and therefore no calibration adjustments have been applied to the 2013 and 2018 models.

8 OPERATIONAL NOISE ASSESSMENT

8.1 Traffic Noise Modelling Results (free flowing traffic)

Based on the modelling procedures described in Section 7, daytime and night time traffic noise levels for the year 2013 and design year 2018 have been predicted at the identified receiver locations. The predicted levels are set out in Table 8-1.

As shown in Table 8-1, typically only marginal changes in traffic noise levels are predicted between 2013 and 2018. This is principally attributed to the relatively minor changes in anticipated vehicle volumes between these years (as shown in Tables 7-3 and 7-4) coupled with the fact that the network re-alignment would not be in the very close vicinity of most of the receivers considered.

8.2 Existing Exceedances of Residential Criteria

The noise modelling results indicate that the RNP base criteria are already exceeded at the receivers facing Botany Road and Wentworth Avenue during the daytime and night. The existing traffic noise levels at these receivers are also acute in most cases.

The highest existing traffic noise levels of up to 72-73 dBA (day) and 66-67 dBA (night) are predicted at receivers R33-R37 on Botany Road. These comprise exceedances of the base criteria of up to 13 dB during the day and 12 dB at night.

Existing traffic noise levels of up to 70-72 dBA (day) and 64-65 dBA (night) are typically predicted at receivers with facades facing Wentworth Avenue (R39-R47 and R98-R113). These comprise exceedances of the base criteria of up to 12 dB during the day and 10 dB at night.

With respect to existing traffic noise levels at the receivers on Baxter Road, exceedance of the base criteria are indicated at only the most exposed receivers (R1, R9, R12, R13 and R14) and none of these exceedances are acute.

Additionally, no exceedances have been predicted at the receivers on McBurney Avenue. It should be noted, however, that the model has not included Southern Cross Drive and therefore the noise contribution from this road has not been accounted for.

A total of up to 36 residential receivers are predicted to be acutely affected (R33-R47, R68, R72, R80, R83, R87 and R98-R113). Most of these are acutely affected during both the daytime and night, apart from R68, R72 and R80 which are only acutely affected during the day.

Upon commencement of the project the noted exceedances would remain relatively unchanged for most receivers.

In terms of the relative change in traffic noise levels, the predicted differences between the "build" and "no-build" scenarios are no more than 2 dB (and typically no more than 1 dB) at all but two receivers. On this basis there would be expected to be no perceptible difference in traffic noise levels for the large majority of receivers. The exceptions to this are discussed in the following Sections.

8.3 Change in Residential Traffic Noise Levels due to the Project

Differences of marginally more than 2 dB may be expected to arise at R38 and R67, due to the

removal of the acquired properties on the northern side of Wentworth Avenue. It should be noted, however, that no account has been made for any boundary screening which may be provided to these properties. This should be considered during detailed design.

8.4 Traffic Noise Levels at Church on Botany Road

Appreciable noise levels also already occur at the Church on Botany Road. External noise levels of 69 dBA during the day and 63 dBA at night are predicted to currently arise at the Church's external façade. Upon commencement of the project these levels may be expected to increase by approximately 2 dB during the daytime and by a lesser margin at night, principally due to the removal of the acquired properties on the southern side of Wentworth Avenue.

Whilst external noise levels may be expected to increase, it is considered that due to the Church's substantial brick and tile construction that the $L_{Aeq,1hour}$ 40 dBA internal noise criterion would be maintained during the operation of the Project, whilst the church doors are closed. This may require mechanical ventilation to be installed to provide fresh air while the windows and doors are kept closed. This would also be considered during detailed design.

Table 8-1 Year 2013 "No Build" and Year 2018 "Build" Predicted $L_{Aeq,Period}$ Traffic Noise Levels

Receiver ID	$L_{Aeq,Period}$ (dBA) Year 2013 'No Build'		$L_{Aeq,Period}$ (dBA) Year 2018 'Build'		RNP Base Assessment Criteria		RNP Base Criteria Exceeded? (2018 Build)		Change in Noise Levels - 2018 Build cf 2013 No Build		RNP Acute Criteria Exceeded? (2018 Build)		Consider Mitigation?
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
R01	63	57	63	57	60	55	**Yes**	**Yes**	-0.3	-0.4	No	No	No
R02	61	54	59	53	60	55	No	No	-1.1	-1.1	No	No	No
R03	58	52	57	50	60	55	No	No	-1.3	-1.4	No	No	No
R04	57	51	57	51	60	55	No	No	-0.3	-0.1	No	No	No
R05	57	51	57	51	60	55	No	No	-0.2	-0.1	No	No	No
R06	57	52	57	52	60	55	No	No	0.0	0.2	No	No	No
R07	58	53	58	53	60	55	No	No	0.0	0.2	No	No	No
R08	59	54	59	54	60	55	No	No	-0.2	-0.1	No	No	No
R09	60	55	60	55	60	55	**Yes**	**Yes**	0.2	0.3	No	No	No
R10	59	54	60	55	60	55	No	No	0.4	0.4	No	No	No
R11	59	54	59	54	60	55	No	No	0.1	0.1	No	No	No
R12	61	56	61	56	60	55	**Yes**	**Yes**	0.2	0.3	No	No	No
R13	61	56	61	56	60	55	**Yes**	**Yes**	0.2	0.2	No	No	No
R14	64	58	64	58	60	55	**Yes**	**Yes**	0.2	0.2	No	No	No
R15	60	54	59	52	60	55	No	No	-1.1	-1.1	No	No	No
R16	58	52	58	52	60	55	No	No	0.1	0.1	No	No	No

Receiver ID	$L_{Aeq,Period}$ (dBA) Year 2013 'No Build'		$L_{Aeq,Period}$ (dBA) Year 2018 'Build'		RNP Base Assessment Criteria		RNP Base Criteria Exceeded? (2018 Build)		Change in Noise Levels - 2018 Build cf 2013 No Build		RNP Acute Criteria Exceeded? (2018 Build)		Consider Mitigation?
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
R17	57	51	57	51	60	55	No	No	0.0	0.0	No	No	No
R18	56	51	56	50	60	55	No	No	-0.4	-0.4	No	No	No
R19	56	50	56	50	60	55	No	No	0.1	0.1	No	No	No
R20	55	49	55	49	60	55	No	No	0.1	0.1	No	No	No
R21	56	50	56	50	60	55	No	No	0.3	0.3	No	No	No
R22	56	50	56	50	60	55	No	No	0.0	0.1	No	No	No
R23	56	51	56	51	60	55	No	No	-0.1	0.0	No	No	No
R24	56	51	57	51	60	55	No	No	0.2	0.3	No	No	No
R25	57	52	57	52	60	55	No	No	0.2	0.3	No	No	No
R26	57	52	57	52	60	55	No	No	0.0	0.1	No	No	No
R27	57	52	57	52	60	55	No	No	0.1	0.1	No	No	No
R28	60	55	60	55	60	55	No	No	-0.1	0.0	No	No	No
R29	60	55	61	56	60	55	**Yes**	**Yes**	0.4	0.4	No	No	No
R30	60	55	60	55	60	55	No	No	0.3	0.3	No	No	No
R31	60	55	60	55	60	55	**Yes**	**Yes**	0.3	0.5	No	No	No
R32	57	52	57	52	60	55	No	No	0.0	0.1	No	No	No
R33	73	66	73	66	60	55	**Yes**	**Yes**	0.2	-0.1	**Yes**	**Yes**	**Yes**
R34	72	66	73	66	60	55	**Yes**	**Yes**	1.2	0.7	**Yes**	**Yes**	**Yes**
R35	73	67	74	67	60	55	**Yes**	**Yes**	1.1	0.5	**Yes**	**Yes**	**Yes**

Receiver ID	$L_{Aeq,Period}$ (dBA) Year 2013 'No Build'		$L_{Aeq,Period}$ (dBA) Year 2018 'Build'		RNP Base Assessment Criteria		RNP Base Criteria Exceeded? (2018 Build)		Change in Noise Levels - 2018 Build cf 2013 No Build		RNP Acute Criteria Exceeded? (2018 Build)		Consider Mitigation?
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
R36	73	67	74	67	60	55	**Yes**	**Yes**	1.2	0.6	**Yes**	**Yes**	**Yes**
R37	73	67	74	67	60	55	**Yes**	**Yes**	1.2	0.7	**Yes**	**Yes**	**Yes**
R38	64	58	67	60	60	55	**Yes**	**Yes**	**2.4**	1.4	**Yes**	**Yes**	**Yes**
R39	71	65	72	64	60	55	**Yes**	**Yes**	0.4	-0.8	**Yes**	**Yes**	**Yes**
R40	71	65	72	64	60	55	**Yes**	**Yes**	0.6	-0.7	**Yes**	**Yes**	**Yes**
R41	71	64	71	63	60	55	**Yes**	**Yes**	0.1	-1.2	**Yes**	**Yes**	**Yes**
R42	71	65	71	63	60	55	**Yes**	**Yes**	0.1	-1.2	**Yes**	**Yes**	**Yes**
R43	71	65	72	64	60	55	**Yes**	**Yes**	0.4	-0.9	**Yes**	**Yes**	**Yes**
R44	71	64	71	64	60	55	**Yes**	**Yes**	0.3	-0.9	**Yes**	**Yes**	**Yes**
R45	71	65	72	64	60	55	**Yes**	**Yes**	0.2	-1.1	**Yes**	**Yes**	**Yes**
R46	71	65	72	64	60	55	**Yes**	**Yes**	0.6	-0.7	**Yes**	**Yes**	**Yes**
R47	67	61	67	60	60	55	**Yes**	**Yes**	0.4	-0.9	**Yes**	**Yes**	**Yes**
R48	54	48	54	48	60	55	No	No	-0.1	-0.1	No	No	No
R49	54	48	53	47	60	55	No	No	-0.9	-0.9	No	No	No
R50	52	46	52	46	60	55	No	No	-0.1	-0.2	No	No	No
R51	52	46	52	46	60	55	No	No	-0.1	-0.2	No	No	No
R52	52	47	52	46	60	55	No	No	-0.4	-0.5	No	No	No
R52	53	47	53	47	60	55	No	No	-0.3	-0.4	No	No	No
R54	54	48	54	47	60	55	No	No	0.0	-0.2	No	No	No

Receiver ID	$L_{Aeq,Period}$ (dBA) Year 2013 'No Build'		$L_{Aeq,Period}$ (dBA) Year 2018 'Build'		RNP Base Assessment Criteria		RNP Base Criteria Exceeded? (2018 Build)		Change in Noise Levels - 2018 Build cf 2013 No Build		RNP Acute Criteria Exceeded? (2018 Build)		Consider Mitigation?
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
R55	53	47	53	47	60	55	No	No	-0.1	-0.1	No	No	No
R56	53	47	53	47	60	55	No	No	-0.1	-0.3	No	No	No
R57	53	47	53	46	60	55	No	No	-0.4	-0.7	No	No	No
R58	53	47	52	46	60	55	No	No	-0.6	-0.7	No	No	No
R59	54	48	54	47	60	55	No	No	-0.2	-0.6	No	No	No
R60	54	48	53	47	60	55	No	No	-0.3	-0.5	No	No	No
R61	55	49	55	49	60	55	No	No	-0.3	-0.6	No	No	No
R62	56	50	55	49	60	55	No	No	-1.1	-1.3	No	No	No
R63	55	49	54	48	60	55	No	No	-1.1	-1.3	No	No	No
R64	56	50	55	49	60	55	No	No	-1.0	-1.3	No	No	No
R65	57	51	55	49	60	55	No	No	-1.7	-1.8	No	No	No
R66	57	51	57	49	60	55	No	No	-0.5	-1.5	No	No	No
R67	61	55	63	56	60	55	**Yes**	**Yes**	**2.1**	1.3	No	No	**Yes**
R68	63	57	65	58	60	55	**Yes**	**Yes**	1.4	0.4	**Yes**	No	**Yes**
R69	61	55	63	56	60	55	**Yes**	**Yes**	1.9	1.1	No	No	No
R70	56	50	57	51	60	55	No	No	1.2	0.6	No	No	No
R71	59	53	61	55	60	55	**Yes**	No	1.9	1.2	No	No	No
R72	65	59	65	57	60	55	**Yes**	**Yes**	-0.6	-1.8	**Yes**	No	**Yes**
R73	62	56	61	54	60	55	**Yes**	No	-0.7	-2.0	No	No	No

Receiver ID	$L_{Aeq,Period}$ (dBA) Year 2013 'No Build'		$L_{Aeq,Period}$ (dBA) Year 2018 'Build'		RNP Base Assessment Criteria		RNP Base Criteria Exceeded? (2018 Build)		Change in Noise Levels - 2018 Build cf 2013 No Build		RNP Acute Criteria Exceeded? (2018 Build)		Consider Mitigation?
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
R74	60	53	59	51	60	55	No	No	-0.8	-2.0	No	No	No
R75	57	51	57	49	60	55	No	No	-0.5	-1.7	No	No	No
R76	64	57	63	56	60	55	**Yes**	**Yes**	-0.3	-1.4	No	No	No
R77	60	54	60	53	60	55	No	No	-0.1	-1.1	No	No	No
R78	56	50	56	49	60	55	No	No	-0.1	-1.0	No	No	No
R79	55	49	55	48	60	55	No	No	-0.2	-0.9	No	No	No
R80	66	60	66	58	60	55	**Yes**	**Yes**	0.3	-1.1	**Yes**	No	**Yes**
R81	63	57	63	55	60	55	**Yes**	**Yes**	-0.4	-1.6	No	No	No
R82	59	52	58	50	60	55	No	No	-0.5	-1.8	No	No	No
R83	68	61	68	60	60	55	**Yes**	**Yes**	0.0	-1.2	**Yes**	**Yes**	**Yes**
R84	61	54	61	53	60	55	**Yes**	No	-0.1	-1.3	No	No	No
R85	60	53	60	52	60	55	No	No	-0.2	-1.3	No	No	No
R86	58	52	57	49	60	55	No	No	-0.9	-2.1	No	No	No
R87	67	61	67	60	60	55	**Yes**	**Yes**	-0.2	-1.4	**Yes**	**Yes**	**Yes**
R88	61	55	61	53	60	55	**Yes**	No	0.0	-1.3	No	No	No
R89	60	53	60	52	60	55	No	No	0.2	-1.1	No	No	No
R90	57	51	57	49	60	55	No	No	-0.3	-1.5	No	No	No
R91	61	54	61	53	60	55	**Yes**	**Yes**	-0.1	-1.4	No	No	No
R92	62	56	59	52	60	55	**Yes**	No	0.1	-1.2	No	No	No

Receiver ID	$L_{Aeq,Period}$ (dBA) Year 2013 'No Build'		$L_{Aeq,Period}$ (dBA) Year 2018 'Build'		RNP Base Assessment Criteria		RNP Base Criteria Exceeded? (2018 Build)		Change in Noise Levels - 2018 Build cf 2013 No Build		RNP Acute Criteria Exceeded? (2018 Build)		Consider Mitigation?
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
R93	56	50	56	48	60	55	No	No	-0.3	-1.3	No	No	No
R94	55	49	55	47	60	55	No	No	-0.4	-1.5	No	No	No
R95	61	54	61	53	60	55	**Yes**	No	0.1	-1.2	No	No	No
R96	59	52	59	51	60	55	No	No	0.2	-1.0	No	No	No
R97	57	51	57	49	60	55	No	No	0.0	-1.4	No	No	No
R98	69	63	70	62	60	55	**Yes**	**Yes**	0.3	-1.0	**Yes**	**Yes**	**Yes**
R99	70	64	71	63	60	55	**Yes**	**Yes**	0.5	-0.8	**Yes**	**Yes**	**Yes**
R100	70	63	70	62	60	55	**Yes**	**Yes**	0.4	-0.9	**Yes**	**Yes**	**Yes**
R101	67	61	68	60	60	55	**Yes**	**Yes**	0.5	-0.9	**Yes**	**Yes**	**Yes**
R102	70	64	71	63	60	55	**Yes**	**Yes**	0.4	-0.9	**Yes**	**Yes**	**Yes**
R103	72	65	72	64	60	55	**Yes**	**Yes**	0.4	-1.0	**Yes**	**Yes**	**Yes**
R104	71	64	71	63	60	55	**Yes**	**Yes**	0.4	-1.0	**Yes**	**Yes**	**Yes**
R105	72	65	72	64	60	55	**Yes**	**Yes**	0.4	-0.9	**Yes**	**Yes**	**Yes**
R106	71	64	71	63	60	55	**Yes**	**Yes**	0.1	-1.3	**Yes**	**Yes**	**Yes**
R107	70	64	71	63	60	55	**Yes**	**Yes**	0.5	-0.8	**Yes**	**Yes**	**Yes**
R108	72	65	72	64	60	55	**Yes**	**Yes**	0.2	-1.1	**Yes**	**Yes**	**Yes**
R109	71	64	71	63	60	55	**Yes**	**Yes**	0.3	-1.1	**Yes**	**Yes**	**Yes**
R110	71	65	72	64	60	55	**Yes**	**Yes**	0.2	-1.2	**Yes**	**Yes**	**Yes**
R111	71	64	71	63	60	55	**Yes**	**Yes**	-0.1	-1.5	**Yes**	**Yes**	**Yes**

Receiver ID	$L_{Aeq,Period}$ (dBA) Year 2013 'No Build'		$L_{Aeq,Period}$ (dBA) Year 2018 'Build'		RNP Base Assessment Criteria		RNP Base Criteria Exceeded? (2018 Build)		Change in Noise Levels - 2018 Build cf 2013 No Build		RNP Acute Criteria Exceeded? (2018 Build)		Consider Mitigation?
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	
R112	71	65	72	64	60	55	**Yes**	**Yes**	0.1	-1.3	**Yes**	**Yes**	**Yes**
R113	71	64	71	63	60	55	**Yes**	**Yes**	0.5	-0.8	**Yes**	**Yes**	**Yes**
R114	58	51	57	50	60	55	No	No	-0.2	-1.5	No	No	No
R115	57	50	57	49	60	55	No	No	0.0	-1.0	No	No	No
R116	55	49	55	49	60	55	No	No	-0.3	-0.8	No	No	No
R117	58	52	58	51	60	55	No	No	0.0	-0.5	No	No	No
R118	57	51	57	51	60	55	No	No	-0.1	-0.6	No	No	No
R119	58	52	58	51	60	55	No	No	-0.4	-0.9	No	No	No
R120	55	50	55	49	60	55	No	No	-0.3	-0.8	No	No	No
R121	56	51	56	50	60	55	No	No	-0.4	-0.9	No	No	No
Church	69	63	71	64	70	70	**Yes***	**Yes***	2.0	1.4	**Yes**	**Yes**	**Yes**

Note: * It is considered that the Church's $L_{Aeq,1hour\ 40\ dBA}$ internal noise criterion may be maintained during the operation of the Project, whilst the church doors are closed. This may require mechanical ventilation to be installed to provide fresh air while the windows and doors are kept closed. This would be considered during detailed design.

8.5 Receivers Identified for Noise Mitigation

Up to 36 residential receivers and the Church have been noted as potentially acutely affected at the commencement of the Project and therefore in accordance with the provisions of the ENMM (and Direction No. 24), these receivers should be considered for noise mitigation. Whilst not acutely affected, a relative increase of >2dB is predicted at R67 and therefore this receiver should also be considered.

Accordingly, the ENMM protocol for determining feasible and reasonable noise mitigation measures (as set out in the ENMM Practice Note IV) has been considered.

In terms of practicable mitigation options it is considered that 'at-road' treatments in the form of barriers or low noise pavement would offer limited benefits for this project.

There is limited available space for the installation of barriers; whilst these could potentially be established at the property boundaries they would not be fully effective due to the lack of contiguousness that could be achieved due to the intervening roads and property access openings. Further to this, to be fully effective the minimum height of the barriers would exceed the maximum residential boundary fencing height restriction of 2.1 m typically applied.

Whilst low noise pavements may reduce tyre noise to some degree, it is most effective at higher speeds than permitted within the study area. This treatment would offer minimal improvement during heavy traffic conditions when, due to congestion, average speeds may be somewhat lower than the posted speed limit.

It is expected that architectural treatment would be the most feasible form of mitigation to treat the exceedances.

Table 8-2 identifies the 36 receivers to be considered for mitigation. These are shown graphically in Figure 8-1. Depending on their orientation with respect to the nearby road, the receivers would require differing minimum attenuation requirements and further to this differing minimum attenuation requirements would be required of their individual building facades. Section 9 provides further detailed guidance in this respect.

It is noted that a number of properties to the south of Wentworth Avenue were treated under the Aircraft Noise Insulation Program (in approximately 1995) and therefore potentially some of the receivers identified may have already been adequately treated.

Table 8-2 Receivers Identified for Acoustic Treatment Consideration

Receiver	Address	Change in Noise Level		
		>2dB	<2dB	<1dB
R33	1247 Botany Rd	-	-	Yes
R34	1273 Botany Rd	-	Yes	-
R35	1275 Botany Rd	-	Yes	-
R36	1277 Botany Rd	-	Yes	-
R37	1285 Botany Rd	-	Yes	-
R38	86 Hardie St	Yes	-	-
R39	87 Hardie St	-	-	Yes
R40	90 Johnson St	-	-	Yes

Receiver	Address	Change in Noise Level		
		>2dB	<2dB	<1dB
R41	69 Johnson St	-	-	Yes
R42	5 Johnson Ln	-	-	Yes
R43	80 Alfred St	-	-	Yes
R44	77 Alfred St	-	-	Yes
R45	71 Frogmore St	-	-	Yes
R46	66 Frogmore St	-	-	Yes
R47	184 Sutherland St	-	-	Yes
R67	84 Hardie St	Yes	-	-
R68	85 Hardie St	-	Yes	-
R72	88 Johnson St	-	-	Yes
R80	78 Alfred St	-	-	Yes
R83	75A Alfred St	-	-	Yes
R87	69 Frogmore St	-	-	Yes
R98	68 Wentworth Ave	-	-	Yes
R99	66 Wentworth Ave	-	-	Yes
R100	64 Wentworth Ave	-	-	Yes
R101	62 Wentworth Ave	-	-	Yes
R102	60 Wentworth Ave	-	-	Yes
R103	56 Wentworth Ave	-	-	Yes
R104	54 Wentworth Ave	-	-	Yes
R105	52 Wentworth Ave	-	-	Yes
R106	50 Wentworth Ave	-	-	Yes
R107	48 Wentworth Ave	-	-	Yes
R108	46 Wentworth Ave	-	-	Yes
R109	44 Wentworth Ave	-	-	Yes
R110	42 Wentworth Ave	-	-	Yes
R111	40 Wentworth Ave	-	-	Yes
R112	38 Wentworth Ave	-	-	Yes
R113	36 Wentworth Ave	-	-	Yes
Church	1293-1295 Botany Road	-	Yes	-

Figure 8-1: Receivers to Consider for Mitigation

Note: Red: Acute and >2dB change (R38, R67); Gold: Acute and <2dB change (R34-R37,R68); Purple: Acute and < 1dB change (R39-R47, R72,R80, R83, R87, R98-R113).

9 ARCHITECTURAL TREATMENT DETAILS

The provision of noise mitigation in the form of architectural treatments would need to be considered on an individual basis for the receivers identified in Table 8-2 and Figure 8-1, taking into account the construction of the dwellings and their noise control efficacy and additionally the efficacy of any existing screening at the property boundaries.

The acoustic treatments that may be considered during detailed design include:

- provision of mechanical ventilation systems to allow for windows and doors to be kept closed. Any such system must meet the Building Code of Australia requirements;
- upgraded windows and glazing and solid core doors on the exposed façades of masonry structures only (these techniques would be unlikely to produce any noticeable benefit for light frame structures with no acoustic insulation in the walls);
- upgrading window and door seals;
- sealing of wall vents; and
- installation of external screen walls.

The *ENMM* notes that any such acoustic architectural treatments may be implemented only after extensive consultation with the residents and after obtaining the agreement of all affected parties, as described in Practice Note IV(b).

The mitigation measures should be designed to achieve the internal noise levels that would have prevailed had the external traffic noise criteria been able to be achieved. In this respect 10 dB below the external criterion is taken as the internal noise level goal. Most buildings will achieve an internal noise level 10 dB below the external noise level with the windows open partially for ventilation, without providing additional treatment.

Physical inspections of the properties identified for mitigation consideration would be required to determine the most appropriate treatment. Notwithstanding this, given that acute noise levels are predicted at the receivers identified, it is anticipated that upgraded windows and glazing and the provision of solid core doors would be required on the facades exposed to the proposed upgrade, in addition to the provision of mechanical ventilation.

10 ASSESSMENT OF MAXIMUM NOISE LEVELS

The network re-alignment would not be expected to give rise to any material increase in maximum noise levels with respect to the existing layout. As the new intersection would diverge away from the closest residential receivers on the northern side of Wentworth Avenue, maximum noise levels experienced by these receivers may potentially reduce marginally. It is considered, therefore, that the project would not give rise to any material risk of increased maximum noise level impacts.

It is noted that the road would move closer to the church on Botany Road. Maximum noise level assessment, however, is not relevant to this receiver as there would be no residential receivers. Further to this the L_{Aeq} based assessment undertaken for the church adequately takes account of the range of traffic noise levels that this receiver would experience.

11 CUMMULATIVE NOISE IMPACTS

At the time of assessment details pertaining to other surrounding projects were not available and therefore an assessment of cumulative noise impacts has not been possible.

During future assessment of the surrounding projects, once detailed information is available, the contribution from the WestConnex Enabling Works may be considered in a cumulative noise assessment.

12 CONCLUSION

RMS is planning to upgrade roads east of Sydney airport and remove the General Holmes Drive rail level crossing. This will improve traffic flow and access to the airport, Port Botany and, in the future, the WestConnex motorway. The primary objectives of the proposal are to reduce current levels of congestion, improve the flow of road and rail traffic and provide as a minimum, a light vehicle standard rail underpass to replace the General Holmes Drive level crossing.

Wilkinson Murray has undertaken an operational noise assessment for the Project, based on road design and traffic details provided by RMS. The assessment has been undertaken in accordance with the requirements of the RMS Professional Services Brief.

Due to the particularities of the Project the brief required the consideration of the 'no build' 2013 and 'build' 2018 operational traffic scenarios and the assessment has been undertaken on this basis.

Operational noise levels have been predicted at all potentially affected receiver locations within the study area, as defined in consultation with RMS. A total of 121 receiver locations have been considered.

The predicted traffic noise levels have been compared against the relevant criteria set out in the *NSW Road Noise Policy* to establish the requirements for mitigation measures based on the provisions of the *ENMM*.

The conclusions of this assessment are as follows:

- Typically only marginal changes in traffic noise levels are predicted between 2013 and 2018. This is principally due to the relatively minor changes in anticipated vehicle volumes between these years coupled with the fact that the network re-alignment would not be in the very close vicinity of most of the receivers considered. Based on the marginal changes in traffic noise levels there would be expected to be no perceptible difference in traffic noise levels for the large majority of receivers.

- The RNP base criteria are already notably exceeded at the receivers facing Botany Road and Wentworth Avenue during the daytime and night. The existing traffic noise levels at these receivers are also acute in most cases. Upon commencement of the Project the noted exceedances would remain relatively unchanged for most receivers.

- Some marginal increases in traffic noise may arise at residential receivers currently shielded by some existing properties that would be acquired and removed. It would be expected that these properties would be readily mitigated with boundary fencing and/or architectural treatments during detailed design.

- Appreciable noise levels also already occur at the existing Church on Botany Road. Upon commencement of the Project these levels may be expected to marginally increase principally due to the removal of some acquired properties that currently provide shielding to the church. Notwithstanding this, it is expected that the relevant internal noise criterion would be maintained during the operation of the Project, whilst the church doors are closed.

- In accordance with the provisions of the *ENMM*, the 38 receivers identified as potentially affected at the commencement of the Project should be considered for noise mitigation in the form of architectural treatment during detailed design. Physical inspections of the individual properties identified would be required to confirm the most appropriate treatments with consideration to the recommendations of Practice Note IV of the *ENMM*.

- The network re-alignment would not be expected to give rise to any material increase in maximum noise levels with respect to the existing layout at any residential receivers.

APPENDIX A

SENSITIVE RECEIVERS – CLOSE-IN VIEWS


R1
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Church
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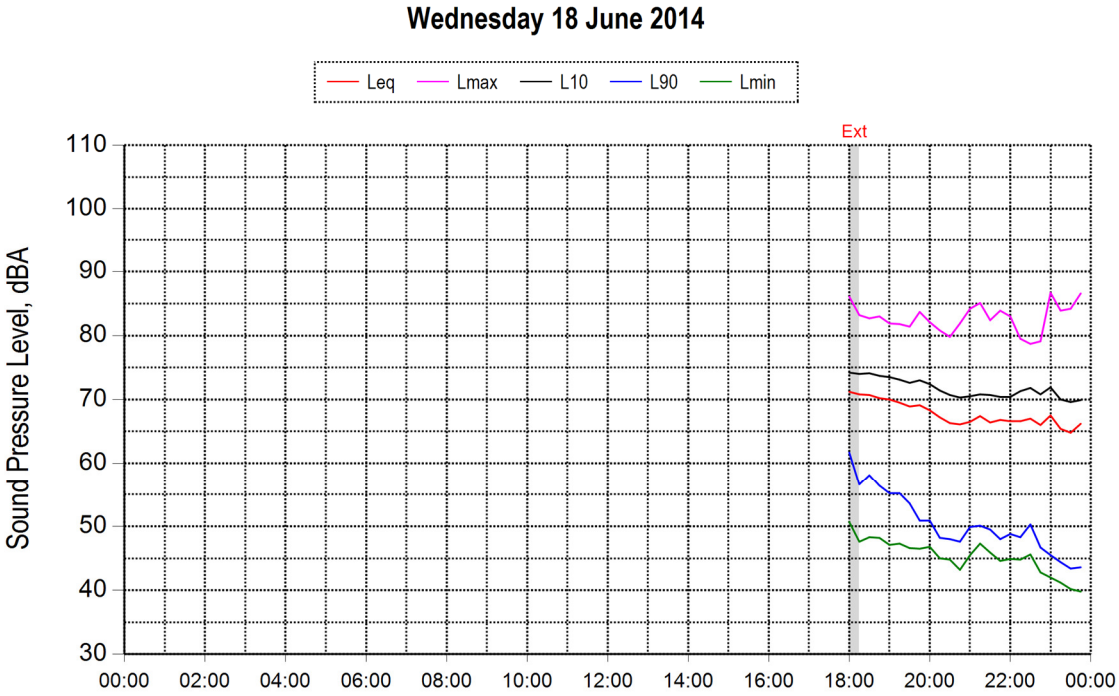
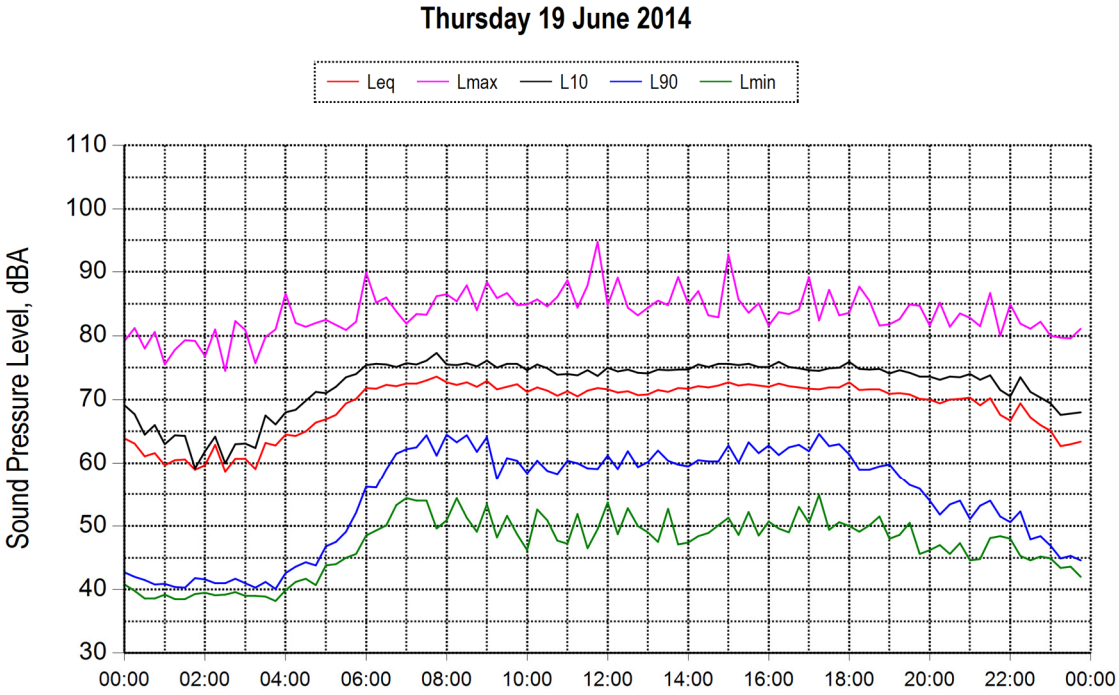
R119

APPENDIX B

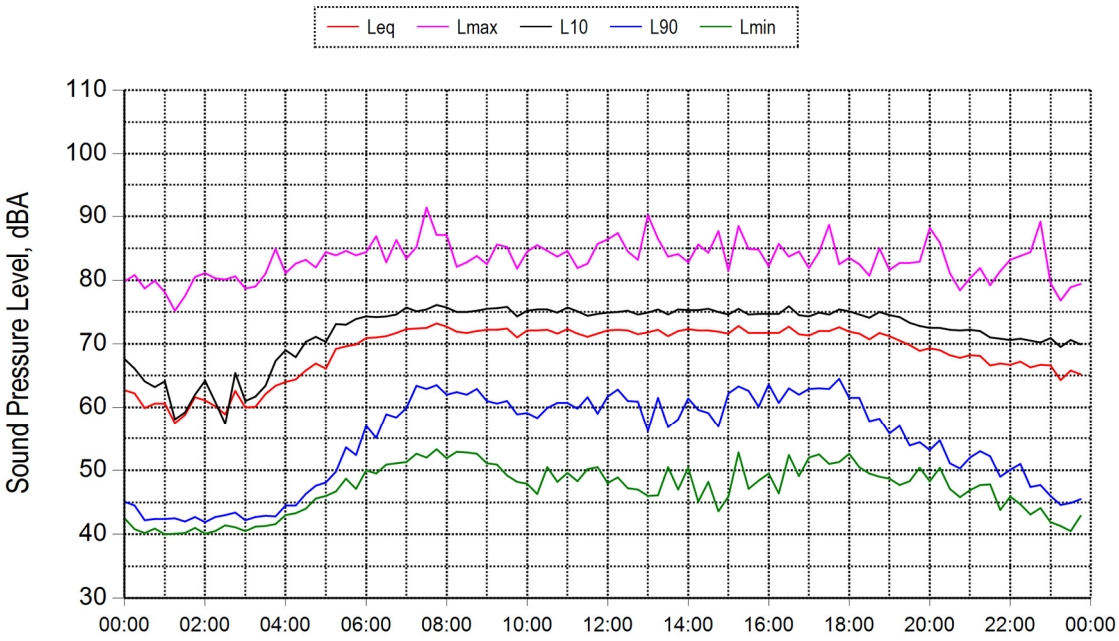
NOISE MEASUREMENT RESULTS

Noise Monitorng Results – 54 Wentworth Avenue, 18-26 June 2014

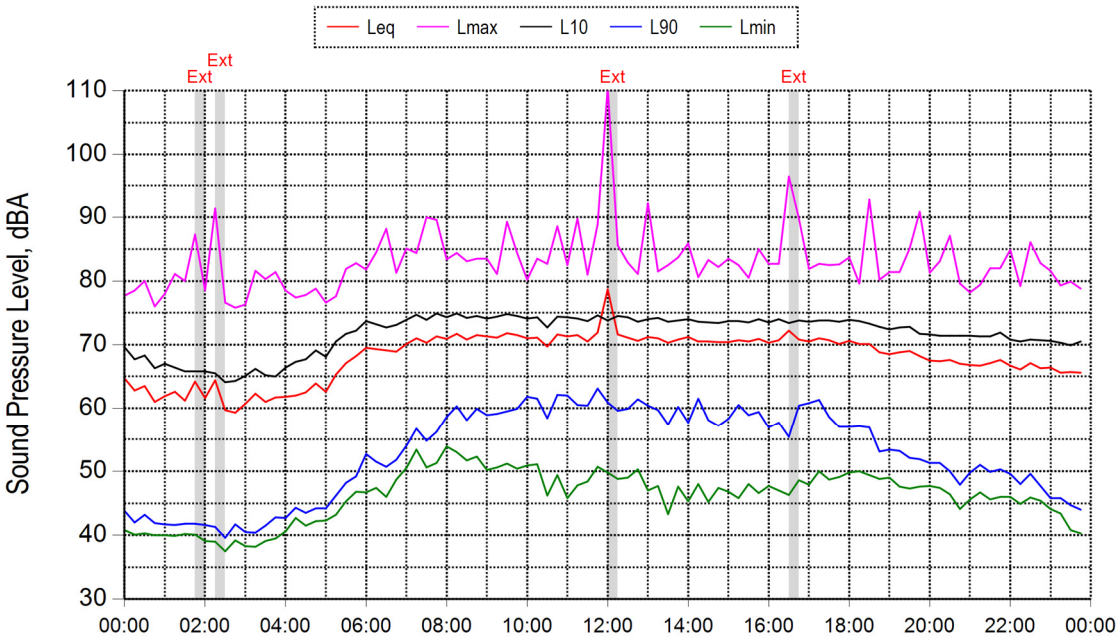




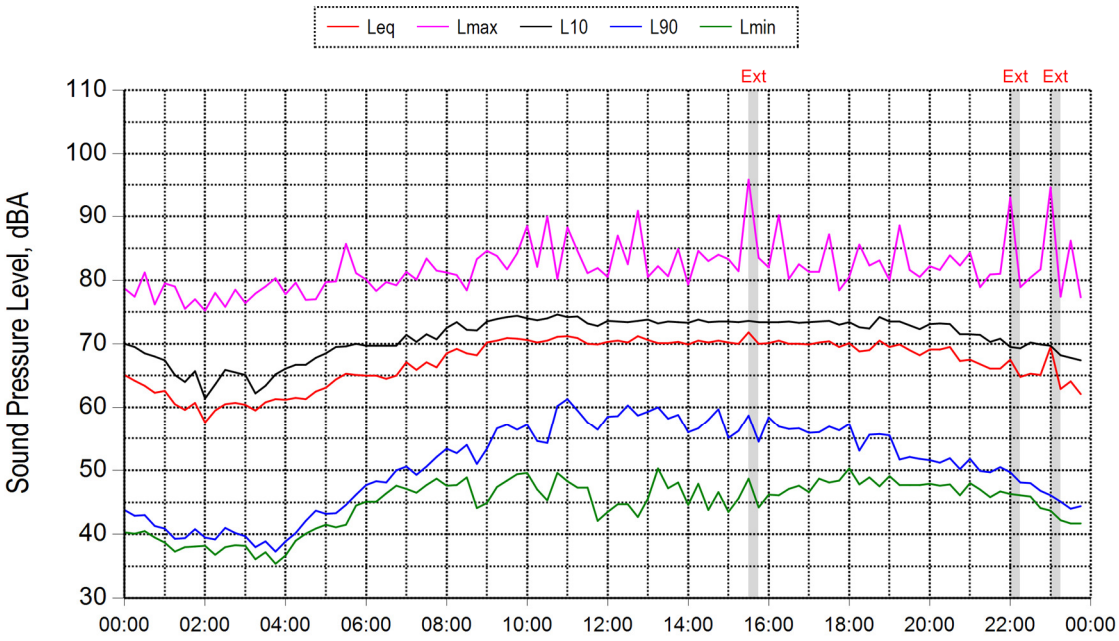
Friday 20 June 2014



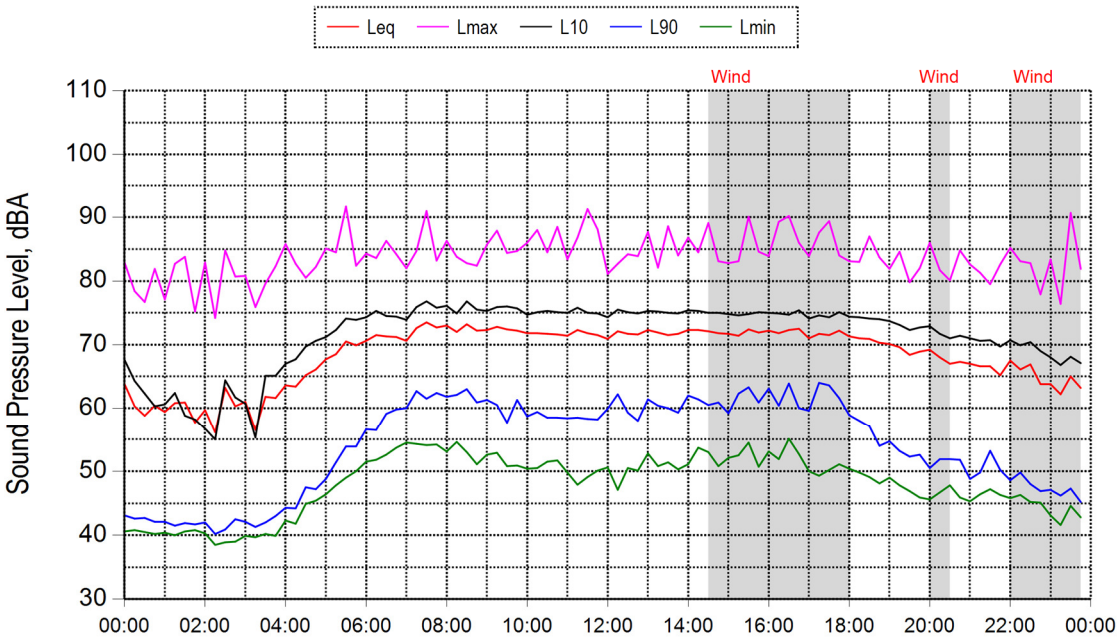
Saturday 21 June 2014



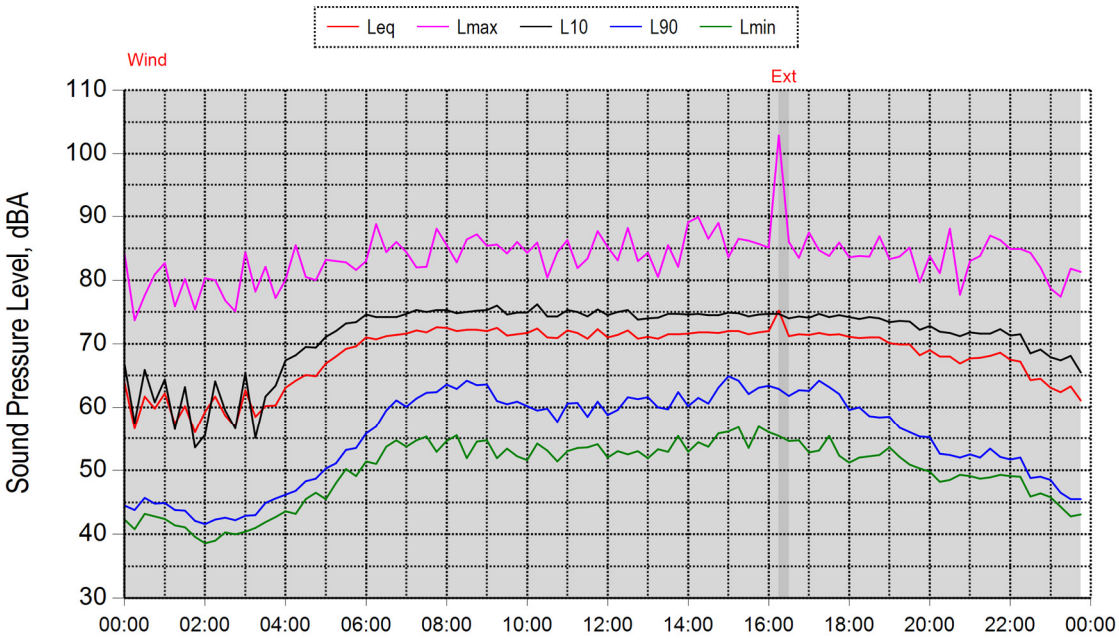
Sunday 22 June 2014



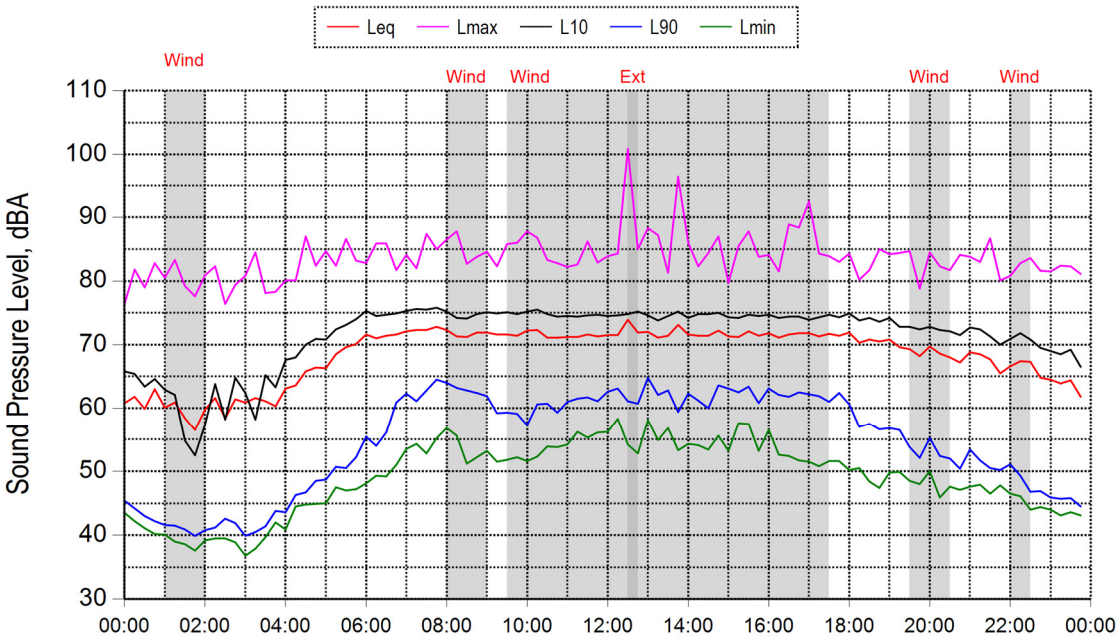
Monday 23 June 2014

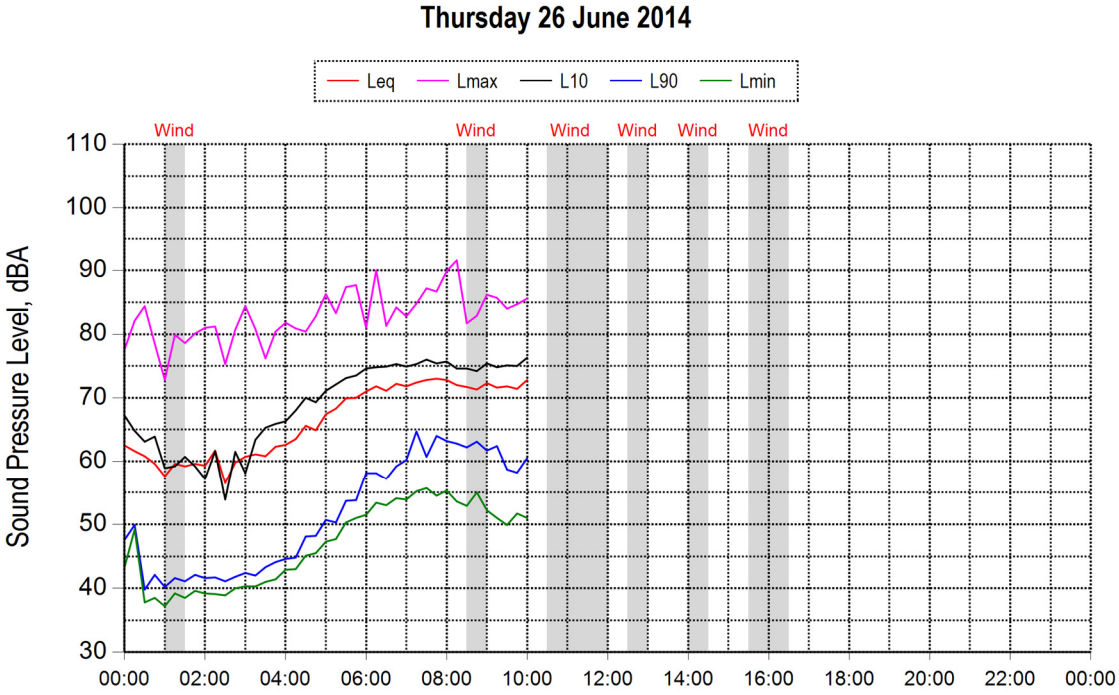


Tuesday 24 June 2014



Wednesday 25 June 2014




Thursday 26 June 2014
Leq
Lmax
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L90
Lmin
Wind
Wind
Wind
Wind
Wind
Wind
Sound Pressure Level, dBA
110
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90
80
70
60
50
40
30
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02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
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