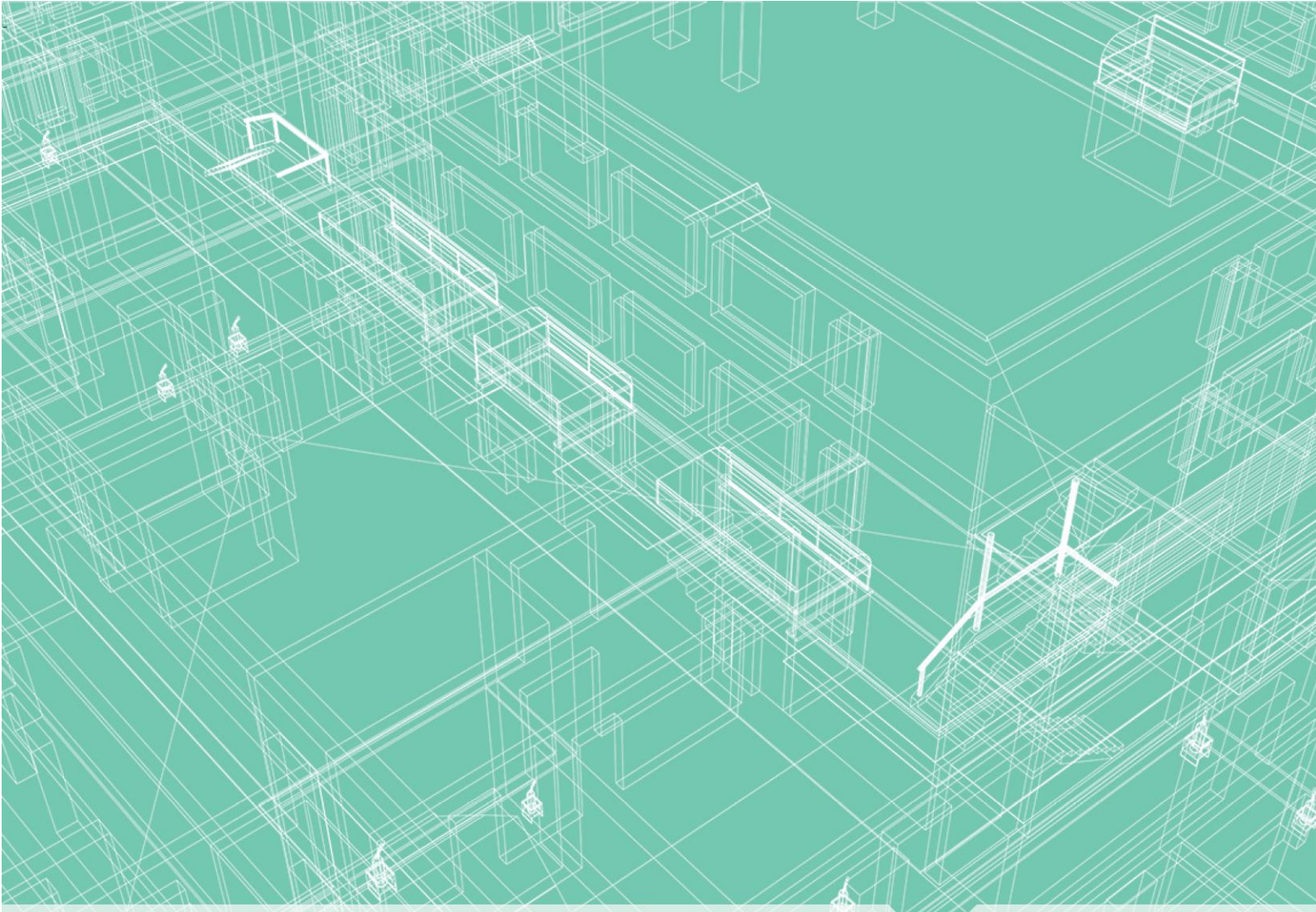

NOISE & VIBRATION IMPACT ASSESSMENT FOR SSDA (SSD-11099584)

THE SUTHERLAND HOSPITAL
OPERATING THEATRE UPGRADE PROJECT

JHA

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Key Contact	Mathew McGrory

Prepared By

Company	JHA
Address	Level 23, 101 Miller Street, North Sydney NSW 2060
Phone	61-2-9437 1000
Email	Mathew.McGrory@jhaengineers.com.au
Website	www.jhaservices.com
Author	Cameron Nurse
Checked	Mathew McGrory
Authorised	Mathew McGrory

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1 INTRODUCTION

1.1 OVERVIEW

JHA Engineers have been engaged by Health Infrastructure to provide a Noise & Vibration Impact Assessment for the proposed Hospital development located at Kingsway and Kareena Rd, Caringbah, NSW.

The objectives of this acoustic assessment are:

- Identify noise and vibration sensitive receivers that will potentially be affected by the operation of the new operating theatres at Sutherland Hospital.
- Establish the appropriate noise levels and vibration criteria in accordance with the relevant standards, guidelines and legislations.
- Carry out noise assessments in order to assess the noise impacts from the operation of the development. Noise assessments consider the following noise sources:
  - Mechanical services noise
  - Transport Impact noise
  - Traffic generation noise
  - Construction noise
- Determine whether the relevant criteria can be achieved based on the proposed operations and construction methods. Where applicable, provide recommendations for any necessary acoustic control measures that will need to be incorporated into the development or use in order to ensure with the assessment criteria.
- Provide recommendations for Construction Noise and Vibration Planning.

The following documentation has been considered for the preparation of this report:

- Architectural drawings prepared by HDR Architects.
- Mechanical services information provided by JHA Engineers.
- Traffic Report prepared by Taylor Thomson Whitting (TTW).
- Noise data collected on-site through the use of noise monitors.

This document and related work has been prepared following JHA Consulting Engineers Quality and Environmental Management Systems, which are based on AS/NZS ISO 9001.2015 and ISO 14001.2015

1.2 RESPONSE TO SEARS

The acoustic report is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD (SSD-11099584). This table identifies the relevant SEAR's requirements and corresponding references within this report.

SEARs Item	*Report Reference*
11. Noise and Vibration *Provide a noise and vibration impact assessment that:* • *Includes a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation and construction.* • *Details the proposed construction hours and provide details of, and justification for, instances where it is expected that works would be carried out outside standard construction hours.* • *Includes a quantitative assessment of the main sources of operational noise, including consideration of any mechanical services (e.g. air conditioning plant).* • *Outlines measures to minimise and mitigate the potential noise impacts on nearby sensitive receivers* • *Considers sources of external noise intrusion in proximity to the site (including, road rail and aviation operations) and identifies building performance requirements for the proposed development to achieve appropriate internal amenity standards* *Relevant Policies and Guidelines:* • *NSW Noise Policy for Industry 2017 (NSW Environment Protection Authority (EPA) .* • *Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009).* • *Australian Standard 2363 Acoustics - Measurement of noise from helicopter operations (AS 2363).* • *Assessing Vibration: A Technical Guideline 2006 (Department of Environment and Conservation, 2006).*	Section 5, 6 & 7
Investigate and assess the potential noise and vibration impacts from adjacent rail corridor and classified road (Kingsway) to the hospital addition; detail mitigation measures if necessary *Relevant Policies and Guidelines:* • *Development Near Rail Corridors and Busy Roads - Interim Guideline (Department of Planning 2008)* • *SEPP (Infrastructure) - Cl 87, 102*"	Section 6

Table 1: Summary of relevant SEAR's requirements

2 DESCRIPTION OF THE PROPOSAL

The Sutherland Hospital Operating Theatre Upgrade Project will build on and support the $62.9 million Sutherland Hospital Redevelopment Stage 1, which delivered a new and expanded Emergency Department, as well as an expanded Intensive Care Unit (ICU) and additional general medical and surgical beds.

The Minister for Health and Medical Research announced an investment of $81.5 million to redevelop The Sutherland Hospital Operating Theatre complex. The Minister has recently announced an additional $7 million to procure and enable the installation of a MRI Suite.

2.1.1 OPERATING THEATRE MAIN WORKS AND OPERATIONS

The SSD component seeks consent for the Construction and Operation of new facilities at Sutherland Hospital, including:

- New operating theatres and procedure rooms
- New Surgical Short Stay Unit and Recovery
- New staff amenities and workspaces
- Facilities for admission and discharge
- New Central Sterilising Services Department
- A new MRI Suite.

2.2 SITE SURROUNDINGS DESCRIPTION

Sutherland Hospital is part of the South Eastern Sydney Local Health District, located in Caringbah. Caringbah is a suburb located 24 kilometres South of Sydney CBD. It belongs to the Local Government Area of Sutherland Shire.

The Sutherland Hospital is bounded to the North by Kingsway Road and to the West by Kareena Road. The Sydney Trains T4 Cronulla Railway Line is adjacent to the southern boundary of the site. The local area immediately surrounding the hospital site has a mix of uses varying from low and high density residential, specialized health facilities, and local scale retail.

Figure 1 shows the site location and nearest noise sensitive receivers.

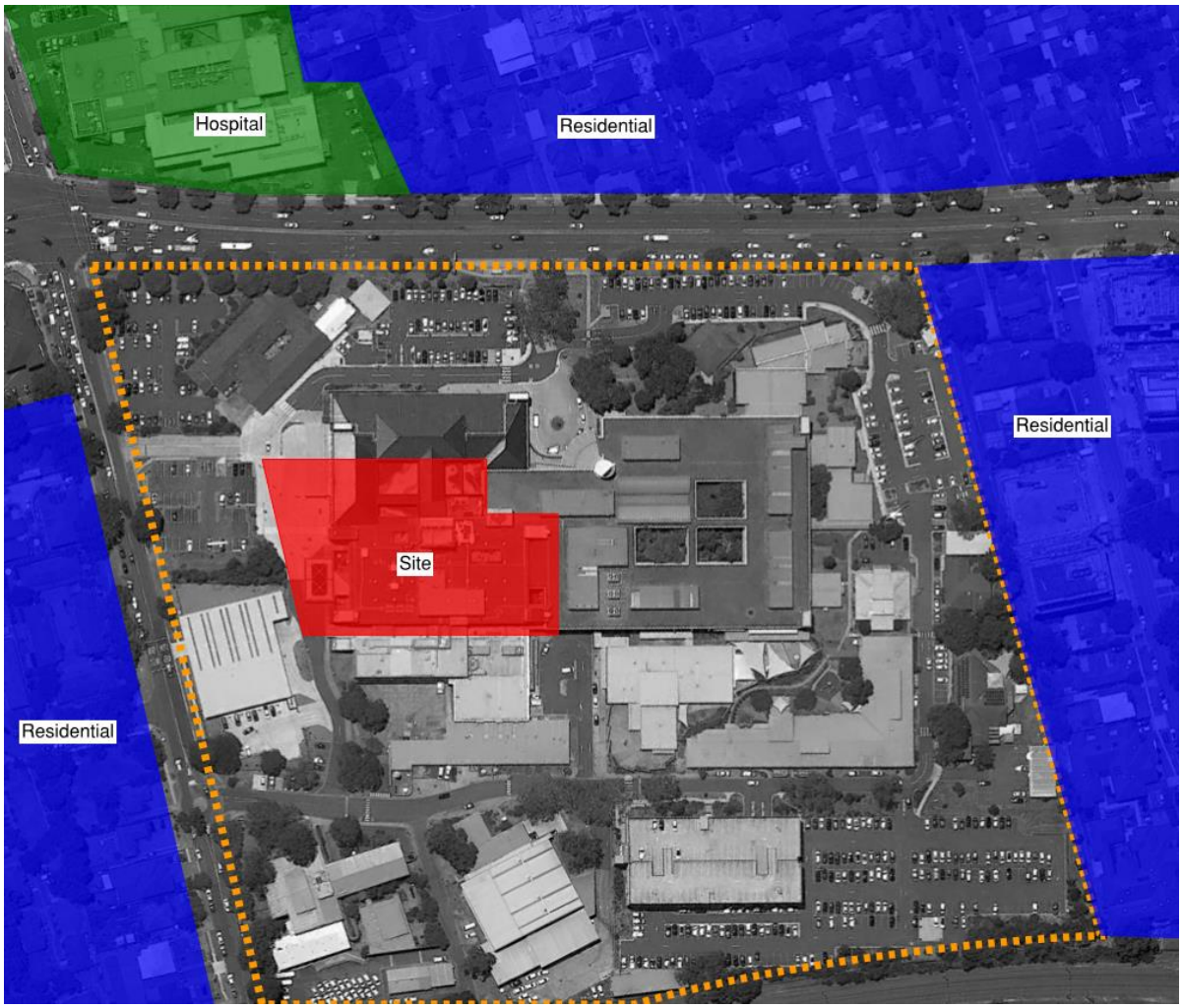

Figure 1: Aerial view of site showing the location of the site (red shading), residential receivers (blue shading) and hospital receivers (green shading).

Receiver	*Direction*	*Distance from Site Boundary*
Residential (Kareena Road)	West	70m
Kareena Private Hospital (Hospital)	North	110m
Residential (Kingsway)	North	120m

Table 2: Distances to Nearest Sensitive Receivers.

3 EXISTING NOISE ENVIRONMENT

3.1 GENERAL

Attended and unattended noise surveys were conducted in order to establish the ambient and background noise levels of the site and surrounds. JHA Consulting Engineers carried out the noise survey, in accordance with the method described in the *'AS/NZ 1055:2018 Description and measurement of environmental noise'*. The long term and short term noise monitoring locations are shown in Figure 2.

Figure 2: Noise survey locations and boundary of the site.

3.2 SHORT-TERM NOISE MONITORING

On Monday 15th June, Tuesday 23rd June and Tuesday 30th of June, 2020, short-term noise measurements were carried out during day-time period. Short-term noise measurements were carried out with a NTI XL-2 hand-held Sound Level Meter (SLM) (Serial Number A2A-13742-E0). The calibration of the SLM was checked before and after each use and no deviations were recorded.

The SLM microphone was mounted 1.5 metres above the ground and a windshield was used to protect the microphone. Measurements were undertaken in the free-field – i.e. more than 3 metres away from any building façade or vertical reflective surface. Weather conditions were calm and dry during the attended noise monitoring.

Short-term noise monitoring was carried out to obtain representative third-octave band noise levels of the site plus noise emissions from road traffic. Three short-term noise monitoring locations were chosen as representative as follows:

- Location M1: At the northern boundary of the site adjacent to Kingsway Road
- Location M2: At the perimeter of the site at the adjacent eastern residential noise sensitive receivers
- Location M3: At the western boundary of the site, adjacent to Kareena Road at the nearest western-most noise sensitive receiver.

From observations during the site visit, it is noted that at location M1, ambient and background noise levels were dominated by noise from the Kingsway Road. For Location M2, activities typical of suburban areas dominated ambient and background noise levels. At Location M3, ambient and background noise levels were dominated by noise from Kareena Road. A summary of the results of the short-term noise monitoring are shown in Table 3.

Location	*Date and Time*	*Parameter*	*Sound Pressure Level, dB re 20μPa*								
			Overall dB(A)	*Octave Band Centre Frequency, Hz*							
				63	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
M1	15/06/2020 11:15am – 11:30am	$L_{90,15min}$	**60**	63	60	55	55	57	52	43	33
		$L_{eq,15min}$	**69**	71	72	65	66	66	60	52	44
		$L_{10,15min}$	**72**	74	72	68	69	69	63	55	46
M2	23/06/2020 10:45am – 11:00am	$L_{90,15min}$	**49**	55	49	45	45	44	41	37	26
		$L_{eq,15min}$	**53**	59	52	49	48	48	45	44	35
		$L_{10,15min}$	**55**	61	55	51	50	49	48	48	38
M3	30/06/2020 11:15am – 11:30am	$L_{90,15min}$	**53**	58	54	51	48	50	46	37	25
		$L_{eq,15min}$	**65**	69	68	62	59	61	57	49	39
		$L_{10,15min}$	**68**	71	68	64	62	65	60	52	41

Table 3: Results of the short-term noise monitoring.

3.3 LONG-TERM NOISE MONITORING

Unattended long-term noise monitoring was carried out between Monday 15th June and Tuesday 23rd June 2020 and Tuesday 21st July and Thursday 30th July 2020 with Rion NL-52 noise loggers (Serial Numbers 1054192 and 0553892). The noise loggers recorded L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise parameters at 15-minute intervals during the measurement period. The calibration of the noise loggers were checked before and after use and no deviations were recorded.

The noise loggers were located at three perimeter locations (L1, L2 and L3) around the site as shown in Figure 2. The locations were secured and are considered to be representative of the typical ambient and background noise levels. The microphones of each noise logger was mounted 1.5 metres above the ground and a windshield was used to protect each microphone. Weather conditions were monitored during the unattended noise monitoring period and generally were calm and dry during the unattended monitoring.

The detailed results of the long-term noise monitoring are presented graphically in Appendix A. As stated in the NSW EPA Noise Policy for Industry (NPI) 2017, any data likely to be affected by rain, wind or other extraneous noise has been excluded from the calculations (shadowed in the Appendix A graphs).

The Rating Background Levels (RBLs) have been established in general accordance with the methodology described in the NSW NPI – i.e. 10th percentile background noise level (L_{A90}) for each period of each day of the ambient noise level. The median of these levels is then presented as the RBL for each assessment period.

These RBLs are shown in Table 4 together with the ambient noise levels (L_{Aeq}) measured for each period.

Location	*Rating Background Levels (RBL), dB(A)*			*L_{Aeq} Ambient Noise Levels, dB(A)*		
	Day 7am-6pm	*Evening 6pm-10pm*	*Night 10pm-7am*	*Day 7am-6pm*	*Evening 6pm-10pm*	*Night 10pm-7am*
L1	60	53	39	62	59	56
L2	47	45	39	54	50	45
L3	48	45	40	59	57	52

Table 4: Results of the long-term noise monitoring.

3.4 TRAFFIC NOISE MONITORING

Traffic noise monitoring results were derived from the unattended noise survey noise data. The summary of the measured traffic noise levels are shown in Table 5.

Location	*Traffic Noise Levels, dB(A)*			
	Period		*Nosiest 1 hour period*	
	Day $L_{Aeq, (15\ hr)}$	*Night $L_{Aeq, (9\ hr)}$*	*Day $L_{Aeq, (1\ hr)}$*	*Night $L_{Aeq, (1\ hr)}$*
L1 (Kingsway Road)	62	56	60	46
L3 (Kareena Road)	59	54	50	44

Table 5: Results of the long-term traffic noise levels.

4 RELEVANT NOISE STANDARDS AND GUIDELINES

4.1 STANDARDS AND GUIDELINES

The following standards and guidelines are considered relevant to the project and have been referenced in developing the project noise level criteria.

- Noise Emissions and Intrusive Noise:
  - Environmental Planning and Assessment (EP&A) Act 1979.
  - Protection of the Environmental Operations (POEO) Act 1997.
  - Sutherland Shire Council Planning Legislation.
  - NSW Environment Protection Authority (EPA) – Noise Policy for Industry (NPI) 2017.
- Transport Noise:
  - NSW Department of Planning (DoP) – Development Near Rail Corridors and Busy Roads – Interim Guideline 2008.
  - Australian / New Zealand Standard AS/NZS 2107:2016 "*Acoustics – Recommended design sound levels and reverberation times for building interiors*".
  - NSW EPA Road Noise Policy (RNP) 2011.
- Construction Noise and Vibration:
  - NSW Department of Environment and Climate Change (DECC) – Interim Construction Noise Guideline (ICNG) 2009.
  - NSW Department of Environment and Conservation (DEC) – Assessing Vibration: A Technical Guideline 2006.
  - Australian Standard AS 2436:2010 "*Guide to Noise and Vibration Control on Construction, Demolition & Maintenance Sites*".
  - NSW Road Maritime Service (RMS) – Construction Noise and Vibration Guideline 2016.

4.2 REGULATORY FRAMEWORK

The Environmental Planning and Assessment Act 1979 (EP&A Act) provides the regulatory framework for the protection of the environment in NSW. The EP&A Act is relevantly about planning matters and ensuring that "environmental impact" associated with the proposed development is properly considered and reasonable before granting development consent to develop.

The assessment of "environmental impact" relies upon the identification of acceptable noise criteria which may be defined in a Development Control Plan, or derived from principles using guidelines like NSW EPA Noise Policy for Industry (NPI 2017) or Noise Guide for Local Government (NGLG 2013).

The Protection of the Environment Operations (POEO) Act 1997 has the objective of protecting, restoring and enhancing the quality of NSW environment. Abatement of noise pollution is underpinned by the definition of "offensive noise" as follows:

"...

a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

i. is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

ii. interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

..."

NGLG 2013 provides a checklist to determine an "offensive noise".

4.3 SUTHERLAND SHIRE COUNCIL LEGISLATION

4.3.1 SUTHERLAND SHIRE COUNCIL DEVELOPMENT CONTROL PLAN

Relevant Planning Documents of The Sutherland Shire Council Legislation have been reviewed for any noise requirement or criteria and no relevant requirements for noise have been found.

4.3.2 SUTHERLAND SHIRE COUNCIL LOCAL ENVIRONMENTAL PLAN

The Sutherland Shire Council Local Environmental Plan (SS-LEP 2015) sets the Land Zoning as shown in Figure 3 as per information extracted from the SS-LEP 2015 map 7150_COM_LZN_006_020_20200310. The site is categorized as Infrastructure (SP1) – Health Services Facility and the surroundings as Low Density Residential (R2), High Density Residential (R4).

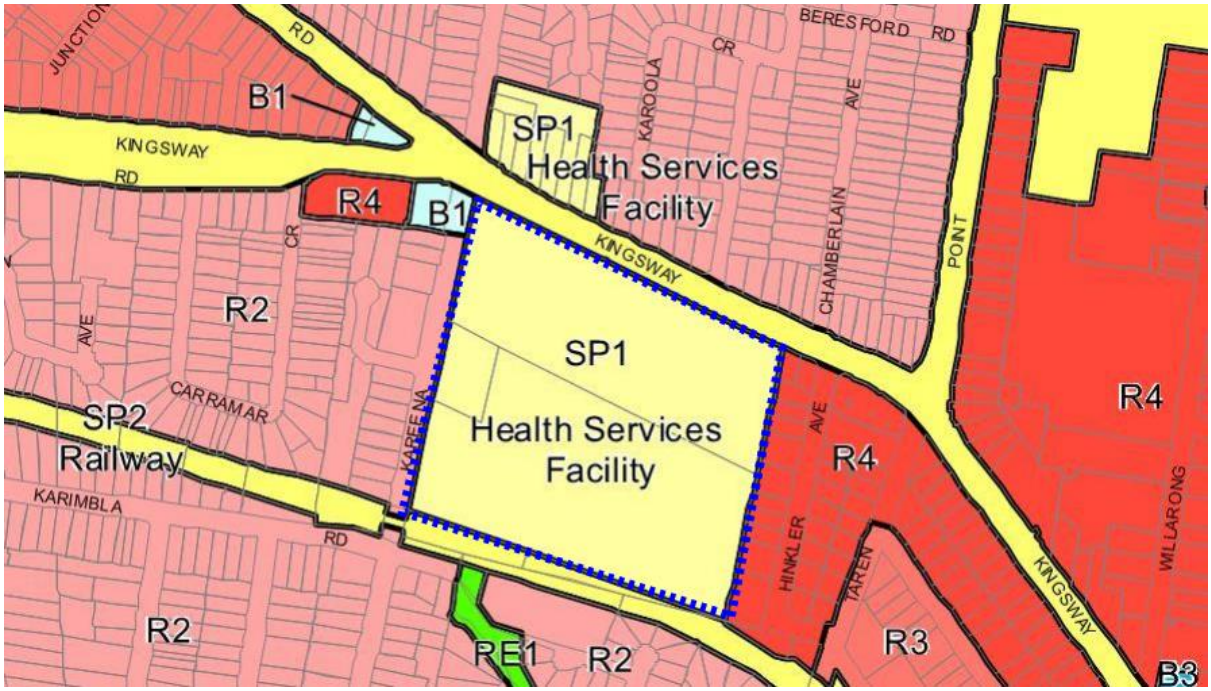

Figure 3: Land Zoning of the site and surroundings.

4.4 NOISE EMISSIONS

4.4.1 NSW EPA NOISE POLICY FOR INDUSTRY

The NSW EPA Noise Policy for Industry 2017 assesses noise from industrial noise sources - scheduled under the POEO. Mechanical noise from the development shall be addressed following the recommendations in the NSW NPI.

The assessment is carried out based on the existing ambient and background noise levels addressing the following:

- Intrusiveness Criteria, to control intrusive noise into nearby sensitive receivers.
- Amenity Criteria, to maintain the noise level amenity for particular land uses.

These criteria are established for each assessment period (day, evening and night) and the more stringent of the two criteria sets the Project Noise Trigger Level (PNTL).

4.4.1.1 Intrusiveness Criteria

The NSW NPI defines the intrusiveness criteria as follows:

"The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15 minute period, and does not exceed the background noise level by more than 5 dB when beyond a minimum threshold."

Based on the intrusiveness criteria definition and the background noise levels on site shown in Table 4, Table 6 shows the intrusiveness criteria for the noise sensitive receivers.

Representative Logger Location	*Indicative Noise Amenity Area*	*Period*	*Measured Rating Background Level (L_{A90}), dB(A)*	*Intrusiveness Criteria, dB(A)*
L3	*Low Density / Medium Density Residential (R2)*	Day	48	53
		Evening	45	50
		Night	40	45
L2	*High Density Residential (R4)*	Day	47	52
		Evening	45	50
		Night	39	44

Table 6: Determination of the intrusiveness criterion for residential noise sensitive receivers.

4.4.1.2 Amenity Criteria

The NSW NPI states the following to define the amenity criteria:

"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance."

Based on the amenity criteria definition and the land zoning. Table 8 shows the amenity criteria for the noise sensitive receivers as documented in Acoustic Studio Stage 1 SSD[1].

Representative Logger Location	*Indicative Noise Amenity Area*	*Period*	*Recommended Amenity Noise Level (L_{Aeq})*	*Amenity Criterion, dB(A)*
L3	*Low Density / Medium Density Residential (R2)*	Day	55	53 (55-5+3)
		Evening	45	43 (45-5+3)
		Night	40	38 (40-5+3)
L2	*High Density Residential (R4)*	Day	60	58 (60-5+3)
		Evening	50	48 (50-5+3)
		Night	45	43 (45-5+3)
---	*Hospital (SP1)*	Nosiest 1 hour (External)	50	50

Table 7: Determination of the amenity criterion for noise sensitive receivers.

4.4.1.3 Project Noise Trigger Levels

The PNTL's are shown in Table 8 and have been obtained in accordance with the requirements of the NSW NPI. These shall be assessed to the most affected point on or within the noise sensitive receiver boundary.

Indicative Noise Amenity Area	*Period*	*Intrusiveness Criterion*	*Amenity Criterion*
Low Density / Medium Density Residential (R2)	Day	53	53
	Evening	50	43
	Night	45	38
High Density Residential (R4)	Day	52	58
	Evening	50	48
	Night	44	43
Hospital (SP1)	Nosiest 1 hour	---	50

Table 8: Determination of PNTL's (light grey highlight) for noise sensitive receivers.

4.4.2 DEVELOPMENT NEAR RAIL CORRIDORS OR BUSY ROADS – INTERIM GUIDELINE

The Development Near Rail Corridors or Busy Roads – Interim Guideline (DNRCBR-IG) 2008 details the application of clauses 87 and 102 of the Infrastructure State Environmental Planning Policy (ISEPP) which is required to be used when a Healthcare development is adjacent to a rail corridor, a freeway, a toll-way, a transit-way or a road with an Annual Average Daily Traffic (AADT) volume of more than 20000 vehicles.

The DNRCBR-IG outlines two types of noise propagation that are to be taken into account when assessing new developments near rail corridors and busy roads. The first type is airborne noise that propagates through the air from the source to the receiver. The second type is ground-borne noise that propagates through the ground as vibration.

The Kingsway Road has an AADT higher than 20,000 as per RMS information available.

Therefore, there are requirements to assess and include mitigation against road traffic noise for the proposed Educational development under clause 102 of the ISEPP.

The criteria for airborne noise is as stated in ISEPP clause 87 and 102 is presented below in Table 9.

Occupancy		*Interior Design Noise Level (When In Use)*
Hospitals	Wards	35
	Other Noise Sensitive Areas	45

Table 9: Internal noise level requirements for airborne noise.

4.4.3 RAIL NOISE

Rail Noise assessments are based on the requirements of NSW Department of Planning (DoP). 'Developments near Rail Corridors and Busy Roads – Interim Guideline'. Railway noise has been considered for the proposed development. Figure 4 outlines the Acoustic Assessment Zones for developments adjacent to rail corridors.

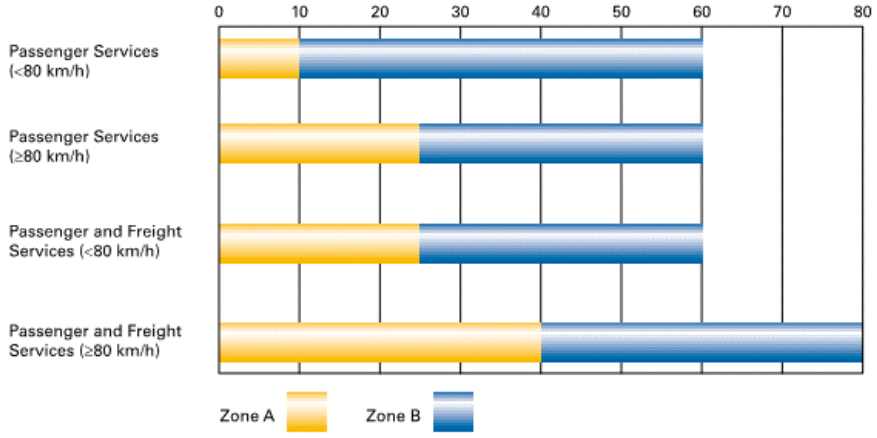

Figure 4: Assessment Zones for Airborne Rail Noise

4.4.4 RAIL VIBRATION

The DNRCBR-IG requires vibration to be assessed for vibration sensitive buildings within 60 metres of the nearest operational track of a rail corridor. A summary of the assessable zones for vibration based on proximity are shown below in Figure 5.

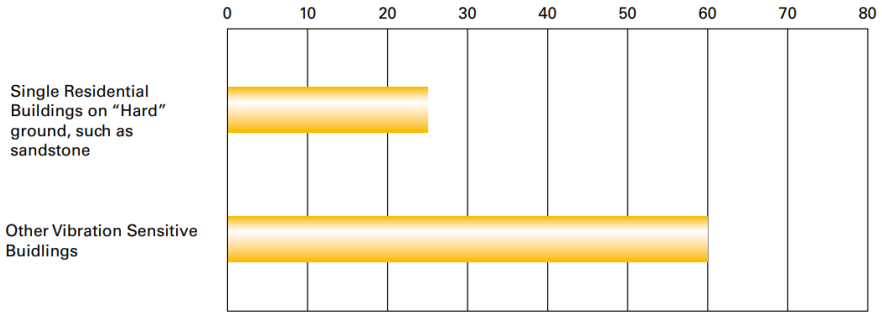

Figure 5: Assessment Zones for Rail Vibration

As the development is at a distance greater than 100m from the nearest railway line, as per Figure 5, a detailed assessment is not be required.

4.4.5 NSW ROAD NOISE POLICY

The NSW Road Noise Policy (RNP) establishes criteria for traffic noise from new roads or additional traffic generated on roads from land use development.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited up to 2.0 dB above the existing noise levels. An increase of up to 2.0 dB represents a minor impact that is considered barely perceptible to the average person.

4.5 CONSTRUCTION NOISE AND VIBRATION

4.5.1 NOISE CRITERIA

As per the Secretary Environmental Assessment Requirements SEARs requirements for the proposed construction activities, noise criteria are established in accordance with the NSW DECCW Interim Construction Noise Guideline (ICNG) 2009. This guideline provides Noise Management Levels (NMLs) for construction works. If NMLs are exceeded a feasible and reasonable action will be triggered to minimise noise impact to the nearest noise sensitive receivers.

The recommended construction hours are as follows as per the NSW ICNG:

- Monday to Friday: 7am to 6pm.
- Saturday: 8am to 1pm.
- Sundays and Public Holidays: No excavation or construction works.

The ICNG suggest construction noise management levels that may minimise the likelihood of annoyance being caused to noise sensitive residential receivers depending on the duration of works. The management levels for long-term duration works are as follows:

- Within recommended standard hours.

  The Noise Management Level (NML) ($L_{Aeq,15min}$) measured at the most exposed boundary of any affected residential receiver when the construction site is in operation must not exceed the background noise level (RBL) by more than 10 dB(A). This noise level represents the point above which there may be some community reaction to noise.

  However, in the case of a highly noise affected area, the NML ($L_{Aeq,15min}$) at the most exposed boundary of any affected residential receiver when the construction site is in operation should not exceed 75 dB(A). This level represents the point above which there may be strong community reaction to noise.

- Outside recommended standard hours.

  The NML ($L_{Aeq,15min}$) measured at the most exposed boundary of any affected residential receiver when the construction site is in operation must not exceed the background noise level (RBL) by more than 5 dB(A). It is noted that a strong justification is required for works outside the recommended standard hours.

ICNG suggests construction noise management levels for other sensitive land uses surrounding construction sites. Table 10 below summarises the airborne construction noise criteria (NMLs) for the noise sensitive receivers surrounding the development site.

Sensitive Receiver		Airborne Construction Noise Criteria, L_{Aeq} dB(A)	
		Within Standard Hours	Outside Standard Hours
Residential suburban (R2)	Noise affected / External	58	45
	Highly noise affected / External	75	N/A
Hospital	External[1]	55	N/A

Table 10: ICNG construction airborne noise criteria for sensitive receivers surrounding the site.

The ICNG recommends internal ground-borne noise maximum levels at residences affected by nearby construction activities. Ground-borne noise is noise generated by vibration transmitted through the ground into a structure and can be more noticeable than airborne noise for some sensitive receivers. The ground-borne noise levels presented below from the ICNG are for residential receivers during evening and night-time periods only, as the objective is to protect the amenity and sleep of people when they are at home.

- Evening: $L_{Aeq,15min}$ 40 dB(A) - internal
- Night: $L_{Aeq,15min}$ 35 dB(A) - internal

The internal noise levels are assessed at the centre of the most affected habitable room.

4.5.2 VIBRATION CRITERIA

4.5.2.1 Human Comfort

The Department of Environment and Climate Change (DECC) developed the document '*Assessing Vibration: A Technical Guideline*' in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. It is based on the guidelines contained in BS 6472.1:2008 '*Guide to evaluation of human exposure to vibration in buildings – Vibration sources other than blasting*'.

The guideline does not address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous (with magnitudes varying or remaining constant with time), impulsive (such as shocks) or intermittent (with the magnitude of each event being either constant or varying with time). Vibration criteria for continuous and impulsive vibration are presented in Table 11 below, in terms of vibration velocity levels.

Place	Time	r.m.s. velocity, mm/s [dB ref 10^{-9}mm/s]			
		Continuous Vibration		Impulsive Vibration	
		Preferred	Maximum	Preferred	Maximum
Critical Areas (Hospitals)	Day or night time	0.10 [100dB]	0.20 [106 dB]	0.10 [100dB]	0.20 [106dB]
Residences	Day-time	0.20 [106 dB]	0.40 [112 dB]	6.00 [136 dB]	12.00 [142 dB]
	Night-time	0.14 [103 dB]	0.28 [109 dB]	2.00 [126 dB]	4.00 [132 dB]

Table 11: Continuous and impulsive vibration criteria applicable to the site

[1] As a guide, the difference between the internal noise level and the external noise level is typically 10 dB with windows open for adequate ventilation as per the NSW ICNG.

When assessing intermittent vibration comprising a number of events, the Vibration Dose Value (VDV) it is recommended to be used. Table 12 shows the acceptable VDV values for intermittent vibration.

Place	*Time*	*Vibration Dose Values, m/s$^{1.75}$*	
		Preferred	*Maximum*
Critical Areas (Hospitals)	When in use	0.10	0.20
Residences	Day-time	0.20	0.40
	Night-time	0.13	0.26

Table 12: Intermittent vibration criteria applicable to the site.

4.5.2.2 Structural Building Damage

Ground vibration from construction activities can damage surrounding buildings or structures. For unoccupied buildings, or during periods where the buildings are unoccupied, the vibration criteria for building damage suggested by German Standard DIN 4150.3:1993 and British Standard BS 7385.2:1993 are to be adopted. Guideline values from DIN 4150.3:1993 and BS 7385.2:1993 are presented in Table 13 and Table 14 respectively.

Structural type	*r.m.s. velocity, mm/s*			
	Foundation			*Plane of floor uppermost full storey*
	Less than 10Hz	*10 to 50Hz*	*50 to 100Hz*	*Frequency mixture*
Dwellings or similar	5	5 to 15	15 to 20	15
Particularly sensitive	3	3 to 8	8 to 10	8

Table 13: DIN 4150.3:1993 Guideline values of vibration velocity for evaluating the effects of short-term vibration.

Structural type	*Peak particle velocity, mm/s*	
	4 to 15Hz	*15Hz and above*
Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s @ 4Hz increasing to 20mm/s @ 15Hz	20mm/s @ 15Hz increasing to 50mm/s @ 40Hz and above

Table 14: BS 7385.2:1993 Guideline values of vibration velocity for evaluating cosmetic damage.

5 OPERATIONAL NOISE ASSESSMENT

External noise emissions from the proposed hospital upgrade have the potential to impact on existing noise sensitive receivers. For the purpose of this noise impact assessment, the noise sources associated with the upgrade are assumed as follows:

- Noise emissions from mechanical plant from the Hospital to the surrounding receivers.
- Noise emissions from traffic generated by the Hospital.

Each of these noise sources has been considered in the noise impact assessment. The acoustic assessment has considered the following:

- The premises will operate 24 hours a day, seven days per week. Therefore the worst-case scenario will be during night-time periods.
- Noise levels have been considered as continuous over assessment time period to provide the worst-case scenario.
- Distance attenuation, building reflections and directivity.

5.1 MECHANICAL SERVICES NOISE

A preliminary noise assessment has been conducted considering the expected noisy plant associated with the proposed development. The units and their associated sound levels are listed in Table 15.

Type	*Number of Units*	*Overall Sound Pressure Level @1m dB(A)*	*Octave Band Sound Pressure Level @ 1m (Hz)*							
			63	*125*	*250*	*500*	*1000*	*2000*	*4000*	*8000*
Cooling Tower Plant Room (North)										
Cooling Tower	1	87	90	90	91	85	79	76	74	73

Table 15: Sound levels of proposed mechanical plant.

Further to the above, a preliminary layout of the proposed plant room can be found in the figure below.

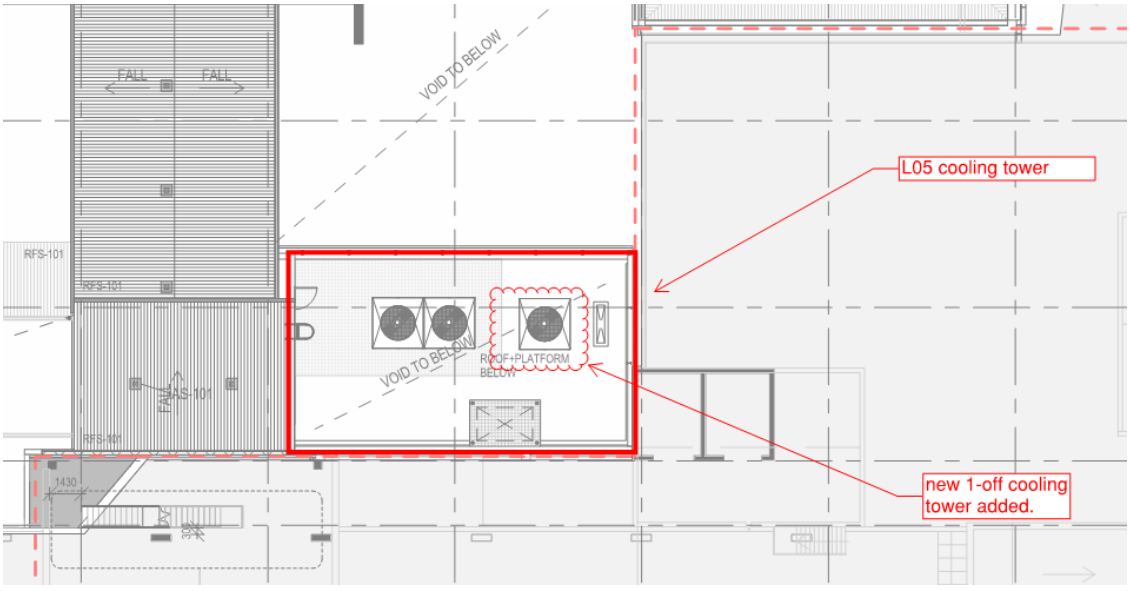

Figure 6: Indicative Layout of Roof Top Mechanical Plant.

Receiver	*Distance from L05 Plant*
R2 Residential	140m
St Georges Private Hospital	180m
R4 Residential	200m

Table 16: Receiver distances to mechanical plant.

5.1.1 MECHANICAL NOISE ASSESSMENT

Noise assessments for the rooftop Mechanical plant to the nearest Residential and Hospital receivers are found in Table 17.

Calculation	*Cooling Tower Plant Room*		
	Residential (R2)	*Hospital*	*Residential (R4)*
Overall L_{Aeq} of Cooling tower plant at 1m, dB(A)	87	87	87
Reflections and Directivity, dB	3	3	3
Distance attenuation, dB	-43	-43	-46
Existing barrier attenuation	-10	-10	-10
Resulting level at receiver boundary, dB(A)	37	37	34
Noise Level Criterion, dB(A)	38	50	43
Complies?	Yes	Yes	Yes

Table 17: Noise assessment for cooling tower mechanical plant at the nearest receivers.

Based on the results of the assessment, the proposed cooling tower plant is expected to meet the external noise requirements as set out in Section 4.

Further to the above, additional noise controls will need to be considered during the design process and prior to Construction Certificate to ensure that the cumulative noise levels from plant to the nearest sensitive receivers meets the noise level criteria.

Usual design noise controls that may need to be implemented will typically include, but are not limited to:

- Strategic location and selection of plant to ensure the cumulative noise levels at the receiver boundaries is met.
- Selection of appropriate quiet plant.
- Acoustic noise control measures to be put in place to minimise noise impacts such as:
  - In-duct attenuation.
  - Noise enclosures as required.
  - Sound absorptive panels.
  - Acoustic louvres as required.
  - Noise barriers as required.

5.2 TRAFFIC GENERATION NOISE

A traffic generation noise assessment has been undertaken in order to determine the potential noise impacts for Kareena Road.

Based on the traffic report prepared by TTW, additional traffic from the Hospital for the year 2023 and 2026 as well as the expected traffic volumes on streets surrounding the proposed hospital are presented below in Table 18.

Peak Hour Vehicle Trips					
Existing Hospital Traffic 2020		*Predicted Traffic 2023 (Phase 1)*		*Predicted Traffic 2026 (Phase 2)*	
am	*pm*	*(am)*	*(pm)*	*(am)*	*(pm)*
106	154	161 (+55)	234 (+80)	188 (+82)	274 (+118)

Table 18: Existing and predicted traffic volumes on Kareena Road.

5.3 ROAD NOISE ASSESSMENT

As noted in Section 4.4.5, when considering land use development and the impact on sensitive land uses, the NSW RNP states that an increase up to 2.0 dB in relation to existing noise levels is anticipated to be insignificant. Considering the predicted traffic volumes as shown above, the increase in traffic noise is summarised below in Table 19.

Period	*Peak Hour Traffic Volume*			*Increase in Traffic Noise (dB(A))*	*Complies?*
	2020	*2023*	*2026*		
AM	106	161	---	1.8	Yes
PM	154	234	---	1.8	Yes
AM	---	161	188	0.5	Yes
PM	---	234	274	0.7	Yes

Table 19: Predicted traffic noise levels increase for Kareena Road (2020 – 2026).

Based on the assessment shown above, traffic generated as a result of the proposed hospital development is not expected to have an adverse noise impact on the surrounding roads and is in compliance with the Road Noise Criteria presented in Section 5.2.

6 RAIL AND TRAFFIC NOISE INTRUSION

A noise assessment for external noise intrusion from the surrounding roads and rail line was undertaken. The Northern facades overlook the Kingsway Road which is a source of continuous traffic noise with an AADT greater than 20,000 as per NSW RMS Data. The Southern façade overlooks the T4 Cronulla Branch Rail Corridor which is also a source of noise and vibration impacting on the development.

As the façade of the development is approximately 160 metres from the nearest operational rail line, this is outside the distance required for an assessment. Hence a noise assessment for rail noise and vibration is not required as per Section 13.

Noise levels from the Kingsway Road have been predicted in accordance with the Calculation of Road Traffic Noise (CoRTN).methodology. This method is recognized by regulatory authorities around Australia and is endorsed by the NSW OEH for use in projects of this scale.

The acoustic assessment has been based on the following

- Detailed noise survey as shown in Section 3.
- Receiver points within internal hospital areas have been located at 1.5m above ground level.
- Internal Hospital areas based on Architectural drawings provided by HDR Architects.
- Solid sections of the façade are assumed to have a sound reduction index of R_w50.
- No specific meteorological characteristics such as dominant wind direction and speed or temperature.
- RMS AADT Data for Kingsway Road.

The predicted noise levels are summarised below in Table 20.

Facade	*Location*	*Period*	*Predicted Noise Levels* $L_{Aeq,\ period}$ *dB(A)*
Kingsway Road	Wards	When In Use	59
	Other Hospital Areas	When In Use	59
Kareena Road	Wards	When In Use	58
	Other Hospital Areas	When In Use	58

Table 20: Road Noise Assessment to Development Façade.

Based on the predicted internal noise levels shown in Table 12, recommended glazing systems and their corresponding sound insulation performances are presented below in Table 21.

Road	*Location*	*Internal Noise Criteria* $L_{Aeq,\ period}$ *dB(A)*	*Fixed Single Glazing System*	*Fixed Double Glazing System*	*Weighted Sound Reduction Index* (R_w)
Kingsway Road	Wards	35	6.38mm Laminate	6mm / 12mm air gap / 6mm	32
	Other Hospital Areas	40	6mm	6mm / 12mm air gap / 10mm	30
Kareena Road	Wards	35	6.38mm Laminate	6mm / 12mm air gap / 6mm	32
	Other Hospital Areas	40	6mm	6mm / 12mm air gap / 10mm	30

Table 21: Recommended glazing to achieve internal noise levels

7 CONSTRUCTION NOISE AND VIBRATION PLANNING

Currently the project is at an early design stage and a detailed construction program is not yet full defined. This section of the Construction Noise and Vibration Planning provides general recommendations only and provides applicable criteria together with best noise and vibration control practices to be observed during the construction of the proposed development.

This preliminary advice in relation to construction noise and vibration management shall form the basis for the Contractor's Construction Noise and Vibration Management Plan.

Any noise from demolition and construction activities to be carried out on site must not result in *'offensive noise'* to any noise sensitive receiver. To this end, the Contractor employed to undertake the demolition and/or construction works is responsible for ensuring that any site noise and, in particular, any complaints shall be monitored, investigated, managed and controlled.

7.1 RELEVANT STANDARDS FOR CONSTRUCTION NOISE AND VIBRATION CRITERIA

Section 4.5 of this report contains the relevant legislation, codes and standards plus construction noise and vibration criteria for this project.

7.2 WORKING HOURS

The following construction hours are proposed as follows:

- Monday to Friday: 7am to 6pm.
- Saturday: 8am to 1pm.
- Sundays and Public Holidays: No excavation or construction works

7.3 PRELIMINARY CONSTRUCTION NOISE ASSESSMENT FOR MAIN WORKS

A preliminary construction noise assessment has been carried out based on typical plant and machinery expected throughout the construction stages. The preliminary noise assessment has been considered at the nearest existing residential receivers and nearest hospital receivers.

These levels are based on the database published by the UK Department for Environmental, Food and Rural Affairs (DEFRA) and Australian Standard AS2436:2010 *'Guide to Noise Control on Construction, Maintenance & Demolition Sites'* for a 15-minute period.

The expected construction noise sources and the predicted noise levels at the nearest residential and hospital receiver are shown below in Table 22.

Receiver	*Nearest Distance*	*Furthest Distance*
R2 Residential	60	150
St Georges Private Hospital	120	180

Table 22: Nearest Affected receivers and distances..

Typical noise levels of construction plant are based on the database published by the UK Department for Environmental, Food and Rural Affairs (DEFRA) & Australian Standard AS2436:2010 *'Guide to Noise Control on Construction, Maintenance & Demolition Sites'* for a 15-minute period.

7.3.1 CONSTRUCTION NOISE ASSESSMENT AT NEAREST RESIDENTIAL RECEIVER

Table 23 shows the maximum allowable sound pressure level at the boundary of the construction site in order to meet the applicable construction noise level criteria at the nearest residential receiver during standard construction hours. Allowances have been made for distance attenuation, shielding and reflections.

Item	*Typical Noise Level* L_{WA} *dB*	*Predicted Noise Level* $L_{Aeq,15m}$ *at nearest residential receiver*	*Complies/ Complies with Highly Noise Affected Criteria?*
Asphalt Paver	108	72-56	No / Yes
Concrete saw	117	73–65	No / Yes
Excavator	107	63-55	No / Yes
Grader	113	69-61	No / Yes
Jack Hammer	121	77-69	No / No
Rock Breaker	118	74-66	No / Yes
Truck (dump)	117	73-65	No / Yes
Vehicle (light commercial)	106	62-54	No / Yes

Table 23: Predicted construction noise levels at the nearest residential receiver

7.3.2 CONSTRUCTION NOISE ASSESSMENT AT KAREENA PRIVATE HOSPITAL

Table 24 shows the maximum predicted internal noise levels within the adjacent hospital. Allowances have been made for distance attenuation, shielding, reflections and façade glazing.

Item	*Typical Noise Level* L_{WA} *dB*	*Predicted Noise Level* $L_{Aeq,15m}$ *at nearest hospital receiver*	*Complies/ Complies with Highly Noise Affected Criteria?*
Asphalt Paver	108	66-55	No / Yes
Concrete saw	117	67-64	No / Yes
Excavator	107	57-54	No / Yes
Grader	113	63-60	No / Yes
Jack Hammer	121	71-68	No / Yes
Rock Breaker	118	68-65	No / Yes
Truck (dump)	117	67-64	No / Yes
Vehicle (light commercial)	106	56-53	No / Yes

Table 24: Predicted construction noise levels at the nearest hospital receiver

Based on the results of the preliminary assessment as shown above, the noise associated with the construction work is expected to exceed the highly noise affected level from the ICNG Guideline at the nearest affected residential receivers with no acoustic screening. The highly noise affected level criteria represents the point above which there may be strong community reaction to noise. Therefore it is recommended that a detailed Construction Noise & Vibration Management Plan is prepared prior to Construction Certificate to further

detail any required mitigation measures. All reasonable feasible measures shall be applied based on the recommendations from the ICNG to further reduce any adverse noise impacts.

7.3.3 VIBRATION

The NSW RMS *'Construction Noise and Vibration Guideline'* provides safe working distances for vibration intensive plant and are quoted for both 'cosmetic' damage (in accordance with BS 7385.2:1993) and human comfort (in accordance with DECC's *'Assessing Vibration: A Technical Guideline'*). The recommended safe working distances for typical construction plant are provided in Table 26.

Plant Item	*Description*	*Cosmetic Damage*	*Human Response*
Small Hydraulic Hammer	5-12 tonne	2m	7m
Medium Hydraulic Hammer	12-18 tonne	7m	23m
Jackhammer	Hand held	1m	Avoid Contact with Structure

Table 25: Recommended minimum working distances for vibration intensive plant from sensitive receivers.

For any vibration intensive plant expected to be within close proximity of the minimum distances described above, the contractor must engage a qualified engineer to carry out a vibration survey in order to assess any potential risks.

The vibration survey and assessment will determine whether the vibration levels might exceed the relevant criteria then vibration mitigation and management measures will need to be put in place to ensure vibration impacts are minimized as far possible.

7.4 MITIGATION MEASURES

7.4.1 PROJECT SPECIFIC MITIGATION MEASURES

In order to meet the noise and vibration requirements of the site, the Contractor is recommended to engage a qualified acoustic consultant to assist in the compilation of a Construction Noise and Vibration Management Plan. The report shall document acoustic measures required to minimise any adverse noise impacts to the nearby affected receivers. The acoustic measures detailed within the report may include fixed and/or mobile acoustic screens, scheduling of works including any respite periods and identifying noisy works that can be further managed. Further to this, a noise and vibration survey is recommended to be defined for any noisy and/or vibration intensive works.

7.4.2 GENERAL MITIGATION MEASURES

It is noted that the reduction of noise and vibration at the source and the control of the transmission path between the construction site and the receiver(s) are the preferred options for noise minimisation. Providing treatments at the affected receivers should only be considered as a last resort. Construction noise and vibration shall be managed by implementing the strategies listed below:

- *Plant and equipment*. In terms of both cost and results, controlling noise and vibration at the sources is one of the most effective methods of minimising the impacts from any work site activities. Work practices that will reduce noise and vibration at the source include:
  - Employing quieter techniques for all high noise activities such as rock breaking, concrete sawing, and using power and pneumatic tools.

  - Use quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
  - Selecting plant and equipment with low vibration generation characteristics.
  - Operate plant in a quietest and most effective manner.
  - Where appropriate, limit the operating noise of equipment.
  - Regularly inspecting and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.
- *On site noise management.* Practices that will reduce noise from the site include:
  - Maximising the distance between noise activities and noise sensitive receivers. Strategically locate equipment and plant.
  - Undertaking noisy fabrication work off-site where possible.
  - Avoid the use of reversing beeping alarms or provide for alternative systems, such as broadband reversing alarms, particularly during night or out-of-hours works.
  - Maintaining any pre-existing barriers or walls on a demolition or excavation site as long as possible to provide optimum sound propagation control.
  - Constructing barriers that are part of the project design early in the project to afford mitigation against site noise.
  - Using temporary site building and material stockpiles as noise barriers. These can often be created using site earthworks and may be included as a part of final landscape design.
  - Installing purpose built noise barriers, acoustic sheds and enclosures.
- *Work scheduling.* Scheduling work during periods when people are least affected is an important way of reducing adverse impacts. The following scheduling aspects may reduce impacts:
  - Provide respite periods, including restricting very noisy activities to daytime, restricting the number of nights that after-hours work is conducted near residences, or by determining any specific requirements, particularly those needed for noise sensitive receivers.
  - Scheduling activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events.
  - Scheduling work to coincide with non-sensitive periods.
  - Scheduling noisy activities to coincide with high levels of neighbourhood noise so that noise from the activities is partially masked and not as intrusive.
  - Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from sensitive receivers.
  - Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
  - Designating, designing and maintaining access routes to the site to minimise impacts.
  - Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.
- *Consultation, notification and complaints handling.*
  - Provide information to neighbours before and during construction.
  - Maintain good communication between the community and Project staff.
  - Have a documented complaints process and keep register of any complaints.
  - Give complaints a fair hearing and provide for a quick response.
  - Implement all feasible and reasonable measures to address the source of complaint. Implementation of all reasonable and feasible mitigation measures for all works will ensure that

any adverse noise impacts to surrounding receivers are minimised when noise goals cannot be met due to safety or space constraints.

7.4.3 ADDITIONAL NOISE AND VIBRATION CONTROL MEASURES

If, during construction, an item of equipment exceeds ether the noise criteria at any location or the equipment noise level limits, the following noise control measures, together with construction best practices, shall be considered to minimise the noise impacts on the neighbourhood.

- Schedule noisy activities to occur outside of the most sensitive times of the day for each nominated receiver.
- Consider implementing equipment-specific screening or other noise control measures recommended in Appendix C of AS 2436:2010.
- Limit the number of trucks on site at the commencement of site activities to the minimum required by the loading facilities on site.
- When loading trucks, adopt best practice noise management strategies to avoid materials being dropped from height into dump trucks.
- Avoid unnecessary idling of trucks and equipment.
- Ensure that any miscellaneous equipment (extraction fans, hand tools, etc.) not specifically identified in this plan incorporates silencing/shielding equipment as required to meet the noise criteria.

Implementation of all reasonable and feasible mitigation measures for all internal and underground works will ensure that any adverse noise impacts to surrounding residential, commercial and recreational receivers are minimised when noise goals cannot be met due to safety or space constraints.

The NSW RMS '*Construction Noise and Vibration Guideline*' provides safe working distances for vibration intensive plant and are quoted for both 'cosmetic' damage (in accordance with BS 7385.2:1993) and human comfort (in accordance with DECC's '*Assessing Vibration: A Technical Guideline*'). The recommended safe working distances for typical construction plant are provided in Table 26.

Plant Item	*Description*	*Cosmetic Damage*	*Human Response*
Small Hydraulic Hammer	5-12 tonne	2m	7m
Medium Hydraulic Hammer	12-18 tonne	7m	23m
Large Hydraulic Hammer	18-34 tonne	22m	73m
Vibratory Pile Driver	Sheet piles	2-20m	20m
Pile Boring	<800mm	2m	N/A
Jackhammer	Hand held	1m	Avoid Contact with Structure

Table 26: Recommended minimum working distances for vibration intensive plant from sensitive receivers.

8 CONCLUSION

A noise & vibration impact assessment for SSDA has been carried out for the Sutherland Hospital Operating Theatre Upgrade Project. This report forms part of the documentation package to be submitted to the Department of Planning as part of the SSDA.

This report establishes relevant noise level criteria, details the acoustic assessment and provides comments and recommendations for the proposed development.

The noise assessment has adopted methodology from relevant guidelines, standards and legislation to assess noise impact. The noise impacts have been predicted at the nearest noise sensitive receiver boundaries.

A preliminary acoustic assessment of mechanical services noise has been conducted. Based on the results of the assessment, the proposed cooling tower plant is expected to meet the external noise requirements as set out in Section 4. Further to the above, additional noise controls will need to be considered during the design process and prior to Construction Certificate to ensure that the cumulative noise levels from plant to the nearest sensitive receivers meets the noise level criteria.

An assessment of traffic noise generation has been carried out on Kareena Rd. Based on the assessment, additional traffic movements will not result in any noticeable change in traffic noise levels and is expected to meet the NSW Road Noise Policy recommendations.

An acoustic assessment of the road and rail noise intrusion has been carried out. Based on the results of the assessment, recommendations have been provided for the minimum sound insulation performance of the external glazing in order to meet the required internal noise levels.

Potential construction noise and vibration impacts on the nearest residential receiver have been presented in this report and recommendations based on the relevant guidelines are provided. If during any construction work, equipment exceeds the established noise and / or vibration level criteria at any sensitive receiver, the additional noise and vibration control measures shall be considered to minimise the noise and vibration impacts.

The information presented in this report shall be reviewed if any modifications to the features of the development specified in this report occur, including and not restricted to selection of equipment and plant, and introduction of any additional noise sources.

Based on the information presented in this report, relevant objectives will be satisfied and therefore approval is recommended to be granted.

APPENDIX A – AMBIENT NOISE MONITORING DATA

ACOUSTIC TERMS

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.

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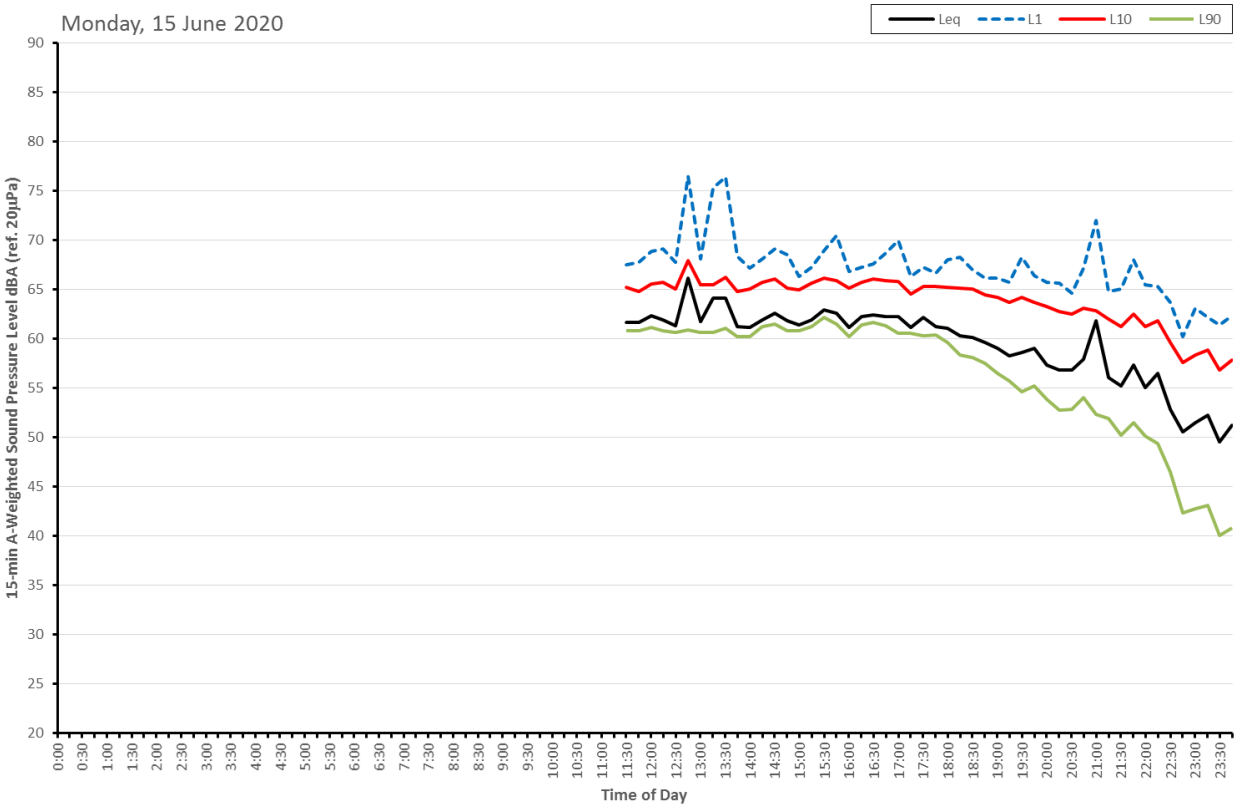
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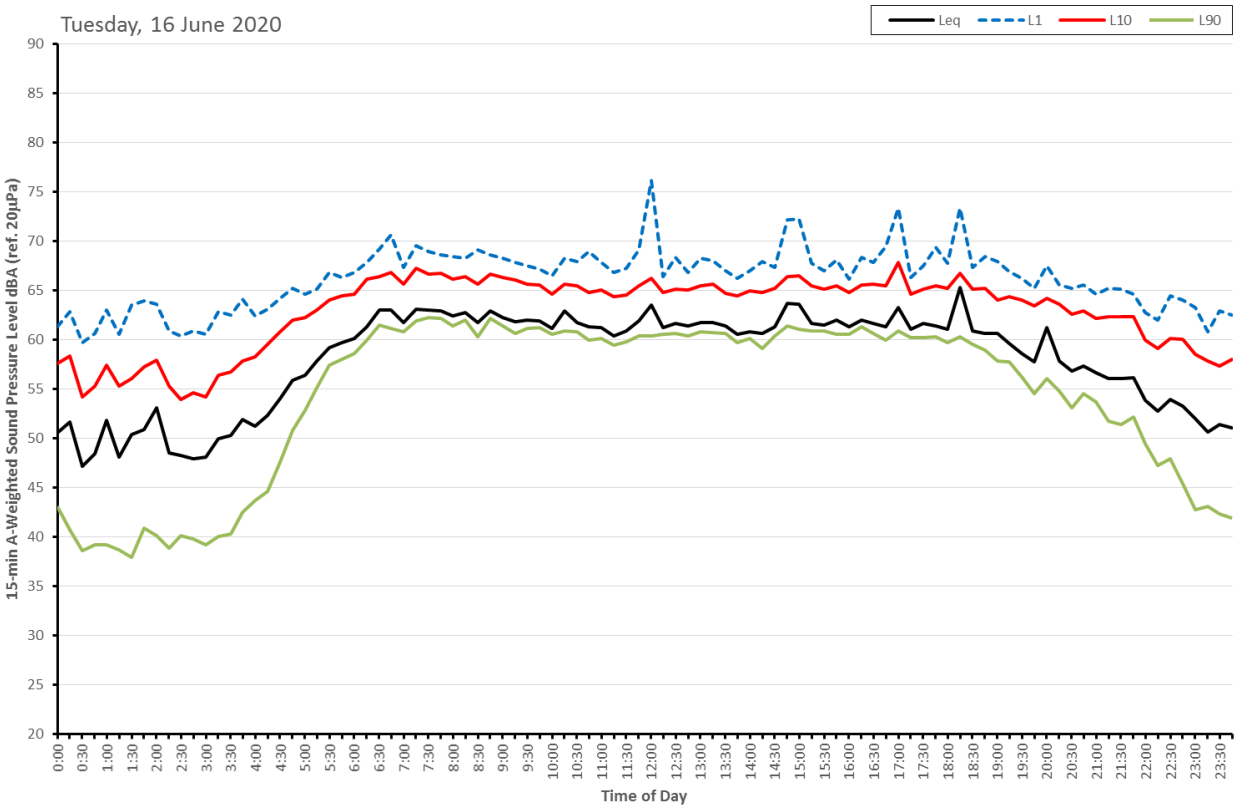
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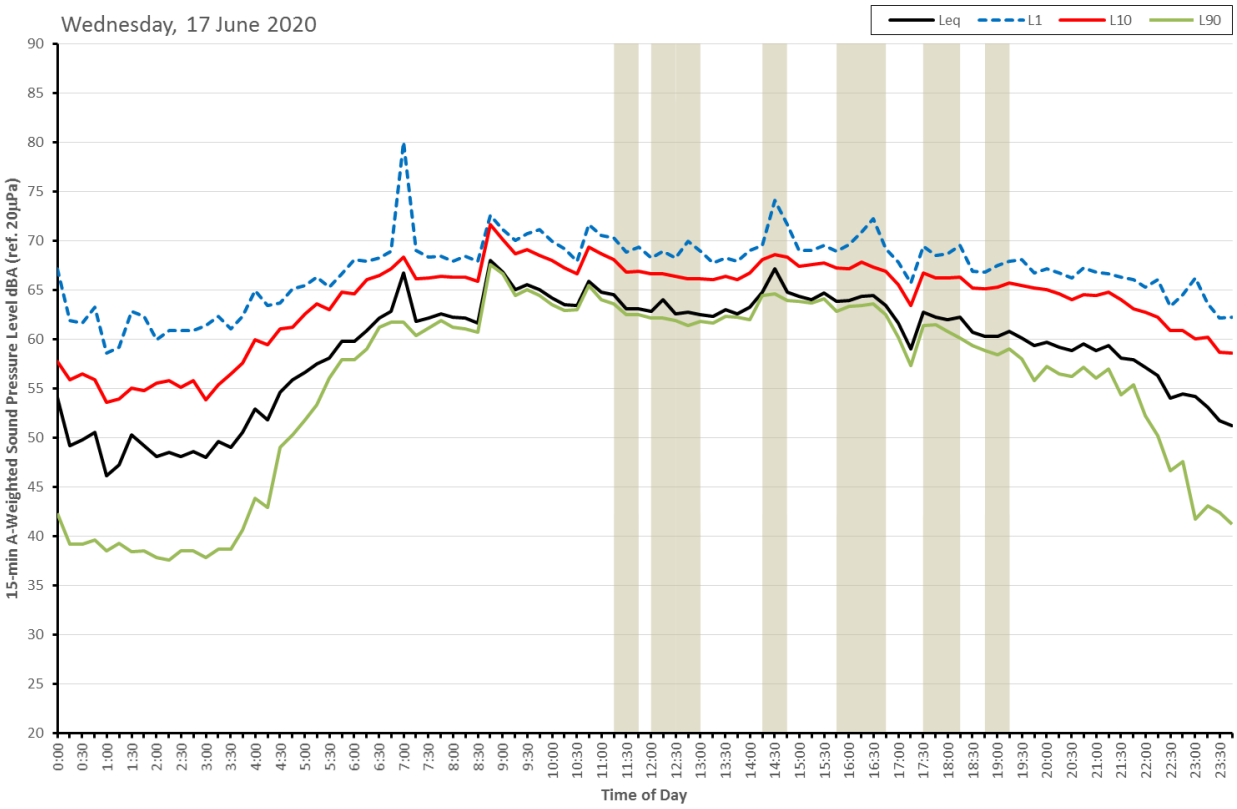
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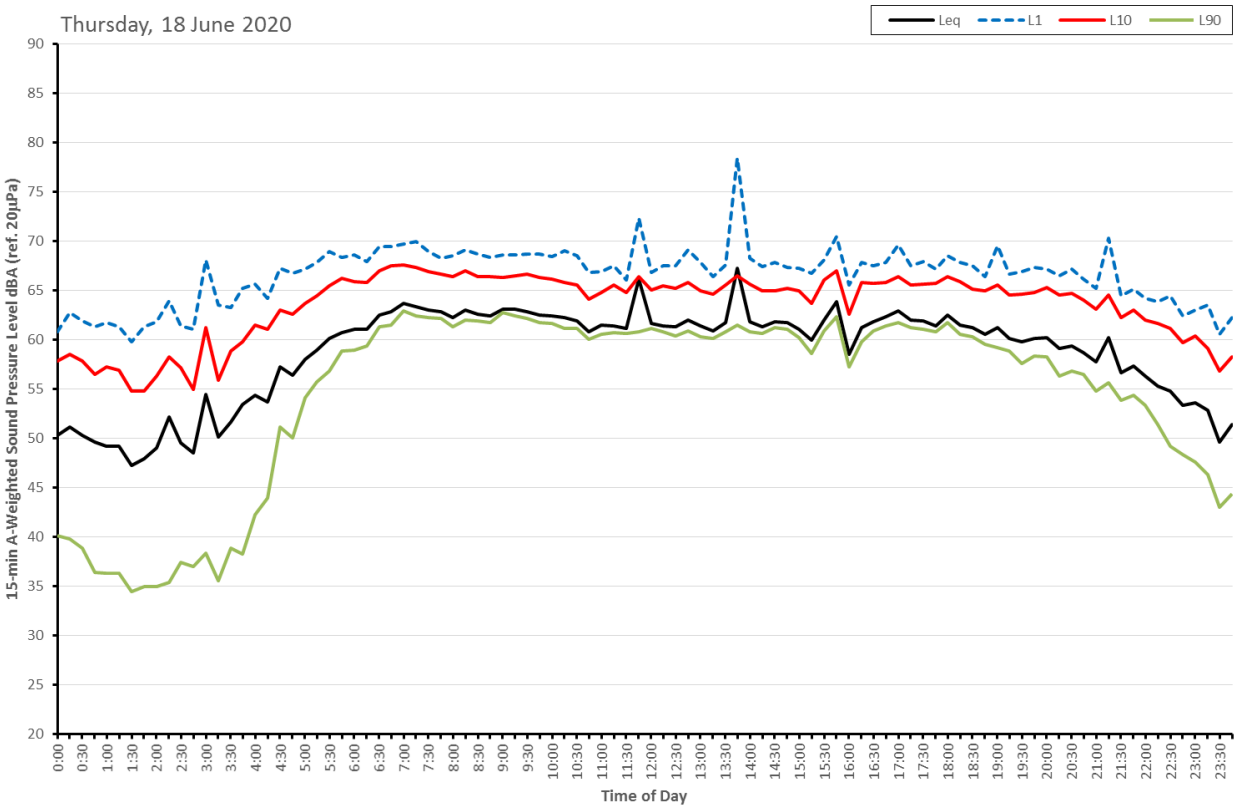
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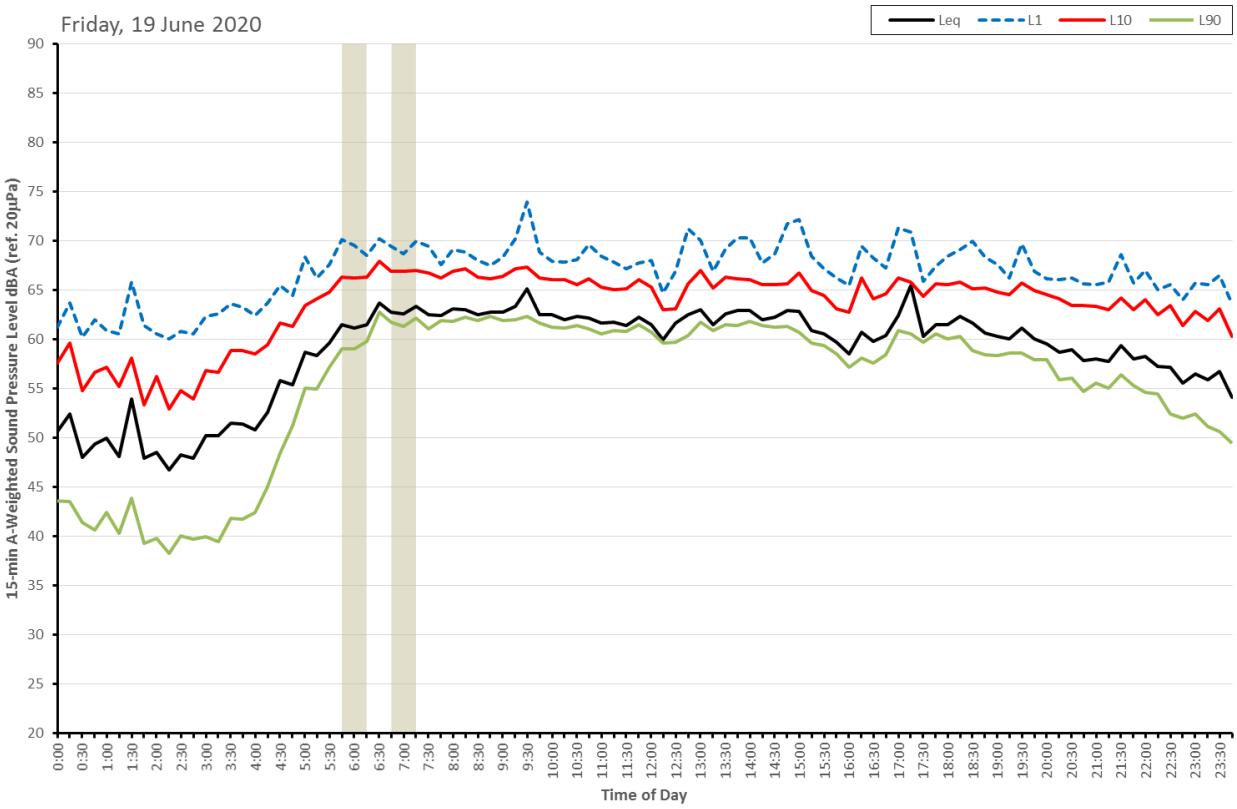
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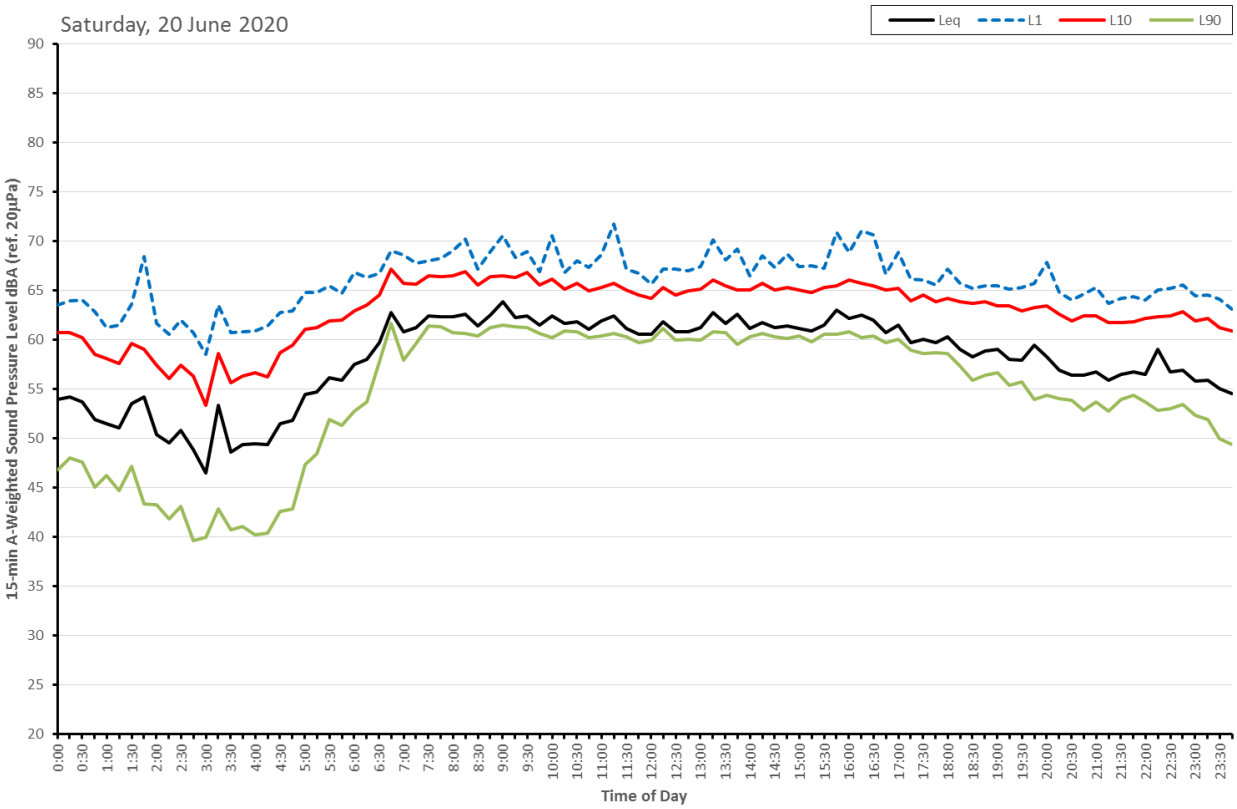
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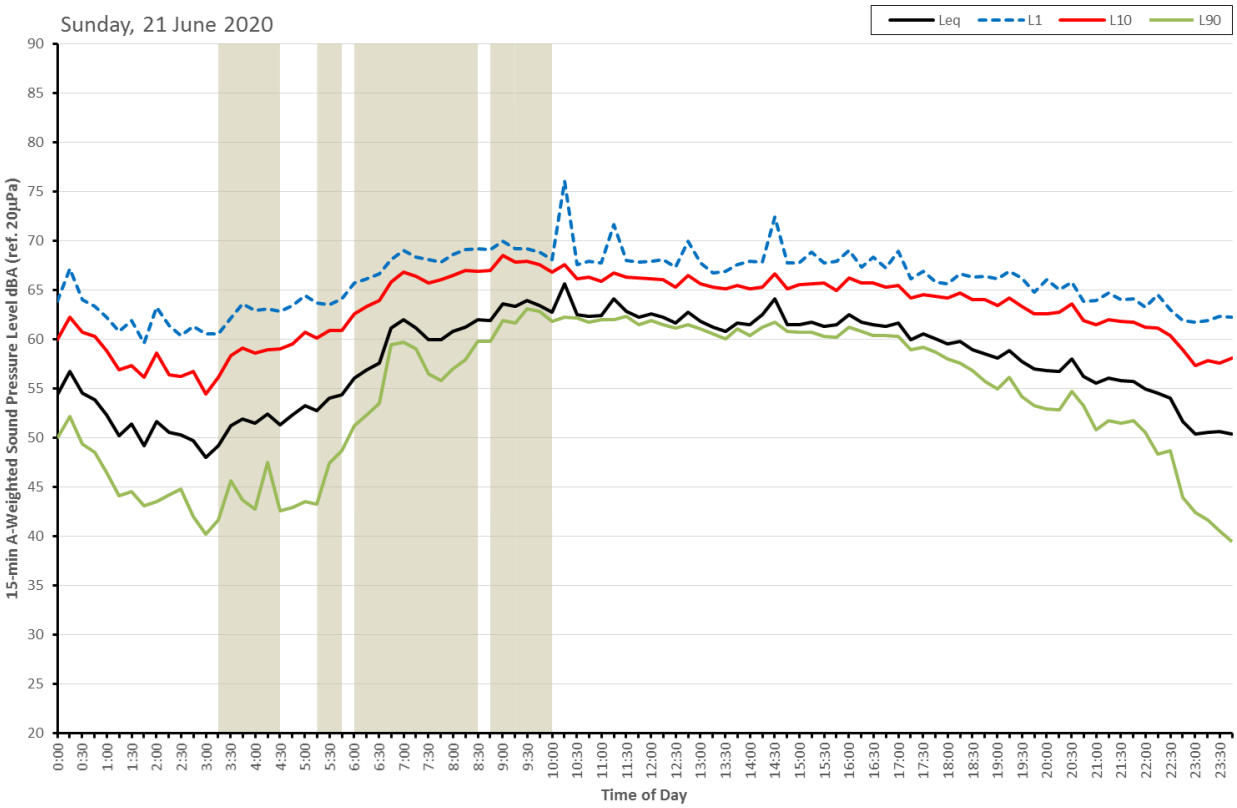
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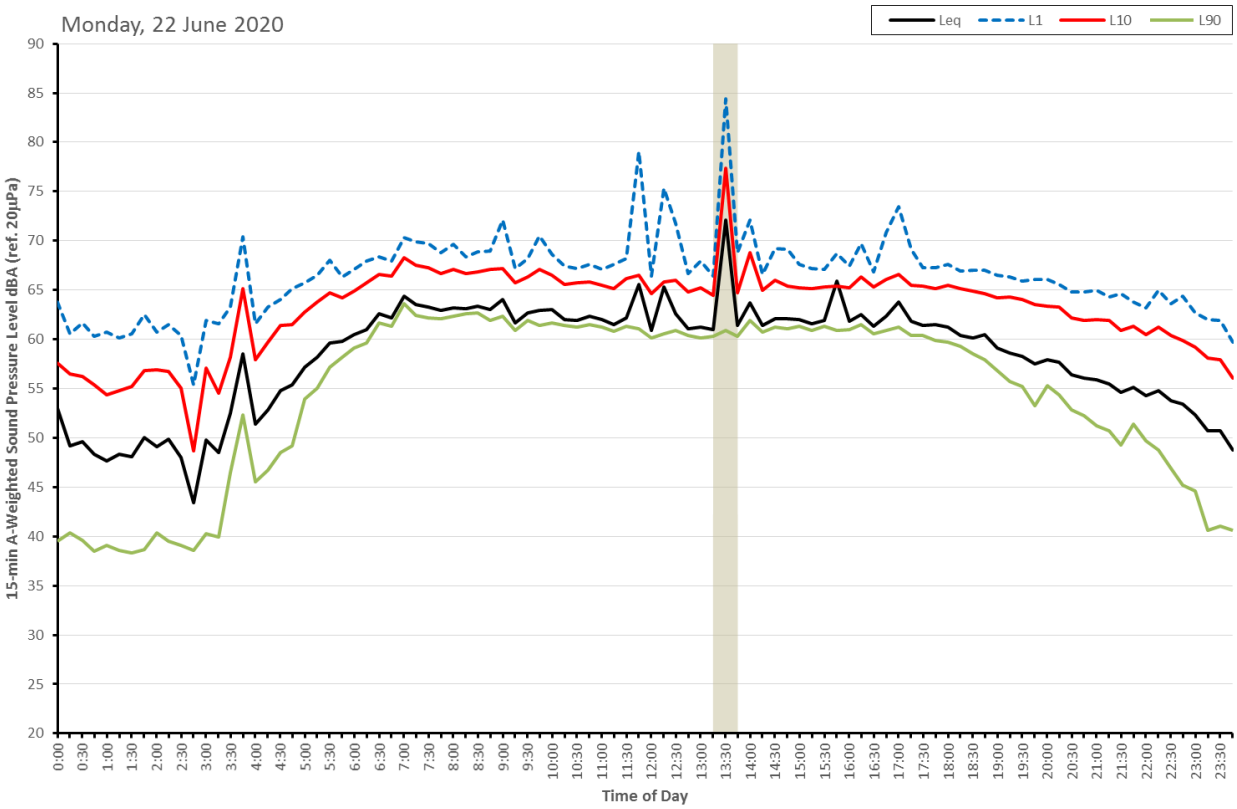
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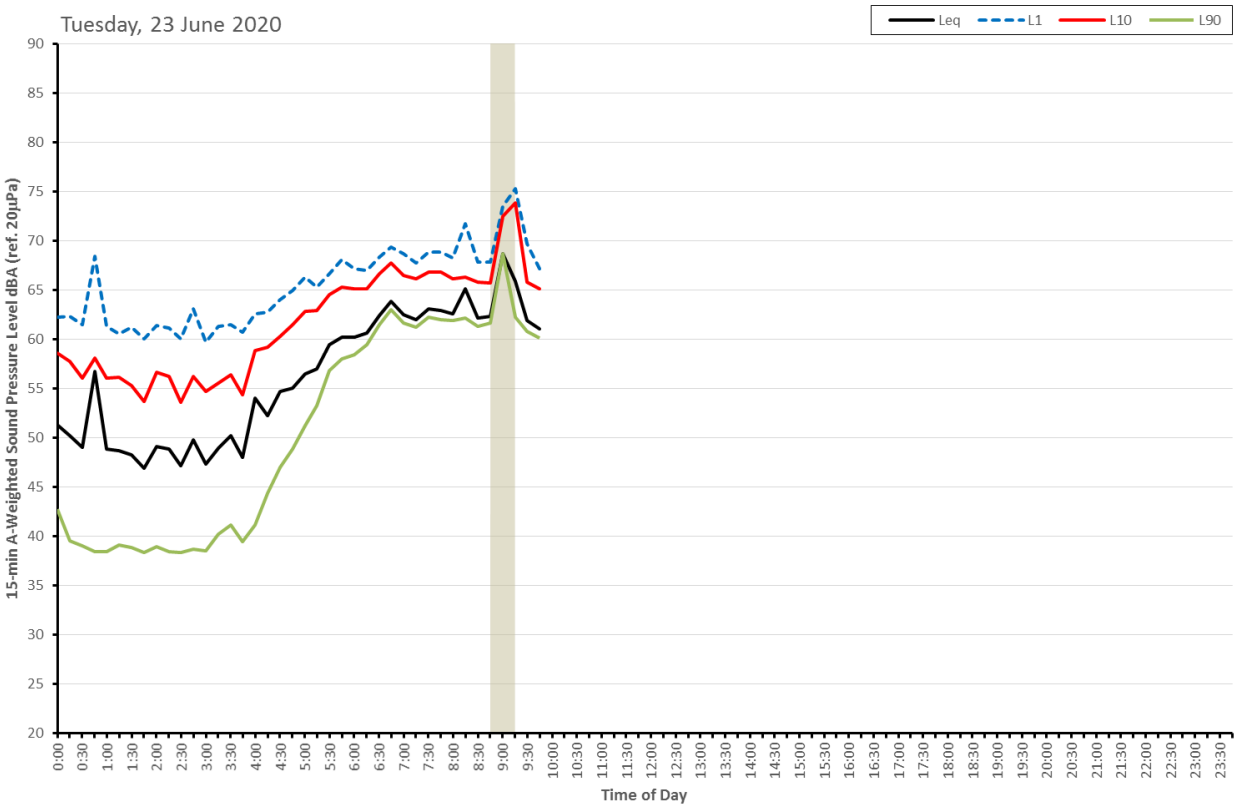
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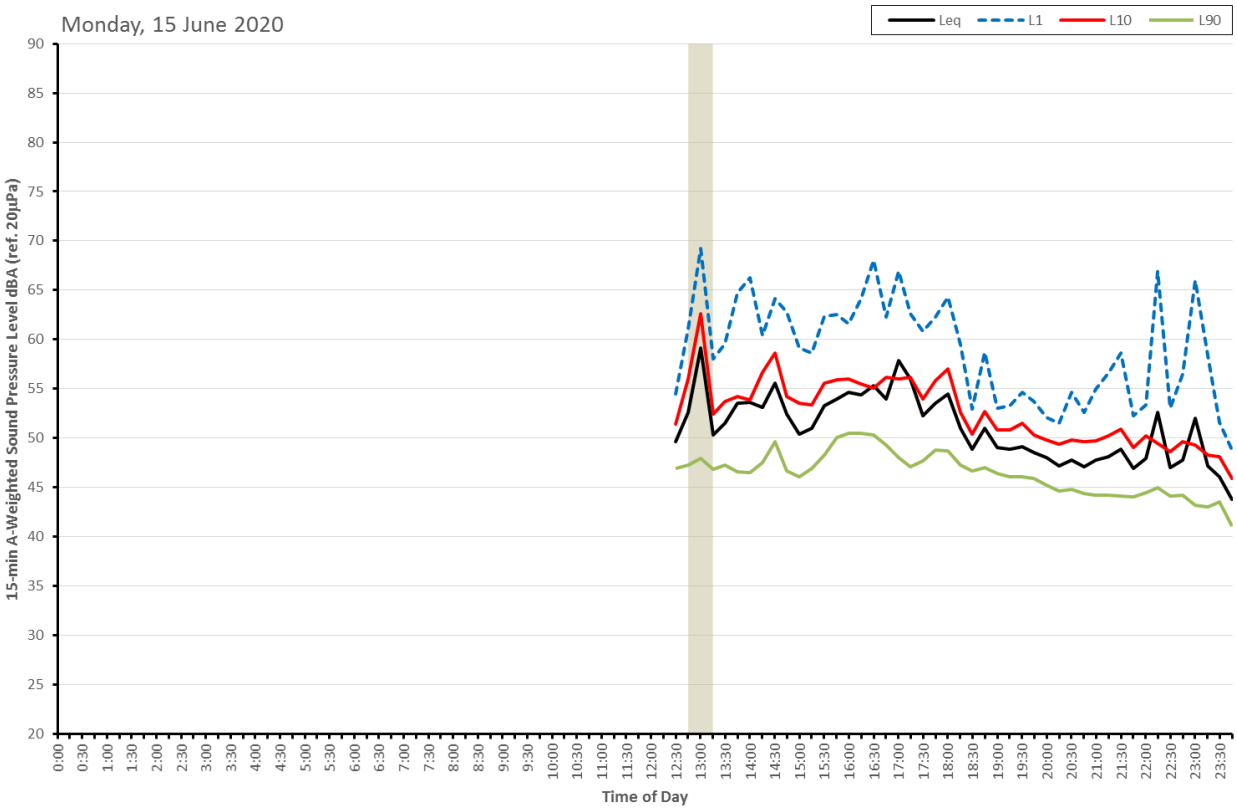
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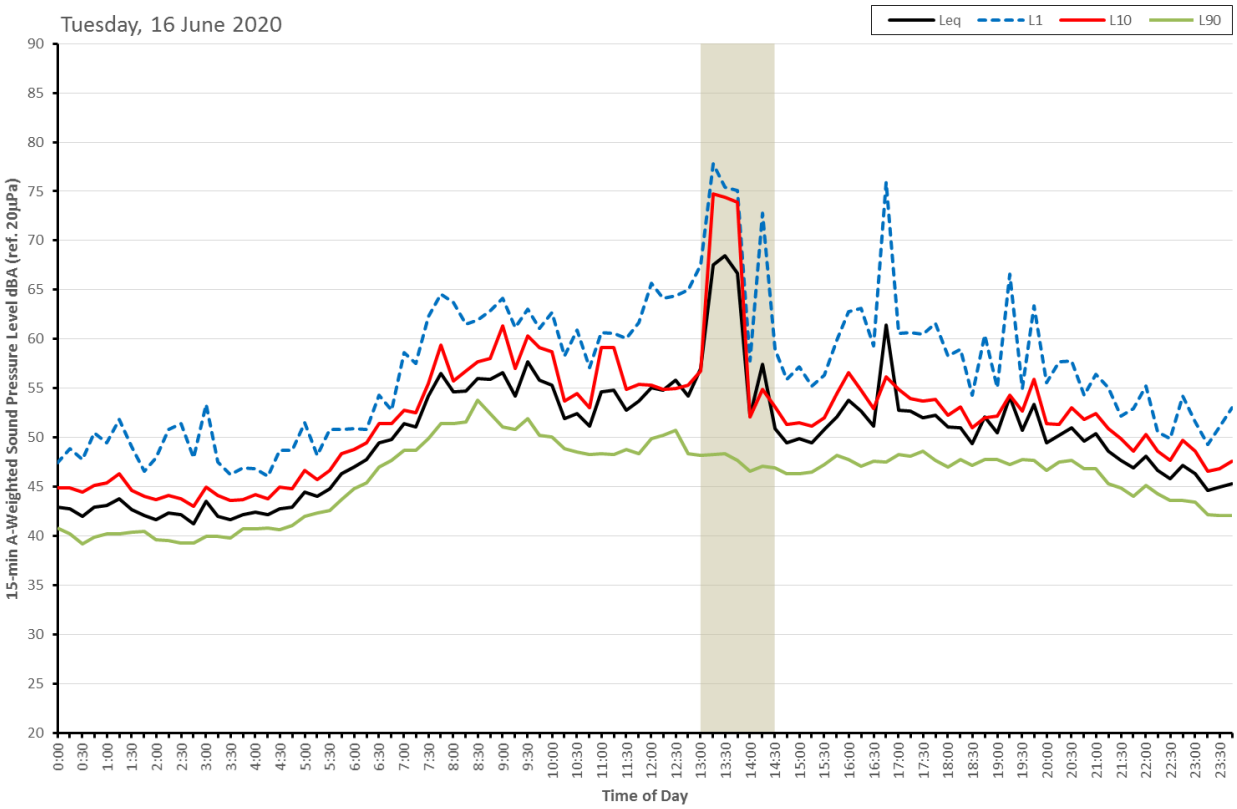
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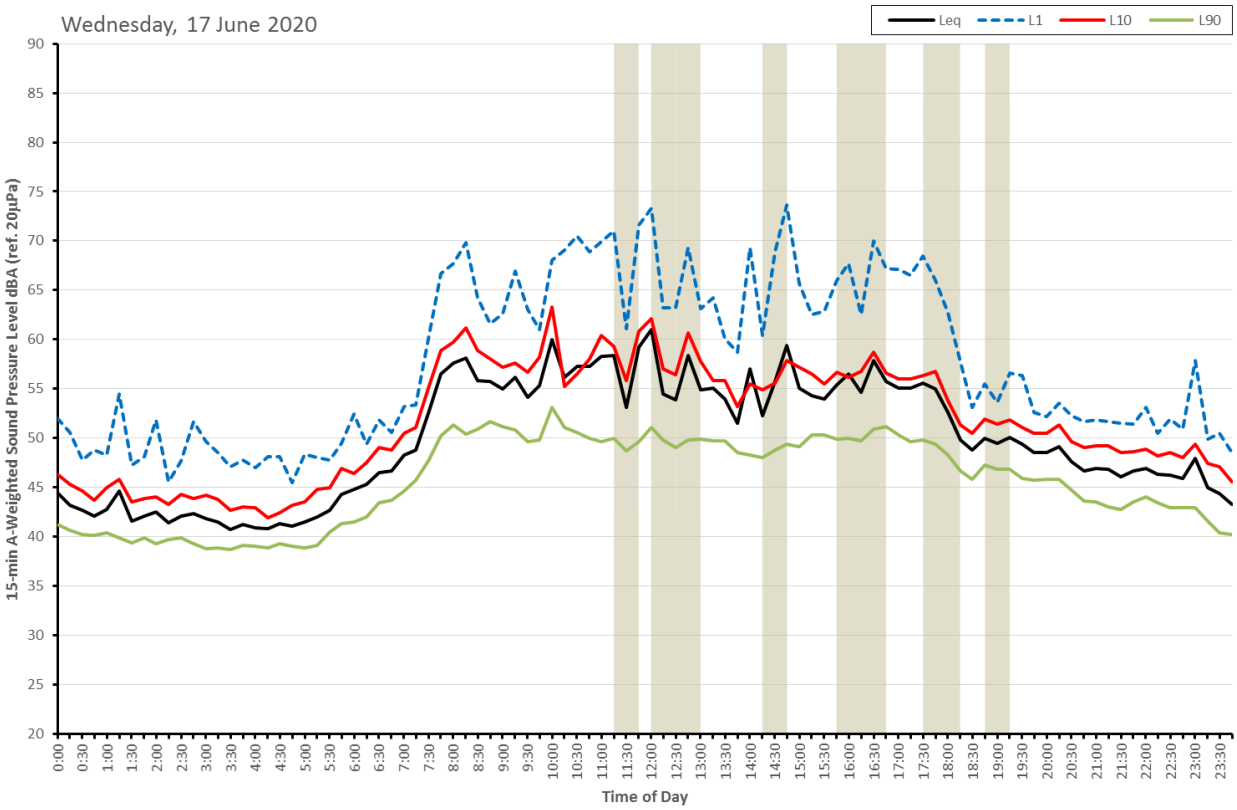
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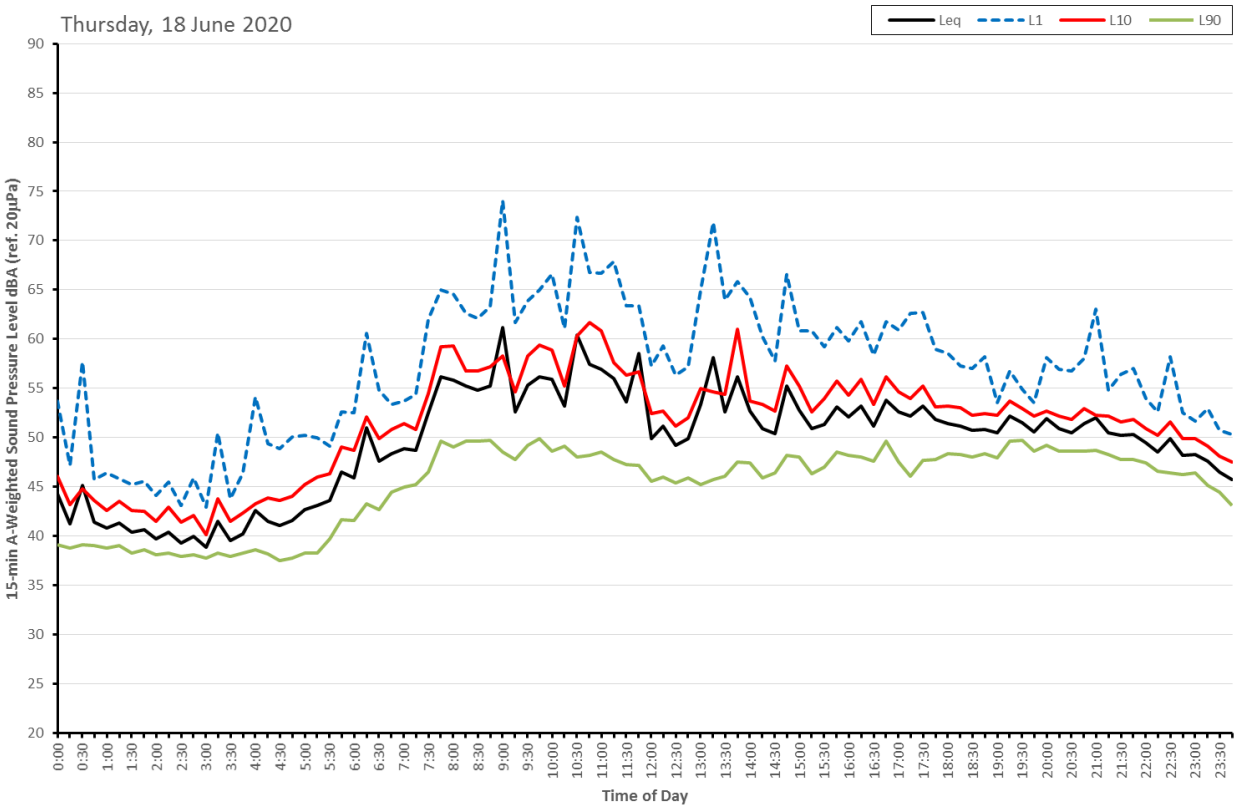
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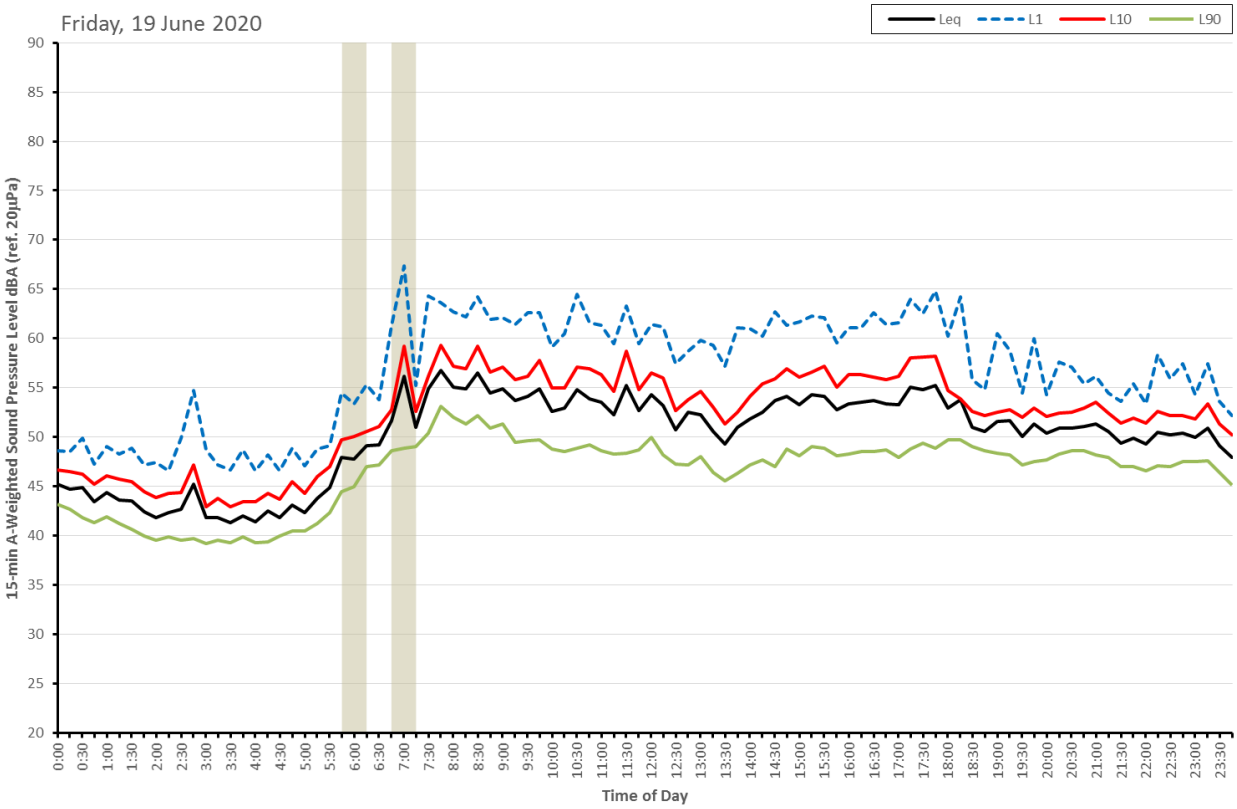
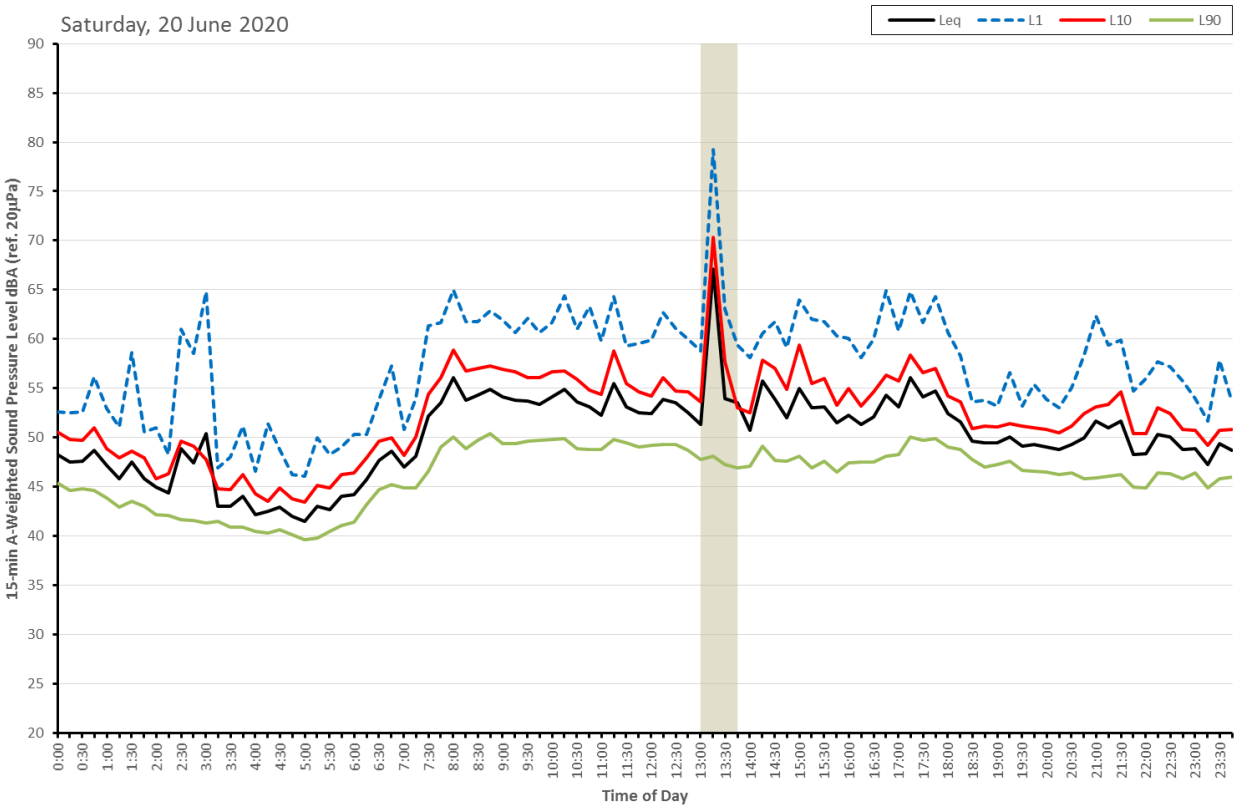
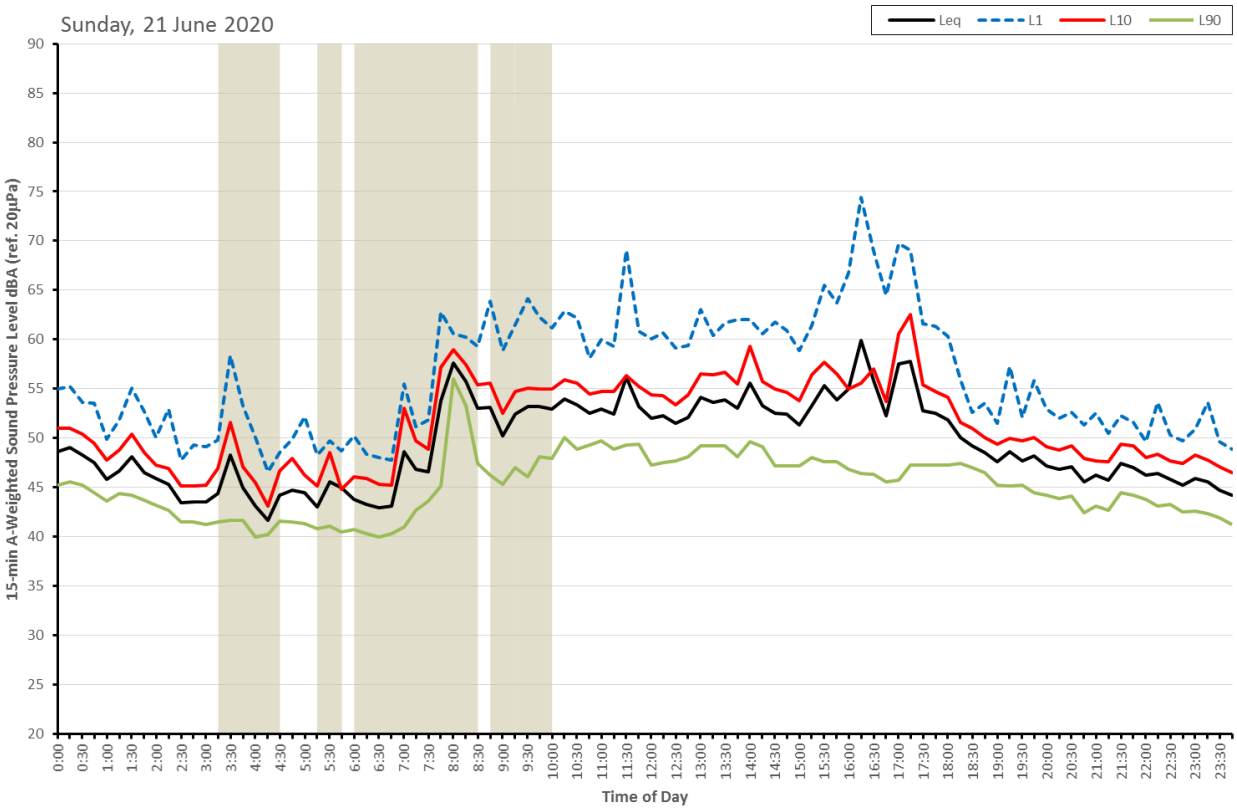
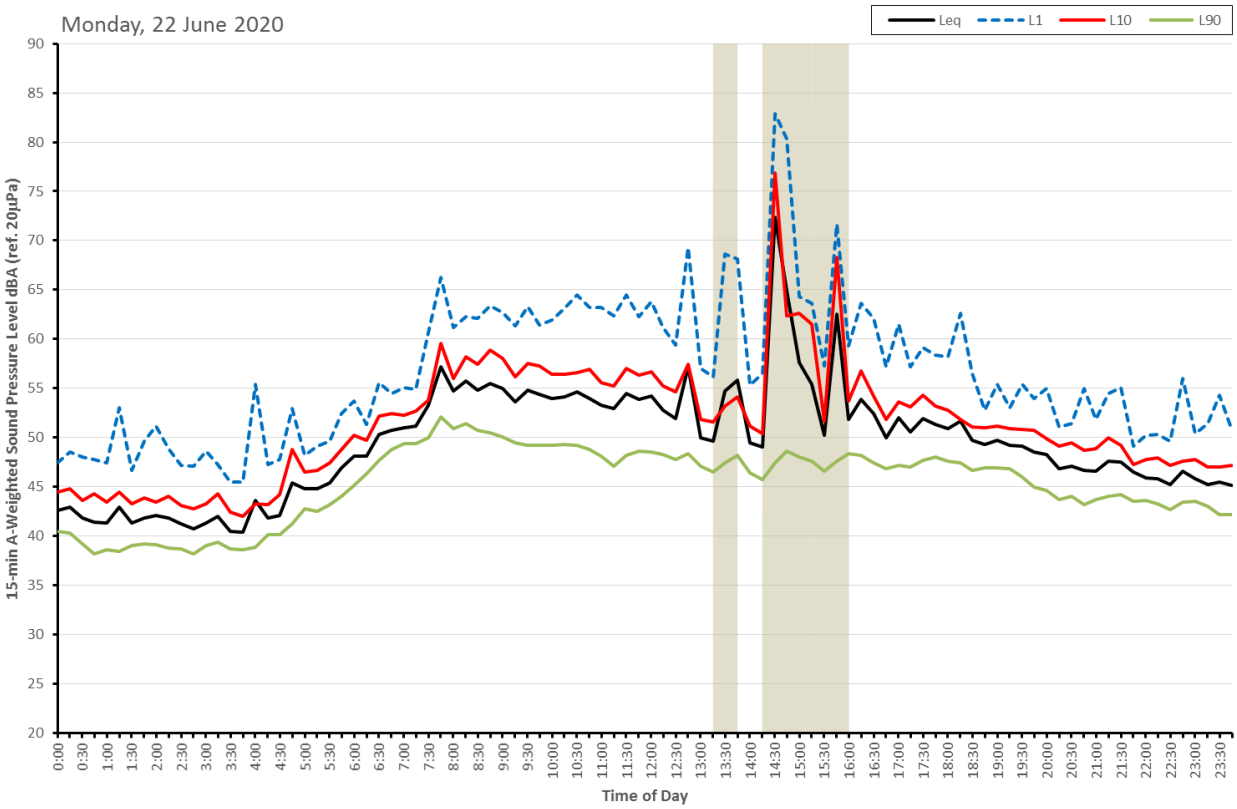
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

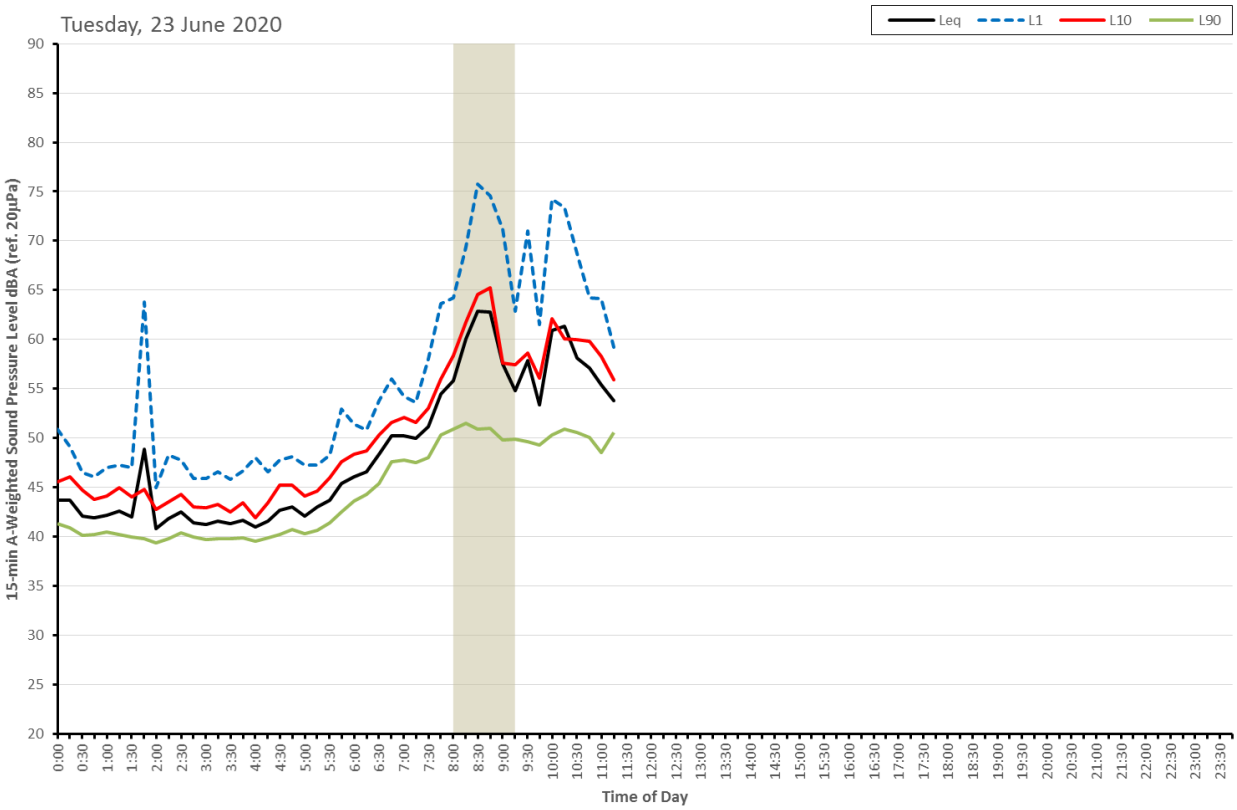
1


Friday, 19 June 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

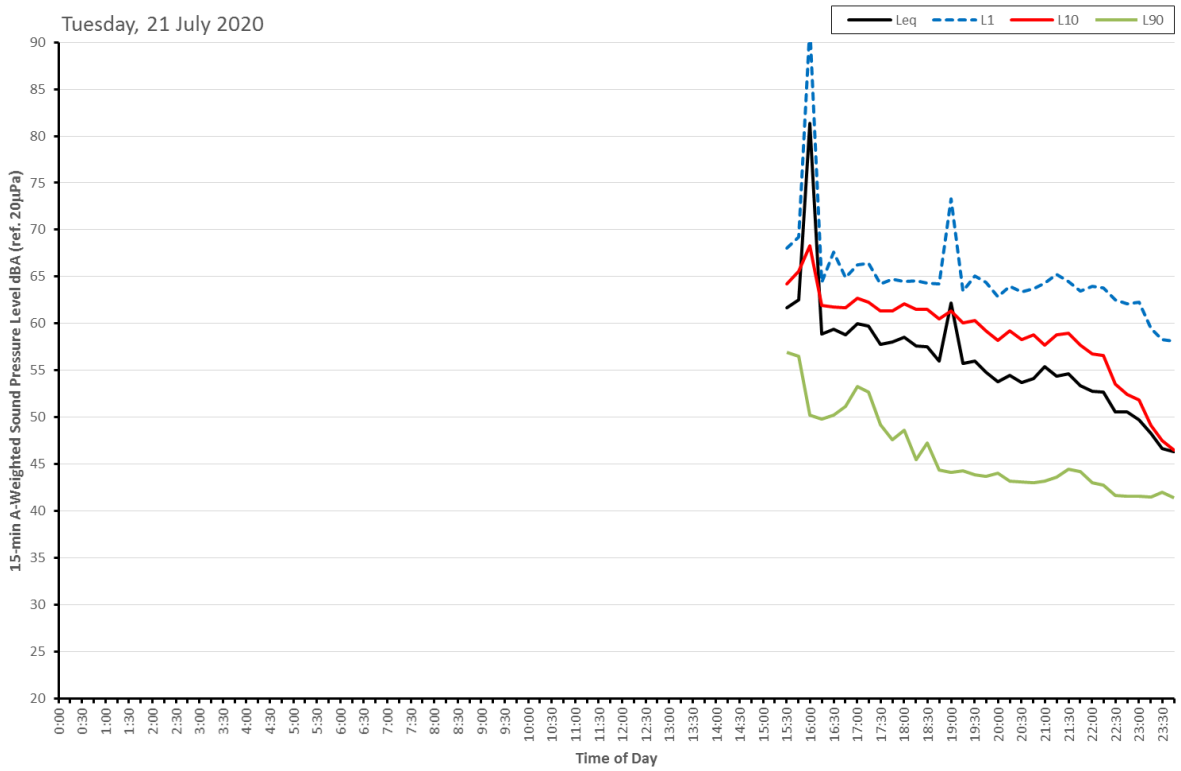

Saturday, 20 June 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

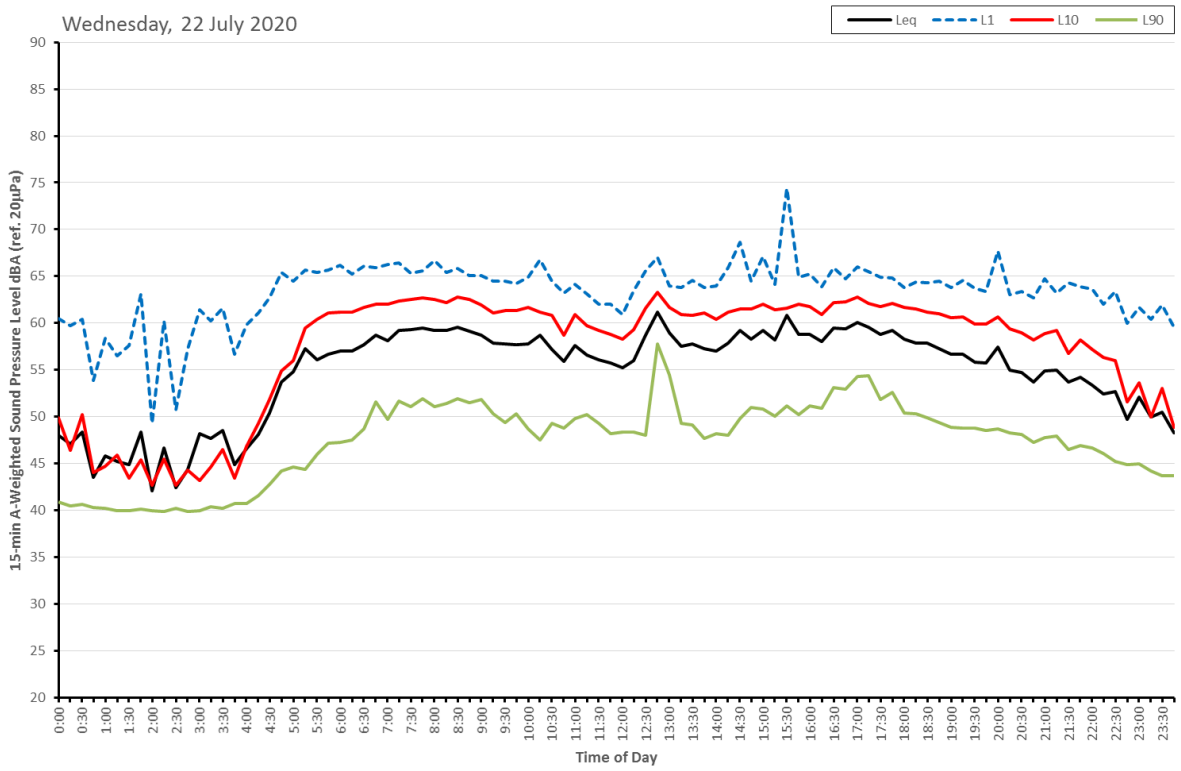

Sunday, 21 June 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

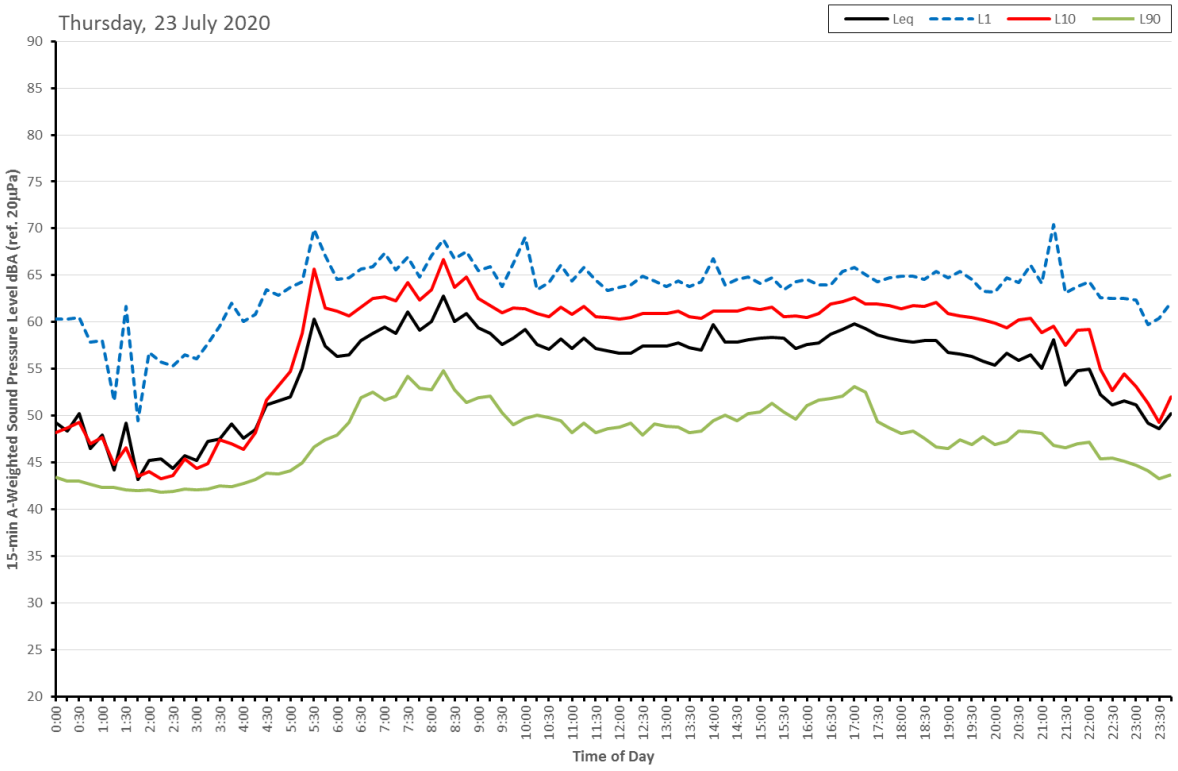

Monday, 22 June 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

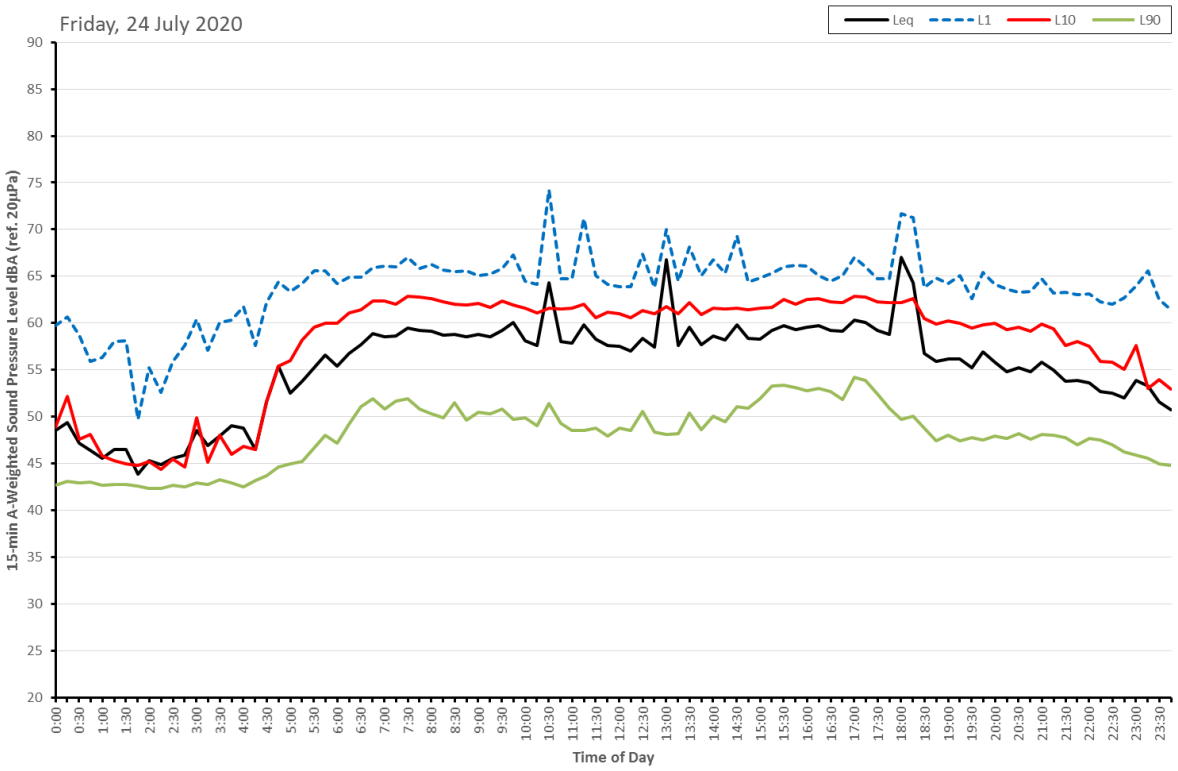

Tuesday, 23 June 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

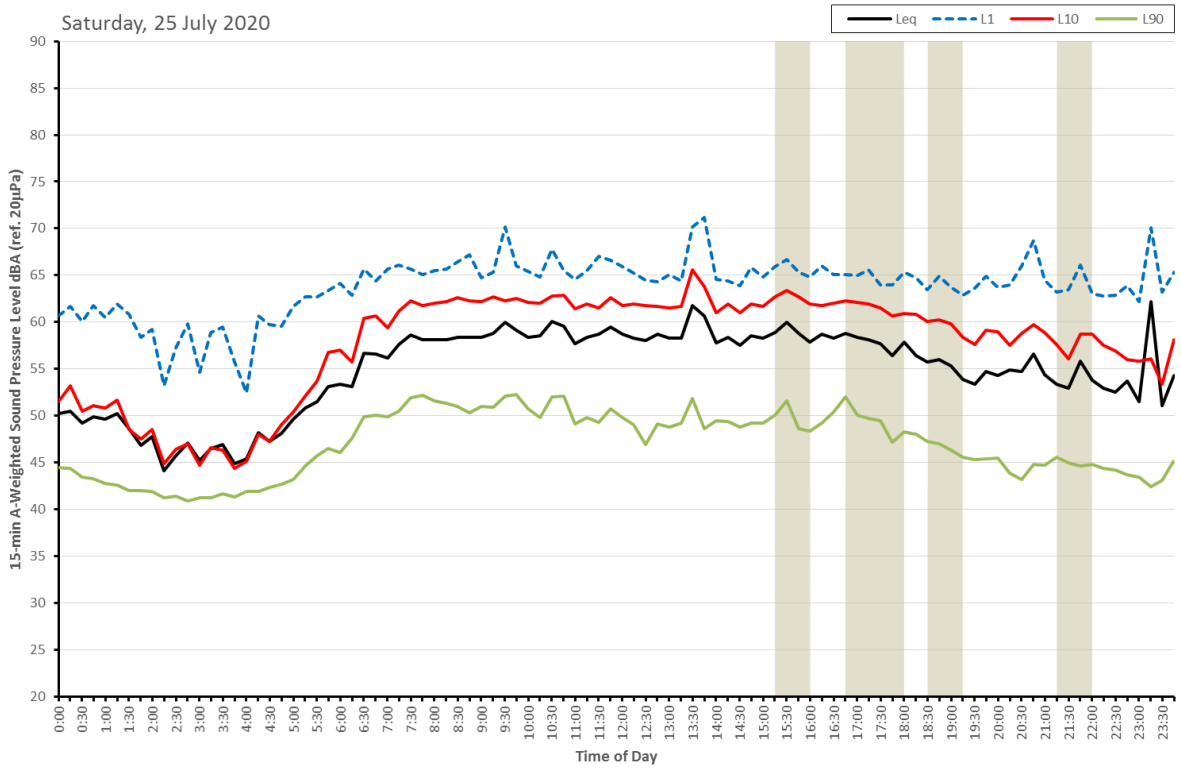
Logger 3

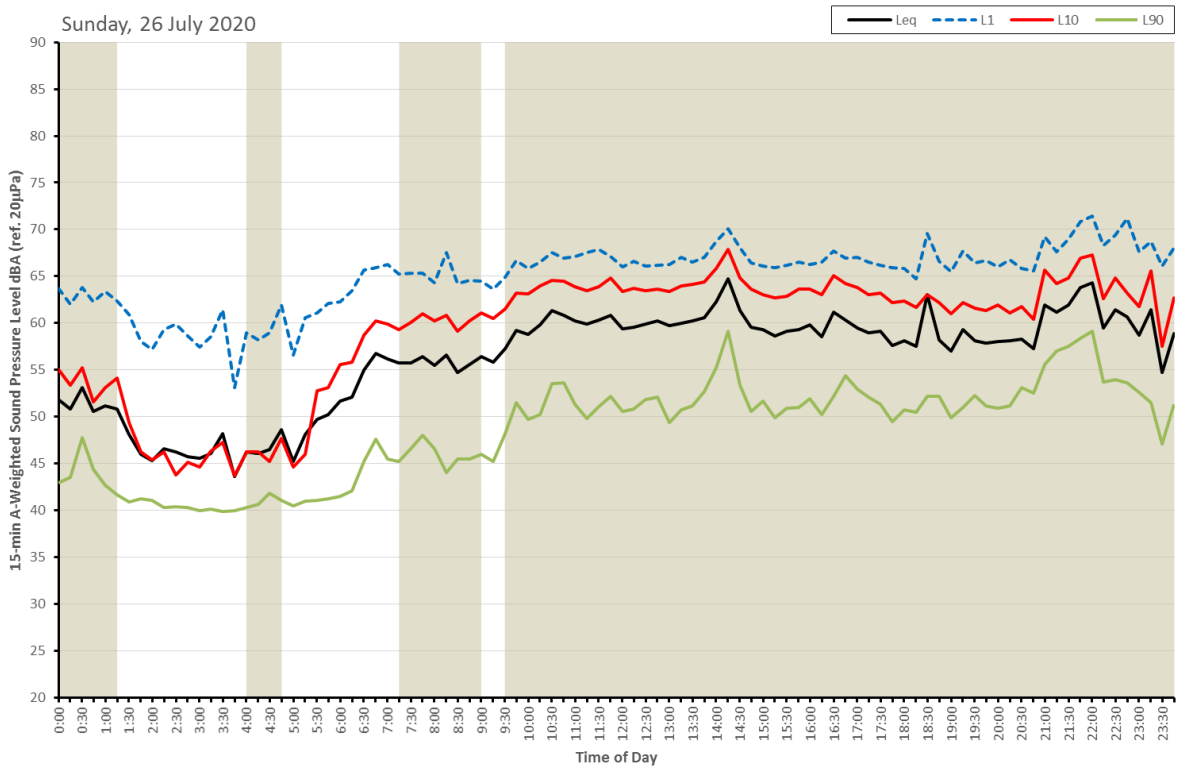

Tuesday, 21 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

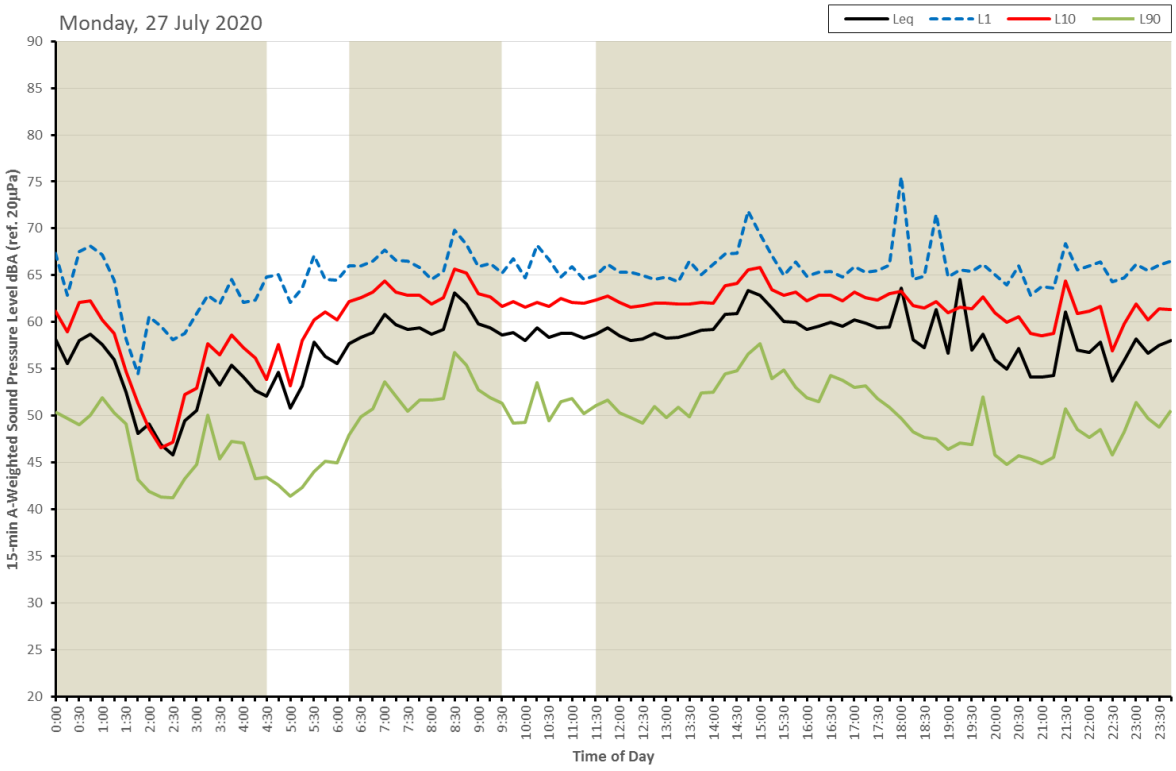

Wednesday, 22 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

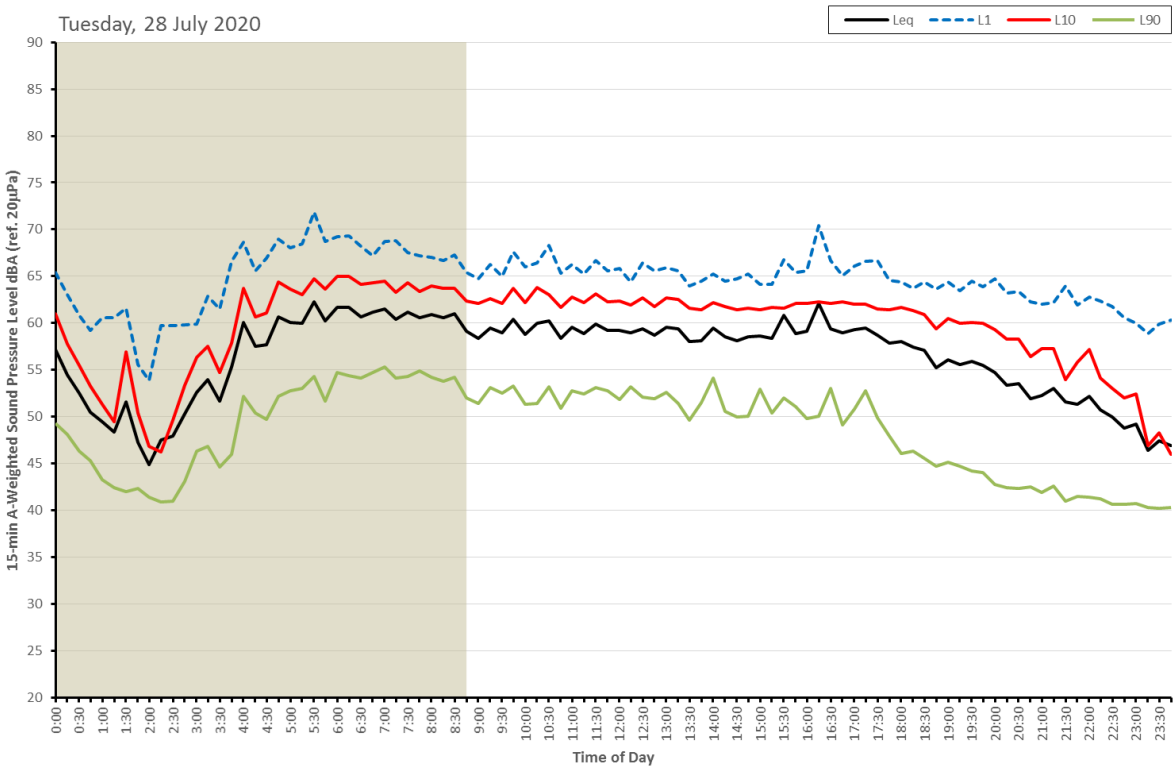

Thursday, 23 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

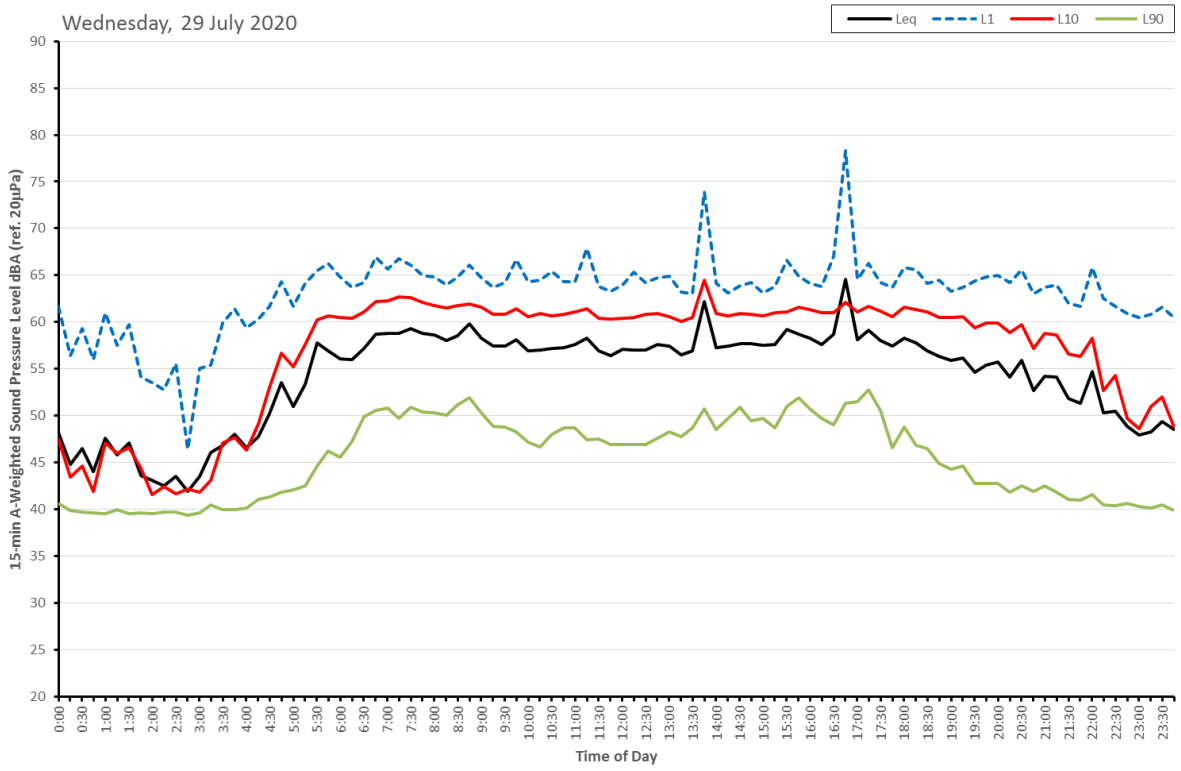

Friday, 24 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

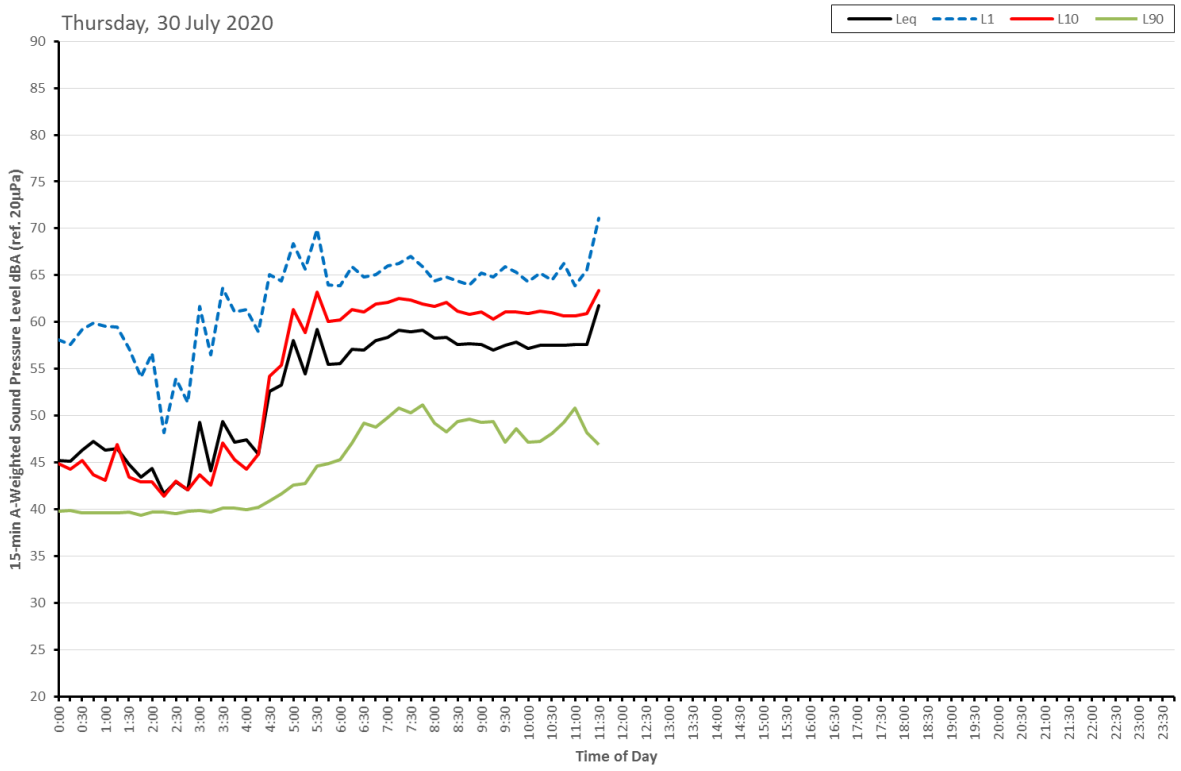

Saturday, 25 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Sunday, 26 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Monday, 27 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Tuesday, 28 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Wednesday, 29 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Thursday, 30 July 2020
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day