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ACOUSTICAL REPORT

PROPOSED RESIDENTIAL DEVELOPMENT AT

1-7 ANDERSON AVENUE & 12 EL ALAMEIN AVENUE, LIVERPOOL NSW

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Approved by	Nick Koikas, MAAS Principal Consultant
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1-7 ANDERSON AVENUE & 12 EL ALAMEIN AVENUE, LIVERPOOL NSW

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1.0 INTRODUCTION

Koikas Acoustics Pty Ltd was engaged by BCL2 Limited to prepare a noise impact assessment for the proposed residential development at 1-7 Anderson Avenue & 12 El Alamein Avenue, Liverpool seeking approval for the construction of a new sixty-three (63) unit residential apartment building over five (5) floor levels.

For the DA proposal, the acoustic adequacy of the proposed design must be assessed in terms of standard planning guidelines issued by Liverpool City Council in their Local Environment Plan (LEP) and Development Control Plan (DCP), and also in terms of other standard planning guidelines related to common sources of noise.

In accordance with Council guidelines and other standard planning instruments, Koikas Acoustics has determined the following acoustical components require assessment at the current DA stage:

1. Traffic noise associated with the Liverpool-Parramatta Transitway (T-Way) and its impact on future occupants of the development;
2. Mechanical plant noise emission from the proposed development to neighbouring dwellings, and
3. Inter-tenancy sound insulation requirements for shared partitions within the building.

This report presents the results and findings of an acoustic assessment for the subject proposal. In-principle acoustic treatments and noise control recommendations are included (where required) so that the premises may operate in compliance with the nominated acoustic planning levels.

2.0 THE PROPOSAL

The development is proposed to occupy the site at 1-7 Anderson Avenue & 12 El Alamein Avenue, Liverpool NSW. The application is for a multi-storey residential building consisting of sixty-three (63) residential units over five (5) above-ground floor levels. The current development design can be seen in architectural drawings as prepared by Kennedy Associates Architects, detailed in Table 1. All calculations and noise modelled scenarios conducted for this assessment are referenced to these architectural drawings.

Table 1. Design drawings used in the assessment

Drawing Title	Drawing No.	Revision	Date	Job No.
Introduction	DA 01	P8	17/09/2019	1846
Proposed Site Plan	DA 06	P8	17/09/2019	1846
Proposed Level -02	DA 07	P8	17/09/2019	1846
Proposed Level -01	DA 08	P8	17/09/2019	1846
Proposed Level 00	DA 09	P8	17/09/2019	1846
Proposed Level 01	DA 10	P8	17/09/2019	1846
Proposed Level 02	DA 11	P8	17/09/2019	1846
Proposed Level 03	DA 12	P8	17/09/2019	1846
Proposed Level 04	DA 13	P8	17/09/2019	1846
Proposed Roof Level	DA 14	P8	17/09/2019	1846

Notes
1. Detailed above are the plans and drawings available at the time of assessment. Where design changes are made without the prior knowledge of Koikas Acoustics, our assessment results and conclusions published within this report may be incorrect.

The development location is situated in a primarily urban residential area. Residential dwellings surround the subject site to the north, south, and west of the proposed development site, whilst due east is a large open park area intersected by the Liverpool-Parramatta Transitway bus route.

The subject site and surrounding properties are identified on the aerial photograph included as Figure 1.

Prevailing ambient noise conditions on-site and in the local area are generally the result of typical environmental noise such as distant traffic and localised domestic noise sources.

Figure 1. Aerial photo of the subject site and surrounding area (Image source – SixMaps)

3.0 AMBIENT NOISE SURVEY

Existing external ambient noise levels were measured by installing a sound level meter data logger at the rear of 3 Anderson Avenue Liverpool. A Convergence Instrument Noise Sentry RT-W noise logger was used for the survey. The installed location in the tree meant that the microphone was approximately 2 metres above the ground level. This meter was placed to measure existing ambient noise levels pertaining to the surrounding area. The noise logger location is shown in Figure 1.

The instrument was set-up to measure A-frequency and 'Fast' time-weighted noise levels. Noise level data was stored within the logger memory at 15-minutes intervals for a period of about one week between Tuesday 20th and Monday 26th August 2019.

Calibration readings were taken before and after each survey with a NATA calibrated and certified Larson Davis CAL200 precision acoustic calibrator. No system drift was observed for this meter.

BOM weather records for the nearest available weather station indicate that inclement weather conditions did not adversely impact on the noise survey.

Table 2. Summary of noise logger results [dB]

Location	**Period, T** [1]	**Ambient noise level** LAeq	**Rating Background Level** LA90	**Traffic noise level** LAeq Period
3 Anderson Avenue	Day	51	41	50
	Evening	44	39	
	Night	45	33	44

Notes

1: The NSW EPA NPI refers to Night as 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays.

2: Refer to **Appendix A** for the unattended noise logger graphs.

Attended measurements were also undertaken of the Liverpool-Parramatta T-Way bus route on the 27th of August, 2019 between the hours of 12:00 and 13:00. An NTi XL2 sound level meter was used to measure bus traffic traversing the transitway. The sound level meter was placed approximately 19 metres from the centre-line of the T-Way and 1.5 metres above the ground in free-field condition. Measurements were taken in order to quantify the sound exposure of the T-Way to the proposed development site.

4.0 ACOUSTICAL REQUIREMENTS

4.1 ROAD TRAFFIC NOISE – ISEPP/DOP

In accordance with Clause 102 of the State Environmental Planning Policy (Infrastructure) 2007, hereafter referred to as ISEPP, development for the purpose of residential, place of public worship, hospital, educational facility or child care centre use must be designed to consider the indoor noise amenity of future occupants.

Where the development is for residential use, and the site is adjacent to a classified road that carries an annual daily traffic volume of more than 40,000 vehicles, and that the consent authority considers is likely to be impacted by road noise or vibration, maximum allowable indoor traffic noise levels are defined as:

- L_{Aeq} 35 dB in any bedroom in the building between the hours of 10pm and 7am.
- L_{Aeq} 40 dB elsewhere in the building (excluding a garage, kitchen bathroom or hallway) at any other time.

ISEPP requires that before any application is determined under which this clause applies, consideration must be given to guidelines that are issued by the Director-General. It is the understanding of Koikas Acoustics that the Director-General has issued guidelines relating to the determination of suitable indoor noise levels for development with open windows allowing natural ventilation of indoor areas. The Director-General has recommended under this condition (open windows) that indoor noise levels should not exceed:

- L_{Aeq} 45 dB in any bedroom in the building between the hours of 10pm and 7am.
- L_{Aeq} 50 dB elsewhere in the building (excluding a garage, kitchen bathroom or hallway) at any other time.

The NSW Department of Planning (DoP) supports the design targets of ISEPP and the Director-General guidelines within their road/rail noise guidelines (*Development near rail corridors and busy roads, Interim Guideline 2008*). The DoP guideline further defines the duration under which noise levels are assessed, being $L_{Aeq\ 9\ hours\ (10pm\ to\ 7am)}$ for bedrooms and $L_{Aeq\ 15\ hours\ (7am\ to\ 10pm)}$ elsewhere.

A summary of the applied traffic noise planning levels are included as Table 3.

Table 3. Design criteria for internal spaces

Description	Area	Period	L_{Aeq} (Period)]dB]
Windows and doors closed	Bedrooms	10pm to 7am	35
	Living areas	At any time	40
Windows & doors open (natural ventilation)	Bedrooms	10pm to 7am	45
	Living areas	At any time	50
Notes 1.	Assessment period for bedrooms taken as the 9 hours period between 10pm and 7am. Assessment period for living areas taken as the 15 hours period between 7am and 10pm.		

4.2 EPA NOISE POLICY FOR INDUSTRY

Noise emission design targets have been referenced from the NSW Environmental Protection Authority Noise Policy (EPA) for Industry (NPfI). The NPfI replaces the former Industrial Noise Policy, also prepared by the EPA.

The NPfI is designed to assess environmental noise impacts associated with scheduled activities prescribed within the Protection of the Environment Operations Act 1997, Schedule 1. It is also commonly used as a reference tool for establishing suitable planning levels for noise generated by mechanical plant and equipment and noise emission from commercial operations.

The guideline applies limits on the short term intrusive nature of a noise or noise generating development (project intrusive noise level), as well as applying an upper limit on cumulative industrial noise emissions from all surrounding development/industry (project amenity noise level).

The most stringent of the project intrusive noise level and project amenity noise level is applied as the **project noise trigger level**. The project noise trigger level is the point, above which noise emission from a source or development site would trigger a management response.

To be able to define the more stringent of the intrusive and amenity noise levels, the underlying noise metrics must be the same. As the intrusive noise level is defined in terms of a $L_{Aeq\ 15\ minutes}$ and the amenity noise level is defined in terms of a $L_{Aeq\ Period}$, a correction +3dB correction is applied to the project amenity noise level to equate the $L_{Aeq\ Period}$ to $L_{Aeq\ 15\ minutes}$.

4.3 PROTECTION OF THE ENVIRONMENT OPERATIONS (NOISE CONTROL) REGULATION 2017

Clause 45 of the regulation requires that air conditioning units installed on residential premises must not emit noise that is audible within a habitable room in any other residential premises between the hours of 10pm and 7am (Monday to Friday) or 10pm and 8am (Saturday, Sunday and public holidays).

4.4 INTER-TENANCY NOISE

In Class 2 or 3 buildings, the BCA acoustical Performance Requirements state that separating walls and floors must provide insulation against the transmission of airborne or impact generated sound sufficient to prevent illness or loss of amenity for the occupants.

A wall or floor partition is considered to satisfy BCA Performance Requirements where it is shown to:

- Have a laboratory tested acoustic rating that meets or exceeds the Deemed-to-Satisfy provisions of F5.4 to F5.7, or
- Complies with Specification F5.2, or
- Is tested on-site to achieve the minimum acoustic performance as defined within *Verification Methods* FV5.1 and FV5.2.

The Deemed-to-Satisfy provisions applying to this specific development are summarised below:

Table 4. BCA acoustic design requirements			
Partition	**Detail**	**Airborne sound**	**Impact sound**
Floor	Separating SOU's, or an SOU from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or part of a different classification	Rw + Ctr ≥ 50	Ln,w ≤ 62
Wall *See notes 1 and 2*	Separating SOU's	Rw + Ctr ≥ 50	Not applicable
	Separating a habitable room (other than a kitchen) in one SOU from a bathroom, sanitary compartment, laundry, kitchen in another SOU	Rw + Ctr ≥ 50	Discontinuous construction
	Separating an SOU from a plant room or lift shaft	Rw ≥ 50	Discontinuous construction
	Separating an SOU from a stairway, public corridor, public lobby or the like, or part of a different classification	Rw ≥ 50	Not applicable
Door	Located in a wall separating an SOU from a stairway, public corridor, public lobby or the like	Rw ≥ 30	Not applicable
Services	Duct, soil, waste or water supply pipes located in a wall or floor cavity and serves or passes through more than one SOU (including a stormwater pipe)	Rw + Ctr ≥ 40 (habitable) Rw + Ctr ≥ 25 (other)	Not applicable
Pumps	A flexible coupling must be used at the point of connection between the service's pipes in a building and any circulating or another pump.		
Notes 1. 2. 3.	Where a wall is to achieve a sound insulation rating and has a floor above, the wall must continue to either the underside of the floor or to the ceiling which has a comparable sound insulation rating to the wall. Where a wall is to achieve a sound insulation rating and has a roof above, the wall must continue to either the underside of the roof or to the ceiling which has a comparable sound insulation rating to the wall. As defined by the BCA, a 'habitable room' means a room used for normal domestic activities such as, bedroom, living room, lounge room, music room, television room, kitchen dining room, study, playroom, family room, home theatre and sunroom.		

5.0 TRANSIT-WAY ROAD NOISE ASSESSMENT

5.1 EXTERNAL NOISE LEVELS

Calculating the resulting level of noise that is transmitted through a façade and into a room is dependent upon the external façade noise level, the sound insulation performance of the building façade (inclusive of all building components), and the level of acoustic absorption that is present within the subject room.

Calculations were conducted to predict external façade road noise levels. The calculations considered:

- Buses generating an average SEL for each pass-by of 73 dB(A);
- A conservative estimate (worst-case 15 minute period) of 1 bus movement every 5 minutes past the Memorial T-Way stop during the day. This is equal to 180 buses passing by the site during daytime hours (7am to 10pm), and
- A conservative estimate of 1 bus movement every 10 minutes past the Memorial T-Way stop during the night. This is equal to 54 buses passing by the site during night-time hours (10pm to 7am)

Maximum external façade traffic noise levels are expected to be $L_{Aeq\ 15\ hour}$ 44 dB / $L_{Aeq\ 9\ hour}$ 41 dB at the ground floor level along the eastern façade of the building exposed to the T-Way. Reduced noise exposure along the sides of the building will result from the limited field of view of the T-Way and partial noise shielding from adjacent buildings. The least noise-exposed façade of the building is along the western side of the development where a high level of noise shielding is generated by the subject building and surrounding buildings.

A maximum façade noise reduction of up to **6 dB** is required in order for the new development to comply with the NSW DoP/ISEPP criteria. Therefore, it is Koikas Acoustics' opinion that standard building materials will be sufficient to mitigate T-Way traffic noise intrusion. No additional acoustic attenuation measures are required.

5.2 VENTILATION

In some cases where external road noise levels are high, it is not a viable option to naturally ventilate rooms through the opening of windows and/or doors. This is due to the level of traffic noise being transmitted through the open doors resulting in a breach of the applied noise criterion.

As a general rule, where windows or doors opened sufficiently to provide natural ventilation to a room, the indoor noise level is 10dB below the outside noise level. Therefore, a window or sliding door to a room may be opened to provide natural ventilation where the outdoor noise level does not exceed 10dB above the “Windows open” criteria as detailed within this report.

In this case, road noise levels are not significant and naturally ventilated rooms are expected to still result in the ‘open windows’ noise criteria being achieved.

6.0 MECHANICAL PLANT AND BUILDING USE NOISE IMPACTS

Mechanical plant and equipment on this project could include air conditioning condensers units where they are installed in the development and other ventilation plant required for basement levels and garbage rooms etc. Outdoor common areas such as the covered gym and pool area are considered to be noise generating areas associated with 'building use'.

6.1 PROJECT NOISE TARGETS

This noise is assessed in accordance with the planning levels contained within the NPfI. Acoustic planning levels are largely determined in relation to the existing environmental noise levels. Noise surveys conducted for this assessment show that environmental noise levels can differ based on the location of a particular receiver and its orientation to major contributors of noise in the area, such road corridors and commercial operations. The following NPfI planning levels apply for this project:

Table 5. Noise planning levels

Period, T (Note 1)	1-7 Anderson Avenue & 12 El Alamein Avenue, Liverpool								
	Intrusive		Amenity					Project noise trigger level	AC Inaudibility Noise Criteria (RBL – 8)
	RBL	RBL + 5	Area classification	Recommended amenity noise level	High traffic area	Project amenity noise level	+3dB correction		
Day	41	46	Urban	60	No	55	58	46	-
Evening	39	44	Urban	50	No	45	48	44	-
Night	33	38	Urban	45	No	40	43	38	30

Notes
1. The NSW EPA Industrial Noise Policy refers to the following time periods, Day – 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and public holidays, Evening – 6pm to 10pm Monday to Sunday, Night – 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays.
2. The amenity criterion is based on the area classification of the site as being 'suburban' and has been corrected for an assessment in areas of high traffic and for existing industrial noise where applicable.
3. Project noise amenity level = recommended noise amenity level – 5dB, except where specific circumstances are met, such as high traffic.
4. The threshold adopted for inaudibility inside a residence is that the development noise must remain 8 dB below the outdoor background level.

Mechanical plant noise levels assessed to nearby commercial properties are not to exceed a recommended project amenity noise level of $L_{Aeq,\ 15minutes}$ 63 dB during business hours.

6.2 DESIGN SCENARIOS

At this stage, a mechanical design is yet to be completed. A detailed mechanical plant noise impact assessment is to be provided once the final mechanical design and specification have been completed.

7.0 INTER-TENANCY NOISE

The following recommendations are expected to satisfy the relevant provisions of the BCA sound insulation requirements between tenancies. Options have been provided in all cases that consider a range of standard constructions.

All wall systems should be installed in accordance with general installation guidelines included in the BCA and as per relevant manufacturer installation guidelines/requirements.

Alternate systems and design may be considered to those recommended within this report provided that they are approved by an appropriately qualified acoustical engineer/consultant.

7.1 RECOMMENDED PARTITION WALLS

Table 6 recommends a number of partition wall systems that are capable of achieving the required acoustic performance.

Table 6. Recommended partition wall systems		
Wall type	**BCA design standard**	**Construction**
Inter-tenancy wall	Rw + Ctr ≥ 50 Discontinuous	*Partition wall between sole-occupancy units – Separating a habitable room (other than a kitchen) in one unit from a bathroom, sanitary compartment, laundry or kitchen in an adjoining unit* **[AFS]** AFS 162 Logicwall, 20mm cavity, 64mm steel studs with 75mm thick Tontine TSB4 insulation within the stud cavity, 10mm Soundcheck. **[Masonry]** Two leaves of 110mm clay brick masonry, 50mm cavity between the leaves (where brick ties are used they are to be of the resilient type), 13mm cement render to each side. *BCA D.T.S.* **[Concrete]** 125mm concrete panel, 20mm cavity, 64mm steel studs, 70mm polyester insulation (9kg/m^3) between the studs, 13mm plasterboard fixed to studs. *BCA D.T.S.* **[Hebel]** 13mm Fyrchek, 75mm Hebel Powerpanel, 35mm cavity, 64mm steel studs with 100mm S6 polyester insulation, 13mm Fyrchek/Aquachek. **[Lightweight]** 2x64mm steel studs, 20mm cavity, 60mm polyester insulation (11kg/m3) positioned between one row of studs, 2x13mm fire resistant plasterboard each side.
	Rw + Ctr ≥ 50	*Partition wall between sole-occupancy units* **[AFS]** AFS 162 Logicwall panel, paint or render finish. **[AFS]** AFS 162 Logicwall panel, 28mm furring channel, Tontine TSB2 insulation within the framing cavity, 13mm plasterboard. **[Masonry / Hebel / Lightweight]** As above. **[Concrete]** 200mm concrete panel, 13mm cement render of each face. *BCA D.T.S.*
Common wall	Rw ≥ 50 Discontinuous	*Partition wall between sole-occupancy unit and plant room or lift shaft* As above for inter-tenancy wall partitions that satisfy discontinuous construction
	Rw ≥ 50	*Partition wall between sole-occupancy unit and stairway, public corridor, public lobby or the like or part of a different classification* **[AFS]** AFS 150 Logicwall panel, paint or render finish. **[AFS]** AFS 162 Logicwall panel, paint or render finish. **[Masonry]** Single leaf 150mm brick masonry with 13mm cement render on each face. **[Concrete]** 125mm thick concrete panel. **[Hebel]** 13mm Gyprock CD, 75mm Hebel Powerpanel, minimum 20mm cavity, 64mm steel framing with 50mm glasswool insulation, 13mm Gyprock CD. **[Lightweight]** 92mm steel studs, 60mm polyester insulation (11kg/m3) positioned between the studs, 2x13mm fire resistant plasterboard each side.
Services shaft wall	Rw+Ctr ≥40	*Services shaft wall to habitable room within unit* **[Masonry]** 110mm brick masonry with 13mm cement render on each face. *BCA D.T.S.* **[Concrete]** 100mm thick concrete panel. *BCA D.T.S.* **[Lightweight]** 2x13mm plasterboard, pipe lagging (Soundlag 4525C, Acoustilag 45)
	Rw+Ctr ≥25	*Services shaft wall to non-habitable room within unit* **[Lightweight]** 2 layers of 13mm plasterboard

Notes:

1. Recommendations within the above table are based on published acoustic data obtained from the manufacturer's website.
2. Laboratory tests of the AFS 162 Logicwall on its own showed non-compliance with the BCA requirement of Rw + Ctr 50. However, an investigation by PKA Consulting concludes that the poor acoustic performance was due to factors not related to the wall system, but rather the test facility. It is expected that the acoustic performance will satisfy the BCA condition. This conclusion is supported by numerous field tests that indicate compliance with the BCA verification methods rating.
3. All installation of proprietary type wall systems must be in accordance with the relevant installation guidelines and manuals.
4. *BCA D.T.S.* = BCA Deemed-to-Satisfy construction. These wall systems are to be installed as per "Construction Deemed-to-Satisfy" notes included within Specification F5.2 of Volume One of the BCA. Where these systems are installed correctly in accordance with the BCA they do not require compliance testing to verify acoustic performance.

7.2 RECOMMENDED PARTITION FLOOR/CEILING

The following floor/ceiling assemblies are recommended to achieve the BCA minimum acoustic rating requirements.

Table 7. Floor system recommendations

System 1 – Tile floor	
Floor covering:	Selected tiles
Additional layers:	n/a
Underlay:	Regupol 4515 (4.5mm), A1 Rubber Acoustamat 3mm, Damtec Standard 2-4mm, Uniroll RF700 (5mm) under screed or RFC750 (4.5mm) under direct-stick tile, or other approved products
Floor slab:	200mm concrete
Ceiling cavity:	Minimum 70mm **(Note 1)**
Cavity insulation:	n/a
Ceiling material:	10mm Superchek or 13mm Soundcheck (Note 2)
System 2 – Timber floor	
Floor covering:	Engineered timber or laminate timber
Additional layers:	n/a
Underlay:	Regupol 4515 (4.5mm), A1 Rubber Acoustamat 3mm, Damtec Standard 2-4mm, Uniroll RF700 (5mm), or other approved products
Floor slab:	200mm concrete
Ceiling cavity:	Minimum 70mm **(Note 1)**
Cavity insulation:	n/a
Ceiling material:	10mm Superchek or 13mm Soundcheck (Note 2)
System 3 – Carpet floor	
Floor covering:	Carpet
Additional layers:	n/a
Underlay:	Carpet underlay such as Dunlop Carpetmate Standard or similar
Floor slab:	200mm concrete
Ceiling cavity:	100mm **(Note 1)**
Cavity insulation:	n/a
Ceiling material:	10mm Superchek or 13mm Soundcheck (Note 2)

Notes

1. The suspended ceiling must be fixed to light steel grid type system such as Rondo Key-lock or similar.
2. With ceiling cavities in excess of 100mm, standard 13mm plasterboard could be used.

The impact isolation requirements and floor system recommendations are applicable to external balconies that are situated above internal areas of another SOU below. The BCA also does not distinguish between habitable or non-habitable spaces, therefore, the above recommendations also apply to wet areas such as bathrooms etc.

Hard floor coverings such as tiles must not make contact with any walls or joinery such as kitchen benches, cupboards etc. During installation of hard floor coverings, temporary spacers of 5-10mm should be used to isolate the floor covering from walls and/or joinery with the resulting gaps filled with a suitable mastic type sealant or off-cut of rubber underlay material.

Alternative floor/ceiling systems could be considered provided that the acoustic performance is tested or assessed by a consulting acoustical engineer to be compliant with the sound insulation performance requirements of the BCA.

The above floor systems have been assessed to comply with the BCA airborne and impact sound insulation requirements. **The 'for construction' floor systems should be re-assessed at the detailed design stage.**

Verification of installed acoustic performance should also be determined in accordance with the recommendations of Section 7.5 of this report.

7.3 SOIL, WASTE, WATER SUPPLY PIPES

Where a duct, soil, waste or water supply pipe is located within a wall or ceiling cavity and serves or passes through one or more SOU's, the following separation details may be used to comply with the required acoustic rating:

Table 8. Services in cavity wall or ceiling			
Option	**Rating**	**Documented source**	**System detail**
1	Rw + Ctr 25	CSR Red Book, Koikas Acoustics opinion	2 layers of 10mm plasterboard
2	Rw + Ctr 25	CSR Red Book	Acoustilag 45 and 13mm plasterboard wall/ceiling lining
3	Rw + Ctr 25	CSR Red Book	Unlagged pipes and 13mm Soundchek wall/ceiling lining. Alternatively, 2 layers of 16mm Fychek may be used as wall/ceiling lining
4	Rw + Ctr 40	CSR Red Book	Acoustilag 45 and 13mm Soundchek wall/ceiling lining. Alternatively, 2 layers of 16mm Fychek may be used as wall/ceiling lining
5	Rw + Ctr 40	Pyrotech Soundlag 4525C brochure	Soundlag 4525C and minimum 10mm plasterboard wall/ceiling lining
Notes: 1. 2. 3.	The acoustic lagging material may be excluded by using Rehau Raupiano Plus pipe system. All installations are to be in accordance with relevant manufacturers' specifications and requirements. Incorporating downlights into ceilings will impact on the acoustic rating of the partition system. Consultation should be made with an acoustic consultant in the event of downlights being proposed in the ceiling. The CSR Red Book provides some guidance on downlights being installed in a services partition system.		

The BCA further qualifies the acoustic requirements of services partitions with the following:

- Services must not be chased into concrete or masonry elements,
- An access door or panel must be firmly fixed so as to overlap the frame or rebate the frame by not less than 10mm and be fitted with proper sealing gasket along all edges and constructed of:
- Wood, particle board or block board not less than 38mm thick; or
- Compressed fibre reinforced cement sheeting not less than 9mm thick; or
- Other suitable material with a mass per unit area not less than 24kg/m2.
- A water supply pipe must only be installed in the cavity of discontinuous construction, and in the case of a pipe that serves only one SOU, must not be fixed to the wall leaf on the side adjoining any other SOU and have a clearance not less than 10mm to the other wall leaf.

7.4 SOUND ISOLATION OF PUMPS

A flexible coupling must be used at the point of connection between the service's pipes in a building and any circulation or another pump.

7.5 VERIFICATION OF ACOUSTIC PERFORMANCE

It is common for comparable floor/ceiling systems designs to achieve varying acoustic insulation and isolation ratings between buildings. This can be due to the quality of workmanship, attention to detail in sealing any penetrations, and the emergence of flanking sound transmission paths within a building. For this reason, one cannot categorically state that any partition will achieve a specific acoustic rating without conducting in-situ testing.

Koikas Acoustics recommend that in-situ testing is conducted on a representative, and fully installed floor/ceiling assembly (for all types of floor coverings – timber, tiles, carpet) to ensure adequate acoustic insulation and isolation is achieved, prior to installing all floors on all floor levels of the building.

8.0 CONCLUSION

Koikas Acoustics was requested to prepare an acoustic report for the proposed residential development at 1-7 Anderson Avenue & 12 El Alamein Avenue, Liverpool NSW. The acoustic report is to accompany a development application being submitted to Liverpool City Council.

The assessment considers potential noise impacts to future occupants of the development, and to surrounding residents such that acceptable acoustic amenity for the area is maintained.

Acoustic planning levels have been referenced from current ISEPP, NSW DoP, EPA, and BCA acoustic planning guidelines and requirements.

The included recommendations are based on designs prepared by Kennedy Associates Architects.

The conclusions reached in this report should assist Liverpool City Council in making their determination of the proposal in terms of compliance with the necessary acoustic design requirements. A further detailed acoustic report may be required for the CC submission should the building design be amended, or as required by Council.

Of the assessed components of noise, the following conclusions have been reached:

1. The building can be sufficiently insulated against existing external sources of noise in the area such as road traffic through the use of standard building materials.
2. A detailed assessment of mechanical plant noise should be prepared for the subject development prior to construction.
3. Acoustic treatment options for the common floors and services partitions included within this report would be adequate for satisfying the sound insulation provisions of the BCA.

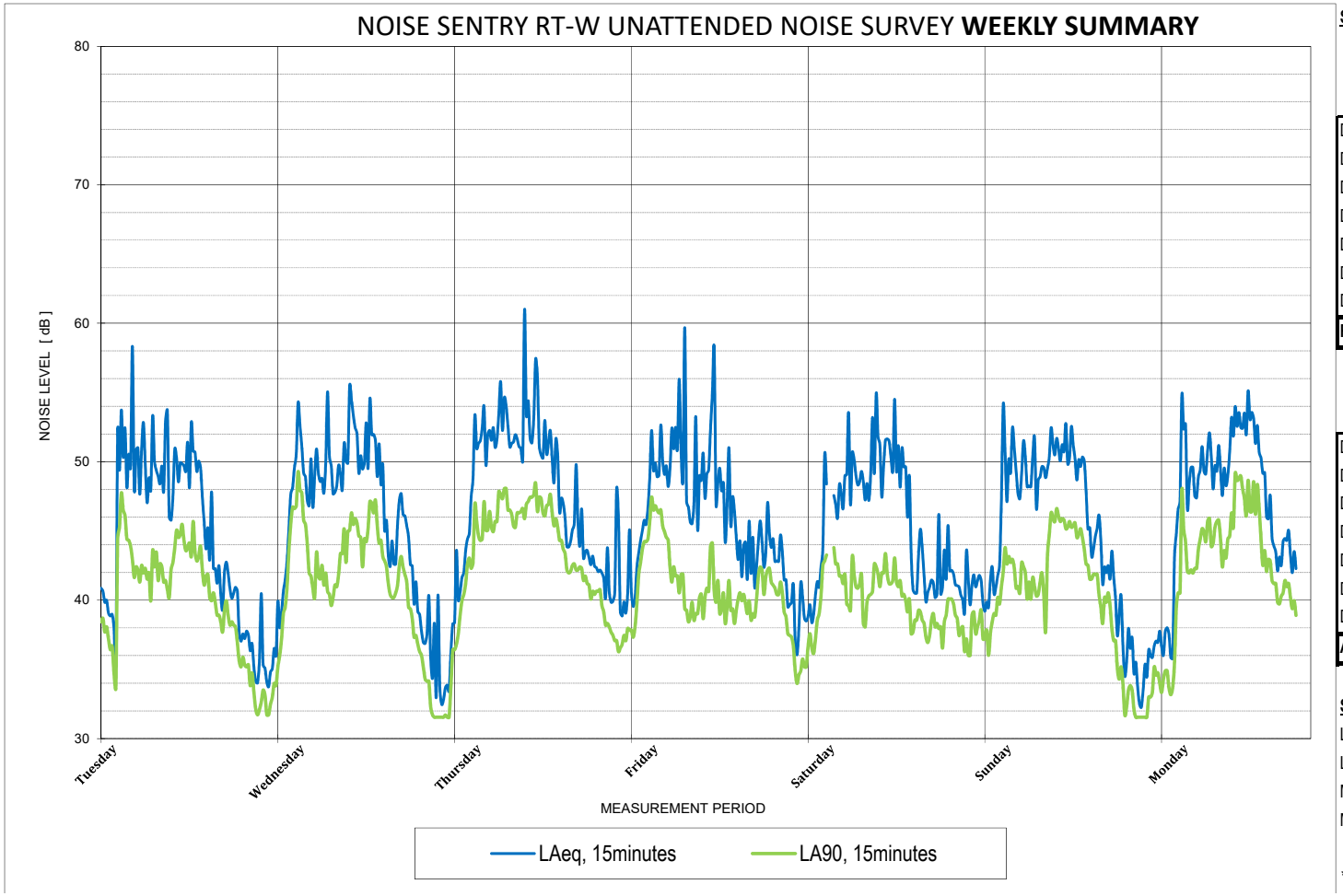
In our professional opinion, there is sufficient scope within the proposed building design to achieve the applied acoustic planning guidelines.

APPENDIX A

APPENDIX A

APPENDIX A

WEEKLY SUMMARY **LOGGER LOCATION:** 3 Anderson Ave, Liverpool NSW **PERIOD:** 20th to the 26th August 2019



SUMMARY OF AMBIENT NOISE LEVELS

	LA90 Daytime	*LA90* Evening	*LA90* Night-time
Day 1	41	38	33
Day 2	41	39	32
Day 3	45	41	32
Day 4	39	39	37
Day 5	39	37	35
Day 6	40	36	37
Day 7	42	40	32
RBL	**41**	**39**	**33**

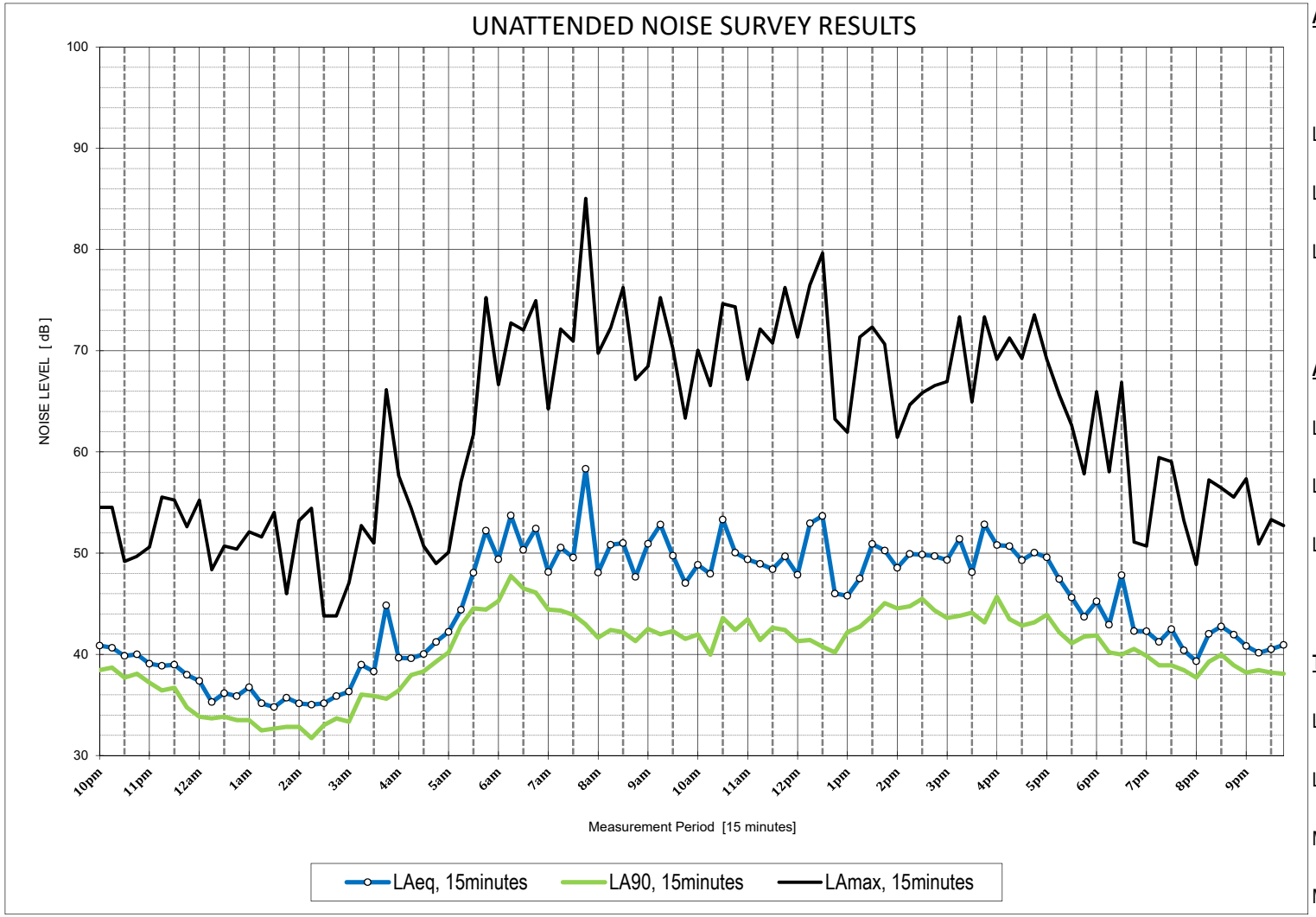
	LAeq Daytime	*LAeq* Evening	*LAeq* Night-time
Day 1	50	43	45
Day 2	51	45	45
Day 3	53	46	44
Day 4	51	44	45
Day 5	50	42	43
Day 6	50	43	46
Day 7	51	44	44
Average	**51**	**44**	**45**

SUMMARY OF TRAFFIC & MISC. NOISE LEVELS

LAeq 15 hrs	0700-2200	50	dB
LAeq 9 hrs	2200-0700	44	dB
Max LAeq 1 hr	0700-2200	52	dB
Max LAeq 1 hr	2200-0700	47	dB

* *Sundays and Public Holidays the hours change to 0800*

DAY 1 **LOGGER LOCATION:** 3 Anderson Ave, Liverpool NSW **DATE:** Tuesday, 20 August 2019



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	41	dB
LA90 Evening	1800-2200	38	dB
LA90 Night-time	2200-0700	33	dB

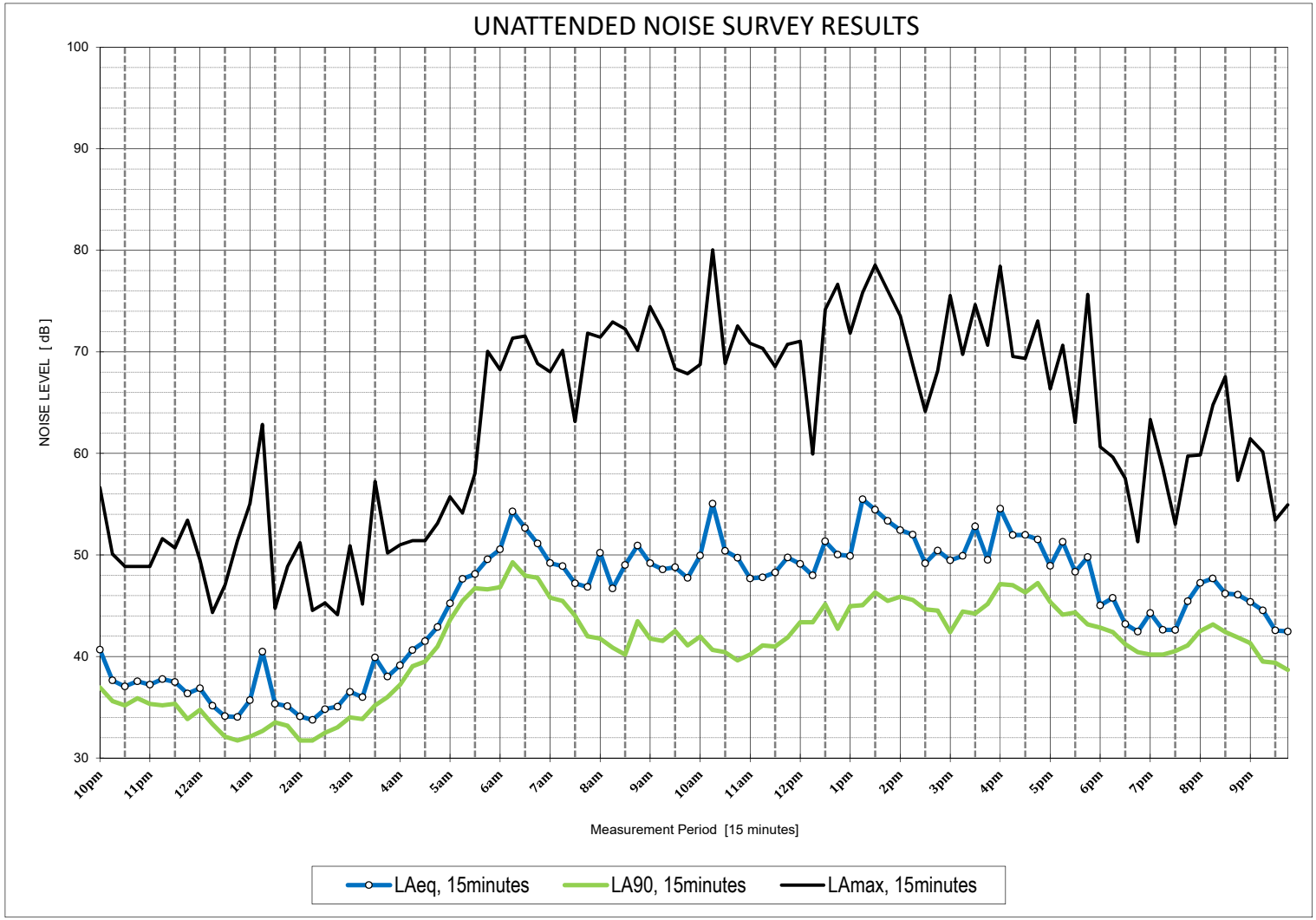
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	50	dB
LAeq Evening	1800-2200	43	dB
LAeq Night-time	2200-0700	45	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	49	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	51	dB
Max LAeq 1 hour	2200-0700	49	dB

DAY 2 **LOGGER LOCATION:** 3 Anderson Ave, Liverpool NSW **DATE:** Wednesday, 21 August 2019



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	41	dB
LA90 Evening	1800-2200	39	dB
LA90 Night-time	2200-0700	32	dB

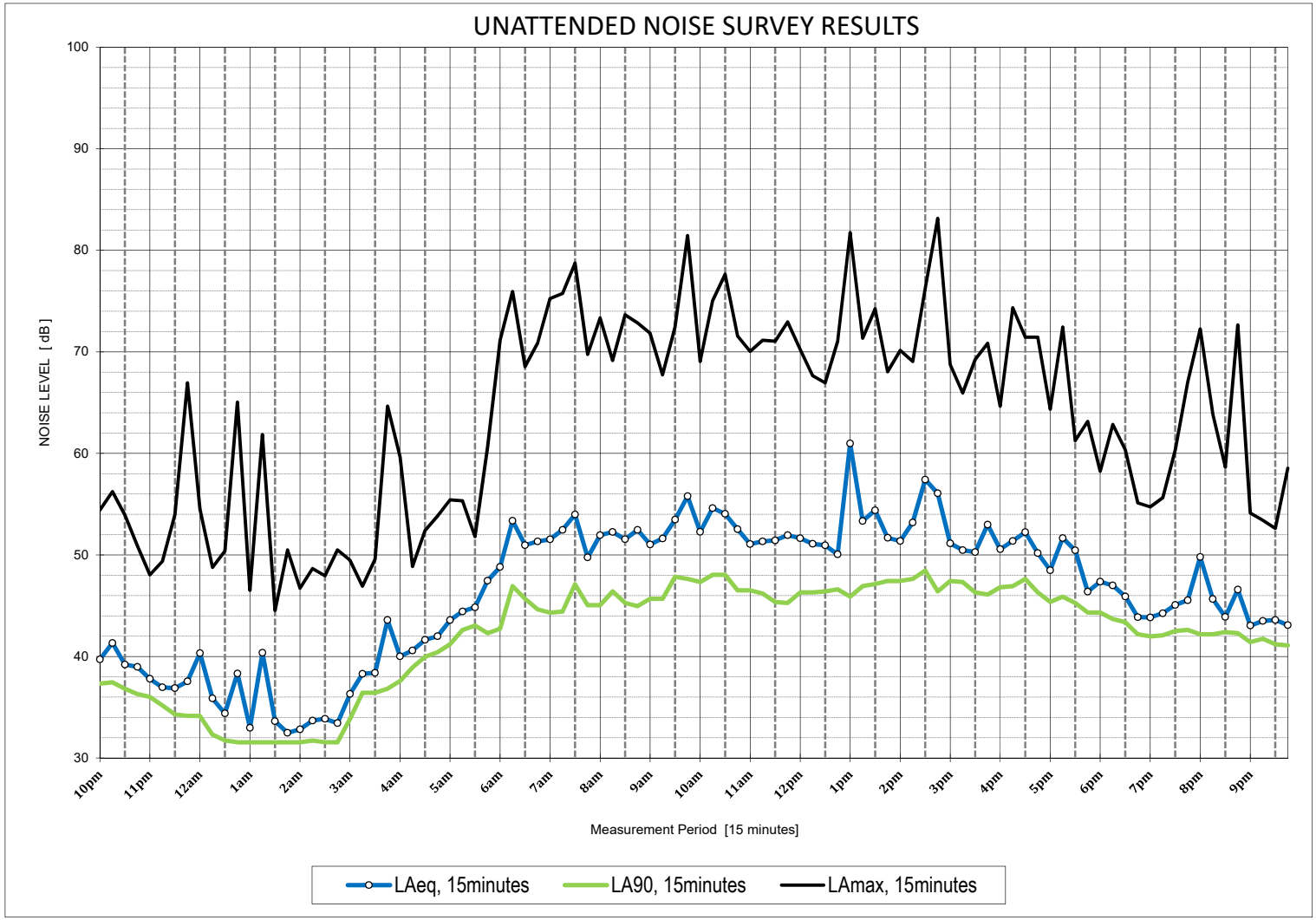
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	51	dB
LAeq Evening	1800-2200	45	dB
LAeq Night-time	2200-0700	45	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	50	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	52	dB
Max LAeq 1 hour	2200-0700	49	dB

DAY 3 **LOGGER LOCATION:** 3 Anderson Ave, Liverpool NSW **DATE:** Thursday, 22 August 2019



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	45	dB
LA90 Evening	1800-2200	41	dB
LA90 Night-time	2200-0700	32	dB

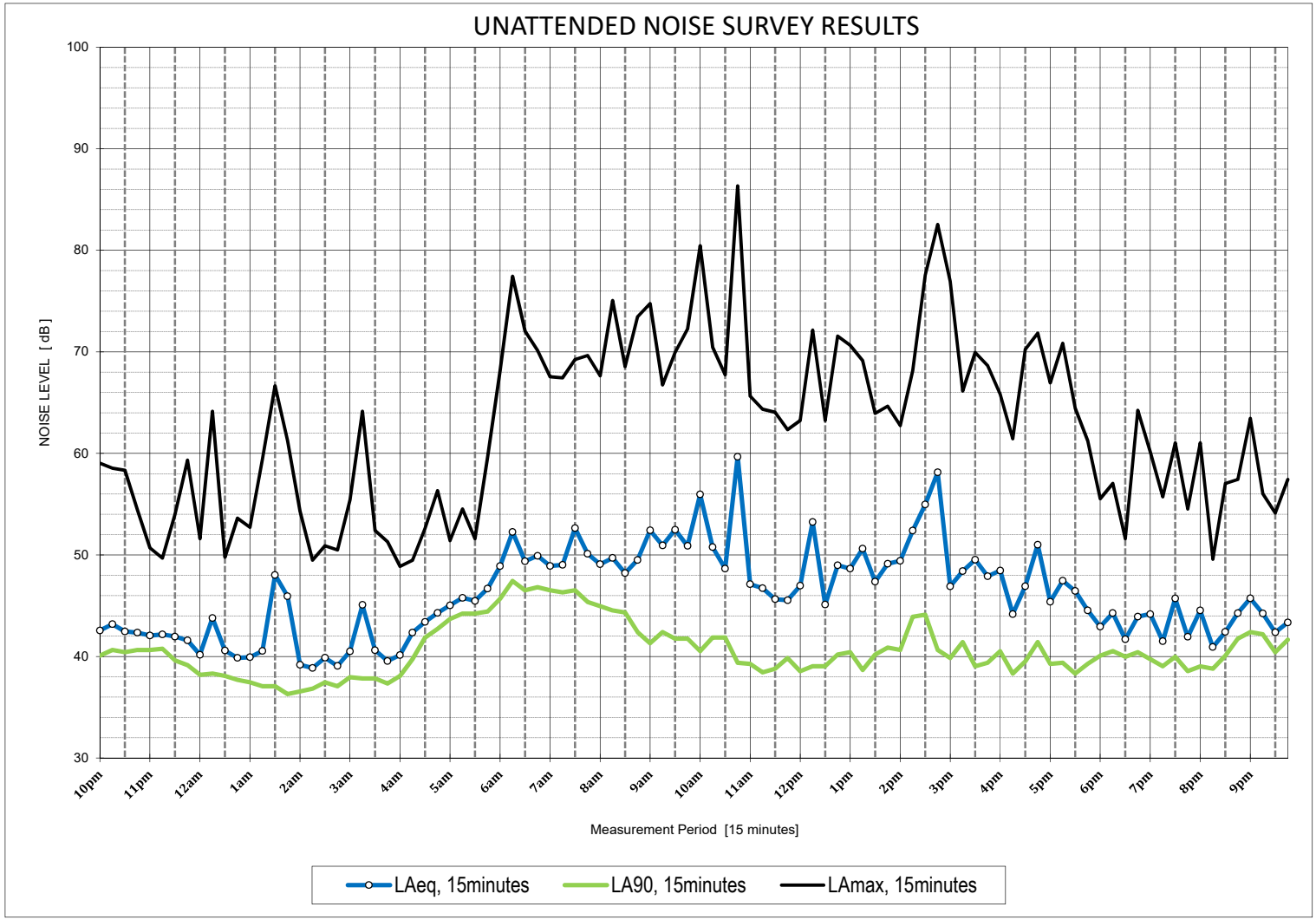
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	53	dB
LAeq Evening	1800-2200	46	dB
LAeq Night-time	2200-0700	44	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	52	dB
LAeq 9 hours	2200-0700	44	dB
Max LAeq 1 hour	0700-2200	55	dB
Max LAeq 1 hour	2200-0700	46	dB

DAY 4 **LOGGER LOCATION:** 3 Anderson Ave, Liverpool NSW **DATE:** Friday, 23 August 2019



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	39	dB
LA90 Evening	1800-2200	39	dB
LA90 Night-time	2200-0700	37	dB

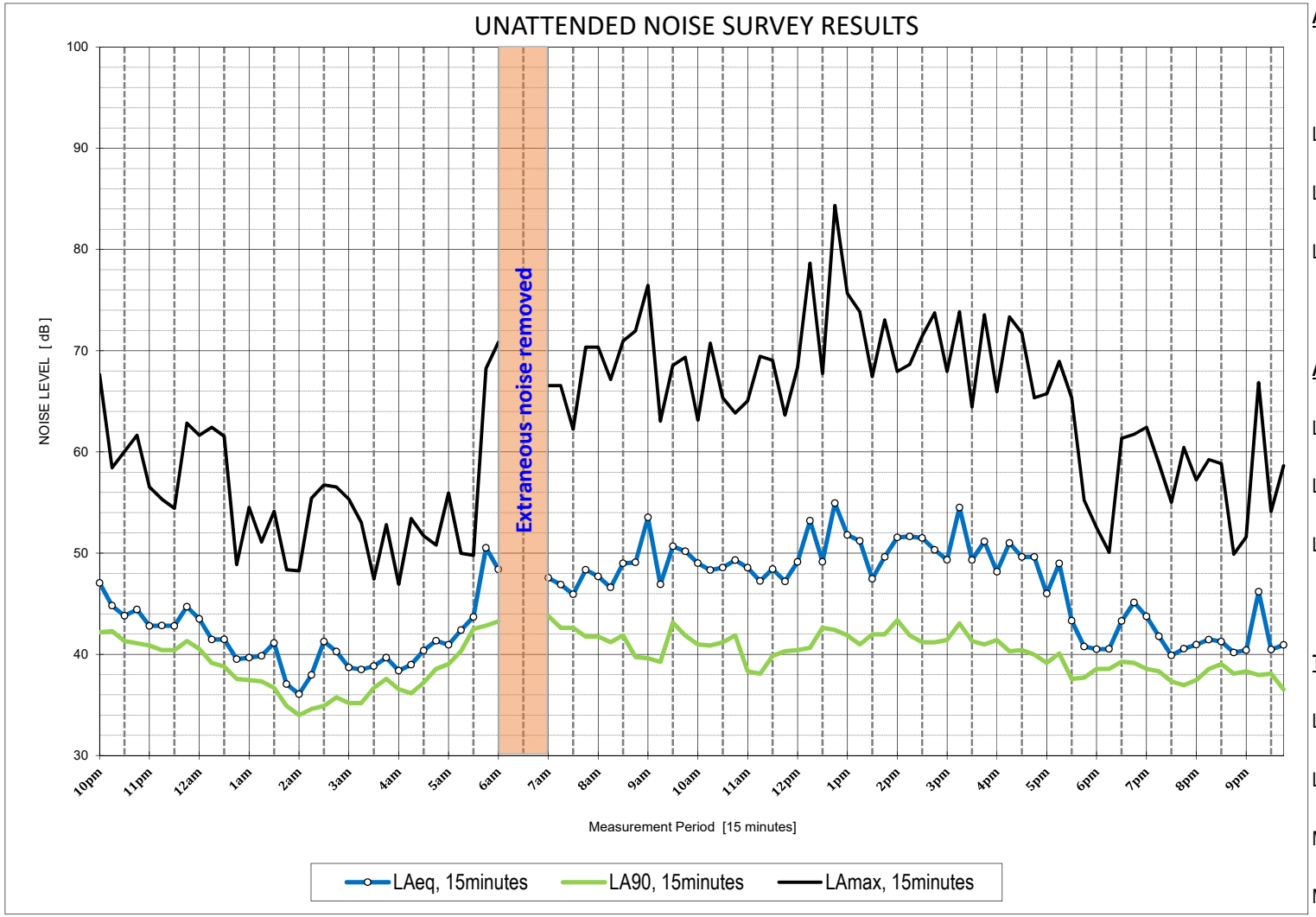
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	51	dB
LAeq Evening	1800-2200	44	dB
LAeq Night-time	2200-0700	45	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	50	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	54	dB
Max LAeq 1 hour	2200-0700	47	dB

DAY 5 **LOGGER LOCATION:** 3 Anderson Ave, Liverpool NSW **DATE:** Saturday, 24 August 2019



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	39	dB
LA90 Evening	1800-2200	37	dB
LA90 Night-time	2200-0700	35	dB

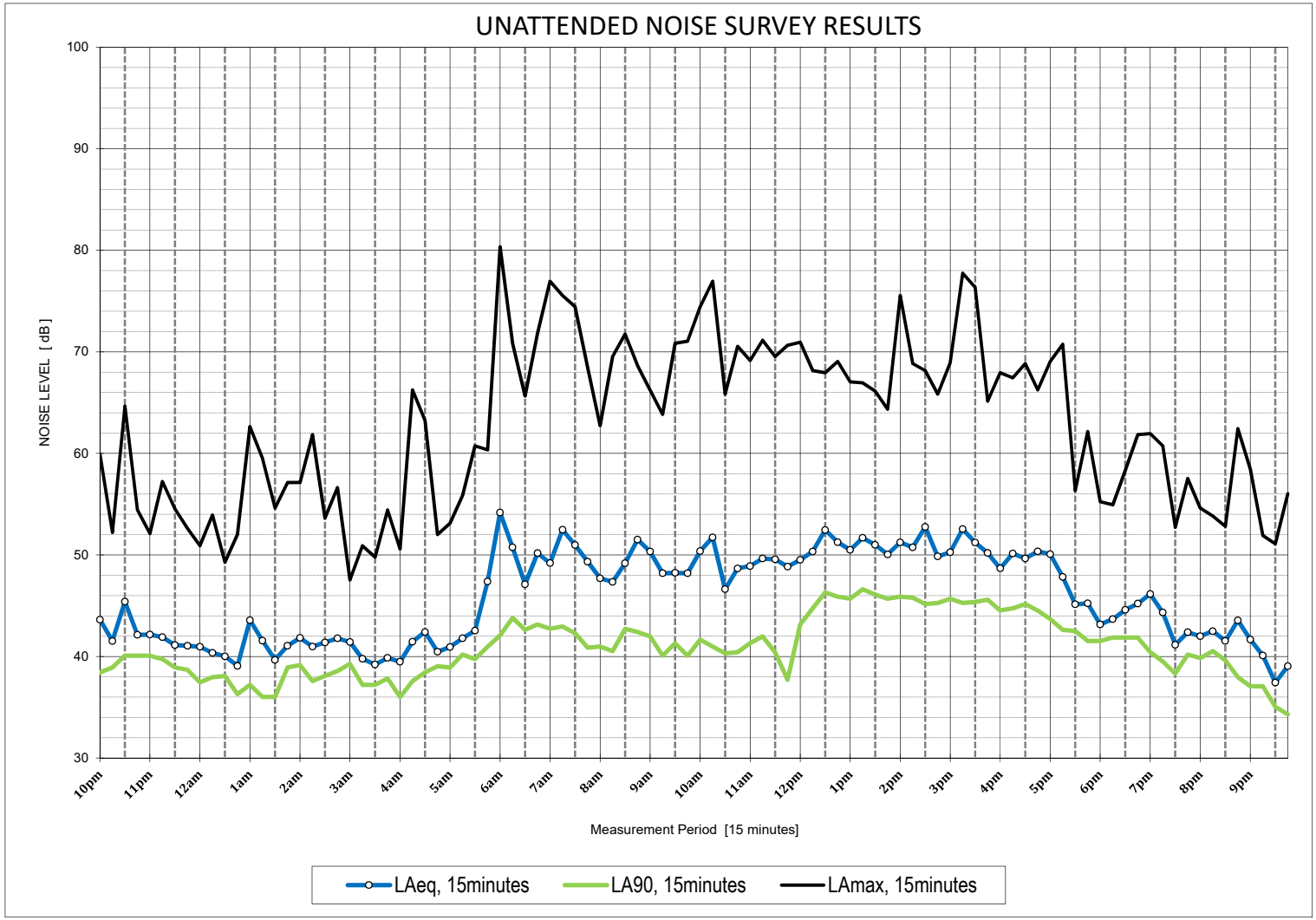
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	50	dB
LAeq Evening	1800-2200	42	dB
LAeq Night-time	2200-0700	43	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	49	dB
LAeq 9 hours	2200-0700	43	dB
Max LAeq 1 hour	0700-2200	52	dB
Max LAeq 1 hour	2200-0700	44	dB

DAY 6 **LOGGER LOCATION:** 3 Anderson Ave, Liverpool NSW **DATE:** Sunday, 25 August 2019



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0800-1800	40	dB
LA90 Evening	1800-2200	36	dB
LA90 Night-time	2200-0800	37	dB

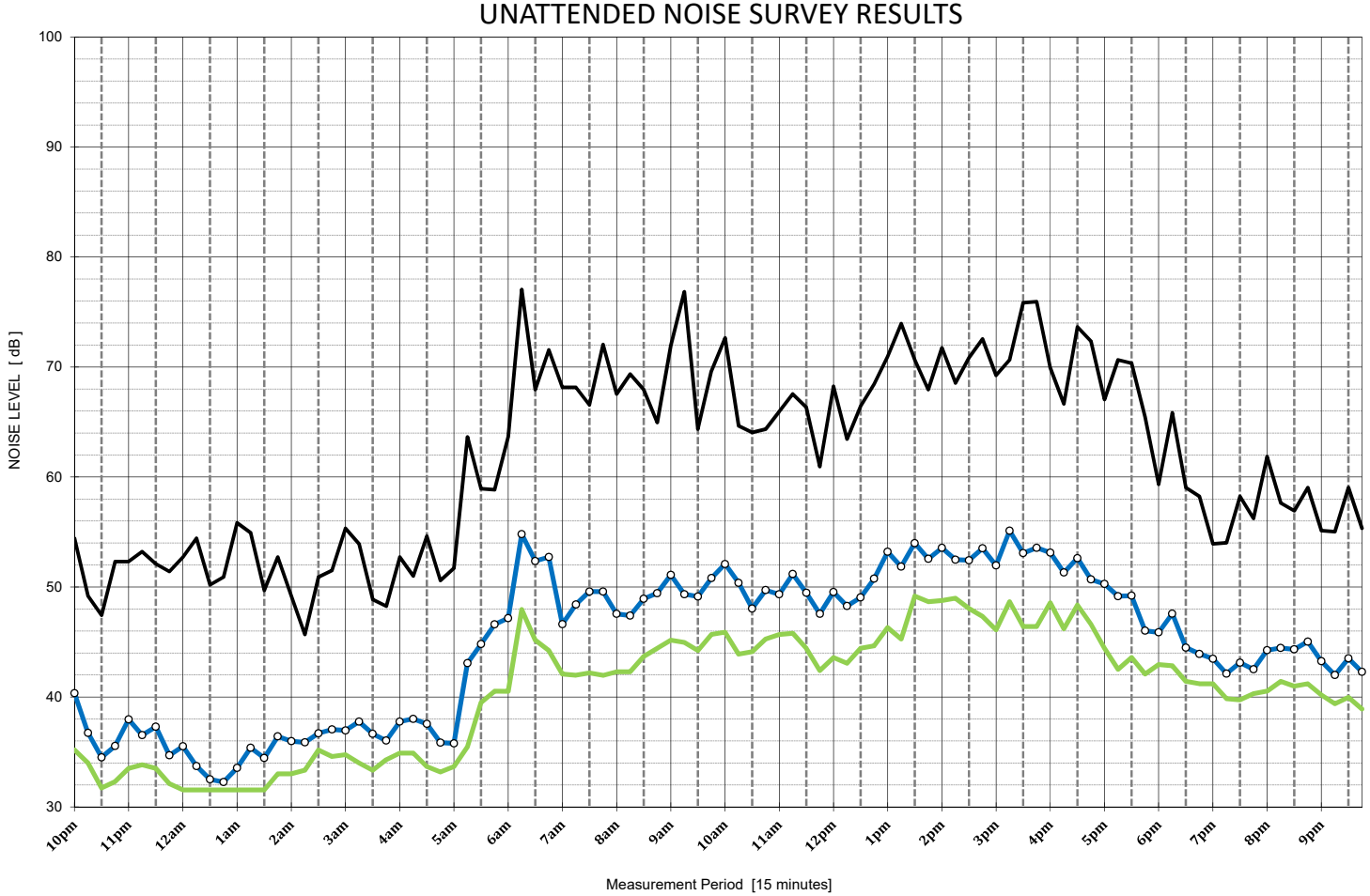
AMBIENT NOISE METRICS

LAeq Daytime	0800-1800	50	dB
LAeq Evening	1800-2200	43	dB
LAeq Night-time	2200-0800	46	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	49	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	51	dB
Max LAeq 1 hour	2200-0700	48	dB

DAY 7 **LOGGER LOCATION:** 3 Anderson Ave, Liverpool NSW **DATE:** Monday, 26 August 2019



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	42	dB
LA90 Evening	1800-2200	40	dB
LA90 Night-time	2200-0700	32	dB

AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	51	dB
LAeq Evening	1800-2200	44	dB
LAeq Night-time	2200-0700	44	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	50	dB
LAeq 9 hours	2200-0700	44	dB
Max LAeq 1 hour	0700-2200	53	dB
Max LAeq 1 hour	2200-0700	45	dB