CHRISTIAN BRETHREN COMMUNITY SERVICES

GLENHAVEN GARDENS

Acoustic Assessment for DA

Issued

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1 Introduction

Christian Brethren Community Services (CBCS) is currently proposing to develop an extension of their Glenhaven Gardens Retirement Village in Glenhaven. The proposal involves to annex and develop an adjacent lot to accommodate 12 new dwellings.

Acoustic Studio has been engaged by CBCS to provide acoustic engineering services for the Development Application.

This report presents the results and findings from the operational noise emissions and traffic noise impact assessments as per The Hills Shire Council request¹.

1.1 Council Requirements

The Hills Shire Council requires the following in relation to the recent DA submission (64/2018/HC):

"... Acoustic additional information required.

Due to the location of the proposed development the applicant is required to submit an Acoustic report. This report must address noise issues associated with the use of the premises on the surrounding residential premises as well as an assessment of road traffic noise on the proposed premises. The acoustical assessment shall include noise emission considerations and details such as;

- Project description
- Relevant guidelines or policy that has been applied
- Background noise measurements
- Details of instruments and methodology used for noise measurements (including reasons for setting and descriptors used, calibration details)
- A site map showing noise sources, measurement locations and noise receivers
- Noise criteria applied to the project
- Noise predictions for the proposed activity
- A comparison of noise predictions against noise criteria

¹ Email from Cynthia Dugan dated 15 August 2017

- A discussion of proposed noise mitigation measures, the noise reduction likely and the feasibility and reasonableness of these measures
- How compliance can be practically determined

The acoustical assessment is to be carried out by an appropriately qualified and practicing acoustical consultant in accordance with the requirements of the Environmental Protection Authority's Industrial Noise Policy. The report shall be submitted to Council for consideration."

In order to satisfy these requirements, Acoustic Studio has undertaken a noise impact assessment for the proposed development and has prepared this acoustic report for submission to Council. This acoustic report provides the noise assessments and their findings.

1.2 The Key Acoustic Issues

The following acoustic issues are addressed as part of the noise impact assessments:

• The potential impact of environmental noise break-out from the proposed development and impacting on surrounding noise sensitive receivers.

The development will contribute noise to the future ambient noise environment. Potential noise impacts on the surroundings that may result from the operation of the proposed development include:

- Noise from mechanical equipment.
- Noise from car movements.

The characters of these noise sources are very different (i.e. the time history and spectral components). Therefore, separate environmental noise assessments (for which different noise criteria will apply) are presented.

The mechanical plant noise levels are assessed against the NSW Office of Environment and Heritage (OEH, previously EPA) Industrial Noise Policy (INP) 2000.

Vehicle movements and associated noise break-out are assessed against the NSW Road Noise Policy.

The operational noise impact assessment is presented in Section 5.

• The control of external noise intrusion into the development.

The ambient noise environment around the site is dominated by traffic noise from Glenhaven Road.

Traffic noise break-in from Glenhaven Road traffic is assessed in accordance with AS 3671:1989 Acoustics – Road Traffic Noise Intrusion – Building siting and construction'.

The external noise impact assessment is presented in Section 6.

2 Description of Proposal

2.1 The Site and Surrounding Area

Glenhaven is 32 kilometres north-west of the Sydney CBD in the local government area of The Hills Shire and Hornsby Shire, part of the Hills District region.

The proposed development site in Glenhaven is located at 140-146 Glenhaven Road. The site is located within a semi-rural environment characterised by light levels of activity during the day.

As shown in Figure 1, the noise sensitive receivers surrounding the site are residential receivers to the North and West. The southern boundaries are vegetated with bushland.

Within the proposed to be annexed lot, there is an existing CBCS building which will not be part of the proposed extension. The existing use of this building will remain uncganged.

The closest residential receiver boundary is 148 Glenhaven Road property – to the West – and 103 Glenhaven Road on the opposite side of Glenhaven Road, approximately 15 meters to the North.



Glenhaven Gardens Proposed Extension Residential Receivers

Figure 1: Project site and surrounds – showing the Glenhaven Gardens (green shading), proposed extension (red shading) and nearest sensitive receivers (blue shading) locations

For the purpose of this noise assessment, it is noted that if noise impacts associated with the development are controlled at the closest residential receivers, then compliance with the recommended criteria and limits at all sensitive receivers will be achieved.

2.2 Proposed Development

The proposed development involves the construction of 12 dwellings to comprise an expansion of the existing Glenhaven Gardens Retirement Village, operated by CBCS. The existing facility contains a hostel and 24 villas.

The dwellings will be constructed on the west side of the site and there will be a driveway access to Glenhaven Road.

As with the existing villas, the proposed building façades are to be of masonry construction.

The closest units to Glenhaven Road (units 1 to 5) will be approximately 10 meters from the roadway.



Figure 2 shows the layout of the proposed development.

Figure 2: Proposed development layout

3 Environmental Noise

3.1 General Survey Information

A noise survey of the existing noise environment around the site was conducted with unattended noise monitors used to continuously record the noise levels on the site. Long-term noise monitoring was carried out from Thursday 14th September to Friday 22nd September 2017 to establish the typical range of noise levels of the site and surrounds.

External long-term noise monitoring was carried out with a RTA noise logger Type 02 (Serial Number 038) and a Brüel&Kjær noise logger Type 3659-B (Serial Number 3010119). The calibration of the noise loggers was checked before and after the surveys using a Brüel&Kjær Sound Level Calibrator Type 4231 (Serial Number 2438997) and no variation in levels occurred.

Operator attended short-term noise monitoring was also carried out on Thursday 14th September 2017 in order to confirm the validity of the long-term outdoor data across the site.

A Brüel&Kjær Hand-held Analyser Type 2250 (Serial Number 2832406) was used to carry out the short-term octave band sound pressure level measurements. The calibration of the analyser was checked before and after the surveys using a Brüel&Kjær Sound Level Calibrator Type 4231 (Serial Number 2438997) and no variation in levels occurred.

Windshields were used to protect the microphones of the noise loggers and the analyser. The analyser and noise logger microphones were mounted 1.5m above ground.

Jorge Reverter of Acoustic Studio Pty Ltd carried out the noise surveys, in accordance with the method of measurement described in the AS/NZS 1055:1997 Acoustics – Description and measurement of environmental noise, parts 1 and 2, plus AS 2072:1984 Acoustics – Methods for the measurement of road traffic noise.

The long-term and short-term noise monitoring locations are shown in Figure 3.



Figure 3: Measurements locations

3.2 Background and Ambient Noise Levels

3.2.1 Long-term Noise Monitoring

The long-term noise monitoring positions were secure locations at the proposed development site. At Location L1, existing traffic noise levels were monitored. Location 2 in the Glenhaven Gardens site establishes existing background noise levels representative of those at the closest residential receivers.

The noise loggers were in the free-field (i.e. away from acoustically reflective surfaces) and locations were selected to be representative of the Glenhaven Road noise levels plus ambient and background noise environment around the site.

The detailed results of the long-term noise monitoring at Location L1 and Location L2 are shown graphically in Appendix B. These data show the background and ambient sound levels of the area (used to establish the limiting criteria as per the NSW INP).

Meteorological conditions were recorded during the long-term noise monitoring and data affected by adverse weather conditions were removed for the analysis procedure. These data are shadowed in the Appendix B graphs.

The background sound level is defined as the sound level exceeded 90% of the time, and is designated as the L_{90} .

The ambient noise level impacting on the site is referred to as the equivalent continuous sound level (L_{eq}). This parameter is commonly used to describe a time varying noise such as traffic noise.

The background sound levels have been established in general accordance with the methodology described in the NSW INP, i.e. the 10th percentile background sound level for each period of each day of the ambient noise survey. The median of these levels is then presented as the background sound level for each assessment period.

These background noise levels are shown in Table 1, together with the L_{Aeq} ambient noise levels measured for each period.

	L ₉₀ Backg	round Noise Le	evels, dB(A)	L _{eq} Ambient Noise Levels, dB(A)			
Location	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	
Location L1	47	42	30	66	64	59	
Location L2	41	38	36	49	45	47	

Table 1: Long-term background and ambient noise levels measured at site

Table 2 shows the traffic noise levels as per AS 3671:1989 and NSW RNP noise descriptors, based on the long-term noise levels measured at Location L1.

Location	Measured Noise Levels dBA				
Location	Day (7am-10pm)	Night (10pm-7am)			
Location L1	L _{Aeq,15 hour} 65	L _{Aeq,9 hour} 59			

 Table 2: Long-term traffic noise levels measured at site

3.2.2 Short-term Noise Monitoring

Short-term noise monitoring was carried out in the long-term noise monitoring locations. At Location L1, the noise environment was dominated by traffic from Glenhaven Road. As shown in Figure 4, the noise environment at Location L2 during day-time was dominated by water running in the pond next to the noise logger location. We have determined that this does not affect the noise level criteria for the most stringent timer periods – ie. evening and night-time periods.



Figure 4: Water running in the pond next to the noise logger location during day-time period

			Sound Pressure Level, dB re 20µPa								
Location	Date and time	Parameter	Overall	Octave Band Centre Frequency, Hz							
			dB(A)	63	125	250	500	1k	2k	4k	8k
	14/09/2017 L1 1:15 pm	L90,15min	52	54	46	45	47	46	41	39	34
L1		Leq,15min	65	69	63	58	62	61	53	48	45
		L10,15min	69	69	65	62	64	67	59	53	51
	L2 2 00 pm	L90,15min	45	49	45	41	40	40	38	35	30
L2		Leq,15min	49	53	49	45	44	43	41	40	36
	2.00 pm	L10,15min	51	55	51	48	47	46	44	43	40

A summary of the short-term noise monitoring is shown in Table 3.

 Table 3: Summary of Short-term background and ambient noise levels measured at the noise monitoring locations

4 Relevant Standards and Legislation

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 criteria:

- Measurement of Noise
 - Australian Standard 'AS 1055:1997 Acoustics Description and measurement of environmental noise'.
 - Australian Standard 'AS 2072:1984 Acoustics Methods for the measurement of road traffic noise'.
- Operational Noise
 - Environmental Planning and Assessment (EP&A) Act 1979.
 - Protection of the Environmental Operations (POEO) Act 1997.
 - EPA / OEH NSW Industrial Noise Policy (INP) 2000.
 - o DECCW NSW 'Road Noise Policy' (RNP) 2011.
- External Noise Intrusion
 - o DECCW NSW 'Road Noise Policy' (RNP) 2011.
 - Australian Standard 'AS 2017:2016 Acoustics Recommended design sound levels and reverberation times for building interiors'.
 - Australian Standard 'AS 3671:1989 Acoustics Road Traffic Noise Intrusion – Building siting and construction'.
 - UK Department of the Environment Calculation of Road Traffic Noise (CoRTN).
 - Australian Government Department of Infrastructure and Transport. *Traffic Growth in Australia* 2012.

4.2 The Hills Shire Council Legislation

Relevant Planning Documents of The Hills Shire Council Legislation have been reviewed for any noise requirements or criteria. The Hills Shire Council noise management policy refers to the Protection of the Environmental Operations (POEO) Act 1997 and Protection of the Environmental Operations (POEO) Noise Controls Regulation 2008.

The Hills Shire Council Local Environmental Plan (TH-LEP) 2012 and Development Control Plan (TH-DCP) 2012 do not include any specific requirements for noise management related to the development. However, TH-DCP refers to AS 3671:1989 Acoustics – Road Traffic Noise Intrusion – Building siting and construction for traffic noise impact assessment of residential developments adjoined classified roads.

4.3 Noise Criteria

4.3.1 Protection of the Environment Operations (POEO) Act 1997

The Protection of the Environment Operations (POEO) Act 1997 defines "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."

The definition provided by the POEO is generally focused around a subjective assessment. Acoustic Studio recommends that a suitable objective criterion for assessing offensive noise before midnight is "*Background* + 5dB", and "*Background* + 0dB" after midnight plus 'inaudibility' within and habitable room of a residential receiver. This has previously been supported by environmental officers for other similar projects and, therefore, is adopted for this assessment.

4.3.2 EPA NSW Industrial Noise Policy

The EPA NSW Industrial Noise Policy (INP) 2000 of the NSW Department of Environmental and Heritage is specifically aimed at assessing noise from industrial noise sources scheduled under the Protection of the Environmental Operations (POEO) Act 1997.

An assessment carried our in accordance with the requirements of the Policy must:

- Identify any beneficial or adverse noise impacts that might result in the surrounding community.
- Describe any noise mitigation measures and strategies that will be necessary to protect the acoustic amenity of the area.
- Describe the methods by which compliance with the acoustic criteria can determined after the facility is operational.

The assessment is carried out by comparing the new predicted intrusive noise level against the criterion based on the estimated background noise level.

Where the intrusive noise is greater than the pre-existing background noise level, the potential exists for disturbance and annoyance. However, the impact is considered marginal if the difference between the pre-existing background noise level and the intrusive noise is 5 dB(A) or less. This concept has resulted in the commonly used criterion of "*Background noise level* + 5dB" – applicable between 7am and midnight.

Often the criterion becomes more stringent after midnight, recognising the increased sensitivity of this late night period in residential neighbourhoods. This has resulted in the commonly used criterion of "*Background noise level + 0dB*" between midnight and 7am.

For the purpose of this assessment the NSW INP criteria are limited to operational noise break-out from the mechanical plant of the proposed development to nearest noise receivers.

Indicative Noise Amenity Area	Period	Intrusiveness Criterion	Amenity Criterion
	Day	46	46
Residential	Evening	43	37
	Night	41	37

Table 4: Determination of INP project specific noise levels (ANLs – light grey shading) for the project site

Appendix A contains an extended NSW INP analysis and the derivation of the environmental noise limits.

4.3.3 NSW Road Noise Policy

Section 2.3.1 of the NSW Road Noise Policy (RNP) provides criteria for traffic noise from new roads or additional traffic generated on roads from land use development.

Regarding traffic generated by the redevelopment, the NSW RNP states that when considering land use redevelopment and the impact on sensitive land uses (residential / schools / hospitals / recreational) an increase up to 2 dB in relation to existing noise levels is anticipated to be insignificant.

4.3.4 Internal Design Sound Levels

Recommendations for the internal design sound levels are made by reference to Australian Standard AS 2107:2016 '*Acoustics – Recommended design sound levels and reverberation times for building interiors*'.

The design sound levels are given as equivalent continuous A-weighted sound pressure levels measured in decibels, L_{Aeq} dB(A). They take into account the function of the area(s) and apply to the space unoccupied but fully fitted-out and ready for occupancy.

The Standard applies to *steady state* and/or *quasi-steady-state* sounds (e.g. airconditioning noise – *steady state*, and continuous traffic noise – *quasi-steadystate*). The sound levels apply to the normal operating conditions of the building and represent the <u>total</u> sound level from <u>all</u> *steady-state* or *quasi-steady-state* sounds normally affecting the space.

The recommended noise level is presented as a range from *satisfactory* to *maximum*.

The satisfactory design sound level is defined as: The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

The maximum design sound level is defined as: The level of noise above which most people occupying the space start to become dissatisfied with the level of noise. It can also be considered acceptable, but there is a greater perception of intrusion of this noise level and effect on the activities of the space. Beyond this maximum level there is a risk of increasing user dissatisfaction with the environment of the space in question.

Table 5 shows the recommended design sound levels within the various spaces as per AS 2107:2016.

Type of occupancy / activity	AS 2107:2016 Design sound level, L _{Aeq,t} dB(A) range			
Housing and apartments in sub-urban areas or near minor roads				
Living Areas	30 to 40			
Sleeping Areas (night time)	30 to 35			

 Table 5: Design sound levels for internal areas

5 Operational Noise Impact Assessment – Noise Emissions

5.1 Noise Sources

5.1.1 Mechanical Plant

Plant noise associated with the operation of the proposed development should be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of neighbouring receivers. In particular, this applies to any externally located plant.

5.1.2 Vehicle Movements

Traffic generated by the proposed development has been obtained from the Traffic Report² prepared by Thompson Stanbury Associates. Section 6 sets 2.1 trips daily per dwelling. This equates to approximately to 25 car movements daily along the driveway and 5 car movements during peak hour.

It is anticipated that these figures will not produce a significant increase in Glenhaven Road traffic due to the development.

5.2 Noise Assessment and Recommendations

At this stage, mechanical selections have not been made and their location are unconfirmed. Therefore, it is recommended that the final selection of the mechanical plant shall not exceed the night-time NSW INP Project Specific Noise Criterion (ie. 37 dBA) at the boundary of any sensitive residential receiver.

This will ensure that there are no adverse noise impacts on existing neighbouring residents as a result of new mechanical plant.

Predicted daily car movements due to the proposed development is 25 vehicles/day. The low number of vehicle movements compared with Glenhaven Road traffic volume (approximately 1500 vehicles/hour during peak hour), indicates that there will be no increase in road traffic as a result of the development.

² Traffic and Parking Impact Assessment. 140-146 Glenhaven Road, Glenhaven (Proposed Alterations and Additions to Existing Retirement Village). May 2017. Thompson Stanbury Associates

As noted in Section 4.3.3, when considering land use development and the impact on sensitive land uses, the NSW RNP states that an increase up to 2 dB in relation to existing noise levels is anticipated to be insignificant.

Therefore, the development will generate no adverse traffic noise impacts in adjacent existing residential receivers.

6 Traffic Noise Impact Assessment – External Noise Intrusion

6.1 Road Description

Glenhaven Road can be categorised as a sub-arterial road as per the NSW RNP. Its functional role is to provide connection between arterial roads and local roads.

It is assumed that traffic flow figures for Glenhaven Road are below the 40,000 veh/day required in the Clause 102 of the SEPP 2007. Therefore, this legislation does not apply to the current project.

It is noted that Glenhaven Road is proposed to be widened, as per the Traffic Report prepared by Thompson Stanbury Associates:

"…

It is understood based on the outcomes of Glenhaven Road Corridor Study undertaken in November 2016 on behalf of The Hills Shire Council and recent discussions with Council's Infrastructure Manager that Glenhaven Road is proposed to be upgraded to comprise a four lane undivided carriageway to better accommodate future traffic demands.

..."

Location	Direction	Existing Peak Hour Traffic Volume			
Location	Direction	AM Peak (7am-9am)	PM Peak (4pm-6pm)		
Claphayon Dood	Eastbound	524	1034		
Glennaven Road	Westbound	930	460		
	Total:	1454	1494		

The Traffic Report also provides traffic volume data for current peak morning and afternoon traffic. The derived data for the development are shown in Table 6.

 Table 6: Derived data of existing peak hour traffic volume for Glenhaven Road at development site

6.2 Road Traffic Noise Levels

As per Section 2.2.4 of the AS3671:1989, the traffic noise level exposure of the site has been calculated in accordance with the Calculation of Road Traffic Noise (CoRTN).

The CoRTN algorithm to estimate road traffic noise was developed for the UK Department of the Environment by Delany et al³. The algorithm is updated on a continuous basis and this calculation method provides an accurate traffic noise level prediction based on traffic flow and site/road characteristics.

Long-term noise level monitoring was carried out as per Section 3.2.1 and correspondent noise descriptors obtained plus CoRTN predictions based on Section 6.1 data and architectural drawings are shown in Table 7.

	Measured Nois	e Levels dBA	CoRTN Prec	CoRTN Predictions dBA		
Location	Day (7am-10pm)	Night (10pm- 7am)	At measurement location (approx 7m)	At façade location (approx 10m)		
Location L1	*L _{Aeq,15 hour} 67	*L _{Aeq,9 hour} 61	67	66		

Table 7: Long-term traffic noise levels measured at site and CoRTN predictions

* Note: A façade correction of 2.5 dB has been applied to measured noise levels as per NSW RNP recommendation

The CoRTN predictions have been carried out for reference and values obtained are found to be similar to the traffic noise levels measured on site. For the purpose of this assessment the measured traffic noise levels have been used.

The following assumptions have been made to provide an allowance for the future traffic noise impact from Glenhaven Road:

- The proposed widening of Glenhaven Road will result in a maximum doubling of traffic volume.
- A 1% yearly traffic volume increase over 10 years has been assumed, based on information obtained from the *Traffic Growth in Australia* 2012, prepared by the Department of Infrastructure and Transport.

Based on the above, Table 8 shows the predicted worst case future traffic noise from Glenhaven Road at the façade of the nearest proposed dwelling.

 $^{^3}$ Delany, M.E., D.G. Harland, R.A. Hood, and W.E. Scholes. 1976. The prediction of noise levels L₁₀ due to road traffic. *Journal of Sound and Vibration* 48(3):305–25

Location	Predicted Noi	se Levels dBA
Location	Day (7am-10pm)	Night (10pm-7am)
Façade	L _{Aeq,15 hour} 70	L _{Aeq,9 hour} 64

Table 8: Predicted future traffic noise levels at site

Based on the noise level measurements at Location L1 and the predicted future traffic noise, the traffic spectra for the required Traffic Noise Attenuation (TNA) is shown in Table 9.

	Sound Pressure Level, dB re 20µPa								
Period	Overall dB(A)	Octave Band Centre Frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
Existing day-time	67	66	62	59	61	65	56	50	48
Existing night-time	61	59	56	53	55	59	50	44	42
Future day-time	70	69	65	62	64	68	59	53	51
Future night-time	64	63	59	56	58	62	53	47	45

Table 9: Existing traffic noise levels and predicted future traffic noise levels

6.3 Traffic Noise Attenuation – Existing Traffic

AS 3671:1989 is used to determine the construction of the building envelope to attenuate traffic noise impact within building spaces and meet the internal noise levels recommended in the AS2107:2016.

The procedure described in Section 3 of the AS3671:1989 has been followed to establish the octave band TNA required for each of the most exposed dwellings' spaces to Glenhaven Road.

In determining the TNA_c for each of the external elements of these rooms, allowances have been made for the number or components (*C*), the ceiling height (*h*) of the spaces, the ratio of areas of each component (S_c/S_f) and the reverberation time (*RT*) of the spaces.

As per Section 3.4.3.1 of the AS3671:1989, we recommend a component weighted sound reduction index (R_w) 6 dB higher than the TNA_c.

Table 10 shows the minimum weighted sound reduction index (R_w) obtained from the TNA_c for each element of the units closest to Glenhaven Road.

Poom		Weighted Sound Re	duction Index R _w (dB)
	Roof	Wall	Window	Sliding Door
Living / Dining Room	47	43	35	40
Bedroom	39	37	32	

 Table 10: Required R_w for external building envelope as per existing road traffic

6.4 Traffic Noise Attenuation – Future Traffic

Based on the predicted future traffic volumes as presented in Section 6.2, traffic noise levels will increase in the future by up to 4 dB - accounting for the future widening of Glenhaven Road.

Under the future traffic noise scenario, the minimum weighted sound reduction index (R_w) for each building envelope element would need to increase from the values in Table 10.

However, we have assumed that any additional noise mitigation that is required for future traffic noise levels as a result of the Glenhaven Road widening will be the responsibility of others.

7 Summary and Conclusions

A noise impact assessment has been carried out for the proposed development for Glenhaven Gardens Retirement Village in Glenhaven. The proposal involves annexing and developing an adjacent lot to accommodate 12 new dwellings

This report presents the results and findings from the operational noise emissions and traffic noise impact assessments as per The Hills Shire Council request.

Operational noise emissions associated with the operation of the proposed development have been assessed. The assessment has adopted methodology from relevant guidelines to assess particular noise sources and impacts.

At this stage, the mechanical plant selections have not been made; therefore, a detailed assessment has not been able to be carried out. A preliminary review has been carried out and established the noise level criterion to be met at the boundary of the nearest sensitive receivers.

Traffic noise levels are not expected to increase as a result of the proposal. Therefore, the traffic noise impact due to vehicle movements associated with the development is anticipated to be insignificant.

The noise impact on the development from Glenhaven Road traffic has been assessed in accordance with recommendations of AS3671:1989 '*Acoustics* – *Road Traffic Noise Intrusion* – *Building siting and construction*'. AS 3671:1989 is used to determine the construction of the building envelope to attenuate traffic noise impacts within building spaces and meet the internal noise levels recommended in AS2107:2016.

Existing traffic noise impacts to the proposed development site have been derived from the long-term noise monitoring results. Based on these results, weighted sound insulation index (R_w) values for each façade component of the dwellings close to Glenhaven Road have been provided in order to meet the recommended internal design noise levels.

Under the future traffic noise scenario, the minimum weighted sound reduction index (R_w) for each building envelope element would need to increase from the values presented herein.

However, we have assumed that any additional noise mitigation that is required for future traffic noise levels as a result of the Glenhaven Road widening will be the responsibility of others.

Appendices

Appendix A: Derivation of Environmental Noise Break-out Limits

The main source of noise break-out from the site to the environment will be mechanical services plant.

The environmental noise impact of the mechanical plant will be assessed in accordance with the NSW Industrial Noise Policy (NP) 2000.

The NSW INP sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. Both are used to derive the project specific noise level.

Assessing intrusiveness

The intrusiveness criterion essentially means that the equivalent continuous noise level of the source should not be more than 5 dB above the measured existing background noise level.

Assessing amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise, including plant. The existing noise level from industry (or plant) is measured - if it approaches the criterion value, then the noise levels from new plant need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion.

The cumulative effect of noise from all industrial or plant sources is considered in assessing impact.

Project specific noise level

For the new plant, the more stringent of the intrusive and the amenity criteria sets the project specific noise level.

The derivation of the project specific noise levels is provided below.

A.1 Existing Background and Ambient Noise Levels

The rating background level (RBL) has been determined from $L_{A90,15min}$ measured during the long-term noise survey in accordance with the methodology prescribed in NSW INP. Data affected by adverse weather conditions were removed for the analysis procedure.

Three time periods are considered (consistent with the operating times of the plant associated with the development and the time of day classifications in the Policy):

•	Day	-	7 am to 6 pm
•	Evening	-	6 pm to 10 pm
•	Night	-	10 pm to 7 am

The estimated RBL's and ambient noise levels are shown below in Table A1.

	L90 RBL Bad	ckground Noise	Levels, dB(A)	L _{eq} Ambient Noise Levels, dB(A)		
Location	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Location L2	41	38	36	49	45	47

Table A1: Long-term background and ambient noise levels measured at project site

A.2 Determination of intrusiveness criterion

The intrusiveness criterion is defined as:

L_{Aeq,15 minute} ≤ Rating Background Level (RBL) plus 5

The intrusiveness criterion has been determined from the RBL's presented in Table A1 for each period.

- Day Intrusiveness criterion of 41 + 5 = 46 dB(A)
- Evening Intrusiveness criterion of 38 + 5 = 43 dB(A)
- Night Intrusiveness criterion of 36 + 5 = 41 dB(A)

A.3 Determination of amenity criterion

To limit continuing increases in noise levels, the maximum ambient noise levels within an area from industrial noise sources should not normally exceed the acceptable noise levels appropriate for the type of area (e.g. the acceptable noise level in a rural area would be less than that in an urban or industrial area).

Recommended LAeq noise levels from industrial noise sources within NSW INP

The Acceptable Noise Levels (ANLs) for each land use type under consideration (as detailed in Table 2.1 of the NSW Industrial Noise Policy) are given in Table A2 below.

The nearest receivers to the project are considered to be in a Noise Amenity Area characterised by the NSW INP as rural.

Indiantivo Naisa Amonity Aroa	Doriod	Recommended L _{Aeq,period} Noise Level (ANL)			
mulcauve noise Amenily Area	Fenou	Acceptable	Recommended Maximum		
	Day	50	55		
Residential	Evening	45	50		
	Night	40	45		

 Table A2:
 Recommended LAeq noise levels from industrial noise sources at residential receivers

For the purpose of this assessment, "Acceptable" noise levels as presented in the table above are to be adopted.

Amenity criterion

The amenity criterion is determined from the relationship of the existing L_{Aeq} noise level and the Acceptable Noise Levels (ANL's) for each land use type under consideration using Table 2.2 of the NSW INP. This process is summarised below in Table A3 for the closest residential receivers to the site.

Indicative Noise Amenity Area	Period	Existing L _{Aeq}	ANL	Adjustment	Amenity Criterion
	Day	49	50	ANL minus 4	46
Residential	Evening	45	45	ANL minus 8	37
	Night	47	40	L _{Aeq} minus 10	37

 Table A3:
 Determination of amenity criterion for residential receivers

A.4 Project specific noise level

The Project Specific Noise Level is defined as the lower of the intrusiveness and the amenity criteria. On this basis, the Project Specific Noise Levels (PNLs) are shown in Table A4 below (PNLs shown shaded).

Indicative Noise Amenity Area	Period	Intrusiveness Criterion	Amenity Criterion		
	Day	46	46		
Residential	Evening	43	37		
	Night	41	37		

Table A4: Deter

Determination of project specific noise levels for the project site

Appendix B: Long-term Noise Monitoring Results



















Time of day

















