MARSHALL DAY Acoustics

SOUTH CREEK WEST –BELMORE RD
NOISE AND VIBRATION IMPACT ASSESSMENT

Rp 001 r01 20220368 | 28 September 2023

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Project: **SOUTH CREEK WEST – BELMORE RD PRECINCT**

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EXECUTIVE SUMMARY

Marshall Day Acoustics (MDA) has been engaged by CKDI Group to prepare a noise and vibration impact assessment to assist Precinct Planning of the Belmore Rd precinct of the South Creek West Growth Area. The project site is referred to in this report as South Creek West – Belmore Rd Precinct.

Modelling of noise propagation over the site has identified potential traffic noise impacts affecting a number of lots within the development site.

This assessment has evaluated these impacts and provided generic noise control recommendations to demonstrate that the affected lots are capable of complying with the relevant noise criteria detailed in this report.

Noise control recommendations include:

- The provision of physical noise controls in the form of acoustic fencing and potential earthworks/berms
- Setback of individual superlots from modelled road traffic noise sources
- Arrangement of individual lots within superlots to maximise shielding effects
- Provision of architectural treatments to dwellings including alternative ventilation and upgraded glazing

The conceptual content of this assessment is sufficient to assist in the finalisation of the development Masterplan, however, detailed development of noise control recommendations specific to individual lots is expected to be conducted later as part of future development stages of the site.

In addition to traffic noise, noise from the proposed Western Sydney Airport and the proposed Sydney Metro Western Sydney Rail Corridor have been considered. This report has established that these sources are unlikely to give rise to adverse impacts on the South Creek West – Belmore Rd Precinct development.

Noise from the operation of the Bringelly Brickworks has been also considered. Currently Bringelly Brickworks operates under an Environment Protection Licence and an associated Noise Management Plan (NMP). Provided that the operation of the Bringelly Brickworks is appropriately managed in such a way that the requirements of the NMP and the Environment Protection Licence are adhered to, any lot within the subdivision will also be subject to compliant noise levels from the Bringelly Brickworks.

With the implementation of the recommendations of this report, all lots are capable of complying with the noise and vibration criteria applicable to the site.

If the information used as part of this assessment, including traffic data, site topography, lot layouts or dwelling properties (dimensions and positioning) change significantly, the findings of this report will require revising and any advice provided may be obsolete.

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1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been engaged by CKDI Group to prepare a noise and vibration impact assessment to assist Precinct Planning of the Belmore Rd precinct of the South Creek West Growth Area. The project site is referred to in this report as South Creek West – Belmore Rd (SCW – Belmore Rd).

The SCW - Belmore Rd study area is being nominated by CKDI Group to be released for development ahead of the *Department of Planning, Infrastructure and Environment's* (DPIE) timeline, through the Precinct Acceleration Protocol. Current land use within the subject site is predominantly agricultural. It is proposed to re-zone and develop the site to establish a residential community with access to employment, public transport, education, and commercial facilities.

At this stage, an Indicative Layout Plan (ILP) has been prepared by URBIS for this project. The ILP comprises of superlots with different proposed densities. No specific individual lots are indicated. MDA has been engaged to consider the following general noise sources:

- Noise and vibration from operation of Western Sydney International Airport (WSI)
- Noise and vibration from rail activities
- Noise and vibration from operation of the Bringelly Brickworks
- Noise and vibration from traffic on arterial and sub-arterial roads (listed in Section 6.0)

Conclusions in this report are based on calculations, measurements and inspections carried out by MDA, in addition to:

- ILP (Rev H) prepared by URBIS, dated 5 September 2023;
- Ground terrain data provided to MDA by URBIS, dated 19 February 2021;
- Traffic data for The Northern Road and all relevant sub-arterial roads (described in Section 6.0)as provided by CKDI via an email, dated 1 March 2022;

If the information provided in the above drawings/documents change or no longer apply to the project, then the outcomes of this report may need to be revised.

This report incorporates both the updated ILP revision referenced above and additional acoustic modelling of relevant sub-arterial roads into the conclusions presented in the previous report issued by MDA for this site *– Rp 001 20210119 – South Creek West – Bringelly – Noise and Vibration Impact Assessment* dated 25 March 2021.

A glossary of acoustic terminology used within this report is provided in Appendix A.

2.0 SITE DESCRIPTION

The SCW- Belmore Rd precinct is located within the South West Growth Area (SWGA) and is bounded by The Northern Road to the east, Greendale Road to the north, lot boundaries to the west and, planned Lowes Creek Link Road to the south.

The extent of the site and the proposed subdivision layout are shown in Appendix B. The updated ILP comprises of superlots of different proposed densities and does not provide any indication of individual lot layouts. The most sensitive lots are expected to be residential lots with a direct line of sight to the roads modelled.

No significant natural shielding along The Northern Road (between the site and The Northern Road) is present. MDA has not been provided with design contours associated with the ILP. Assessment and modelling have been conducted based on existing terrain data. MDA understands that the design elevation of the subject site would not be significantly different to the existing natural ground elevations.

3.0 AIRCRAFT NOISE AND VIBRATION ASSESSMENT

MDA has been requested to provide comments on potential noise and vibration impacts to the proposed development from operation of the future Western Sydney Airport.

Australian Standard AS2021:2015 Acoustics-Aircraft Noise Intrusion-Building, Siting and Construction (AS2021) provides guidance on the location and construction of new buildings exposed to aircraft noise. AS2021 also includes guidelines for the assessment of potential aircraft noise exposure at a given site based on the *Australian Noise Exposure Forecast* (ANEF) system. ANEF contour maps show the forecast of noise exposure levels and allow for future changes and expansion of the operation of the airport. AS2021 uses the ANEF system to determine the suitability or otherwise of a site depending on its proposed use. Residential buildings located in an ANEF-20 or less, are classified as being “Acceptable”.

At this stage of the WSI development, ANEF contours have not yet been finalised. In the interim, the Aircraft Overflight Noise Tool[1] available online, presents Aircraft Noise Exposure Concept (ANEC) contours forecast for 2030, and 2040 operation of WSI and has been used for this assessment. The site is located approximately 7 km from the Stage 1 Development (single-runway facility proposed to be operational from 2030).

Review of the currently available worst-case ANEC forecast (Yr 2040) shows that the site is located well outside the ANEC-20 contours. On the assumption that the final ANEF contours will be broadly similar to the ANEC contours the site would be classified as being “acceptable” for residential use. Hence, aircraft noise is not expected to adversely impact the proposed development and no further assessment has been conducted.

Given the significant distances to the airport site ground borne vibration levels are expected to be negligible.

4.0 RAIL NOISE AND VIBRATION ASSESSMENT

The proposed site is located more than 1 km west of the proposed Sydney Metro Western Sydney Rail Corridor. A high-level assessment conducted by MDA indicates that due to this distance, noise from passenger and freight activities along the rail line will be low and not expected to contribute to the noise environment at the subject residential receivers, which is dominated by road traffic noise.

With respect to vibration, receivers further than 25 m from rail corridors are not required to be assessed in accordance with the *NSW State Environmental Planning Policy (Infrastructure) 2007*

[1]https://wsiflightpaths.aerlabs.com/

(*Infrastructure SEPP*) or the *NSW Department of Planning; Interim Guideline – Development Near Rail Corridors and Busy Roads*.

On this basis, noise and vibration impact from the proposed Sydney Metro Western Sydney Rail Corridor is not further assessed in this report.

5.0 QUARRY NOISE AND VIBRATION ASSESSMENT

Bringelly Brickworks, operated by PGH Bricks, is a clay/shale quarry and brick making facility located at 60 Greendale Road, Bringelly, on Lot 100 in DP 1203966 directly west of SCW - Bringelly. The facility has been in operation since 1968 and currently operates under an Environment Protection Licence (Number: 1808). The Environment Protection Licence sets out noise and vibration emission criteria. It requires the facility to manage its operation such that the applicable criteria are achieved at the most affected nearby residence.

A Noise Management Plan[2], Doc No. BRK- BRI – NMP, Version 4, dated September 2019, (NMP) has previously been prepared for the quarry and brick making facility. The purpose of the NMP is to describe how PGH Bricks proposes to ensure appropriate environmental management measures and procedures are implemented during construction and operational activities throughout the operational lifetime of the facility, including procedures to minimise noise impacts to the nearby sensitive receivers. The sensitive receivers considered in the noise impact assessment carried out in the NMP, include the following adjacent sensitive residences:

- 55 Loftus Road, Bringelly, NSW 2556 (referred to as R1 in the NMP)
- 54 Loftus Road, Bringelly, NSW 2556 (referred to as R2 in the NMP)
- 20 Greendale Road, Bringelly, NSW 2556 (referred to as R3 in the NMP)

The above receivers are currently located east of the quarry and brick making facility, and within the proposed subject Precinct (SCW- Belmore Rd). The proposed lot boundaries in the ILP are within the assessment locations of the existing residences identified above. As such, where compliance is currently achieved, compliance will continue to be achieved within the new subdivision. The main objective of the NMP is to ensure that noise impacts to the local community (including the above locations) are minimised during the lifetime of the facility. To achieve this objective, the following targets are established under the NMP, for the management of noise impacts:

- Ensure full compliance with the relevant legislative requirements.
- Adopt feasible and reasonable noise mitigation measures to ensure the facility complies with the noise criteria stipulated in the CoA (Conditions of Approval for SSD 5684, including Modification 1) listed in the NMP; and
- Ensure complaints from the community and stakeholders are minimised.

Therefore, provided that the operation of the Bringelly Brickworks is appropriately managed in such a way that the requirements of the NMP and the Environment Protection Licence are adhered to, any lot within the subdivision will also be subject to compliant noise levels from the Bringelly Brickworks.

[2] https://www.pghbricks.com.au/-nsw-environmental-reporting

6.0 ROAD TRAFFIC NOISE AND VIBRATION ASSESSMENT

Traffic noise from the following roads will be experienced at the proposed residential lots within the precinct.

- The Northern Road (TNR)
- Greendale Road
- Bringelly Rd (west of TNR Int 1)
- Belmore Rd (west of TNR Int 2)
- N-S sub-arterial (south of Bringelly Rd)
- N-S sub-arterial (south of Lowes Creek Link Rd)

In this report, predictions of traffic noise and the likelihood of adverse noise impacts has been conducted based on the provided ILP to inform the precinct planning process. Detailed development of noise control recommendations specific to individual lots is expected to be conducted at future development stages of the site.

Traffic noise levels have been predicted for two purposes:

- To advise conceptual building construction requirements based on internal noise level compliance; and
- To advise potential physical noise controls required to mitigate noise in Principal Private Open Spaces in order to comply with the applicable external noise criteria.

6.1 Traffic Noise Criteria

Noise criteria for the assessment of road traffic noise has been developed considering the following documents:

- NSW Department of Planning; Interim Guideline – Development Near Rail Corridors and Busy Roads (DNRCBR)
- Camden Environmental Noise Policy 2018 (ENP-2018), adopted May 2018

It is noted that the Camden Environmental Noise Policy-2018 closely follows the DNRCBR noise requirements. ENP-2018 requires that residential dwellings must comply with the internal noise criteria established in the DNRCBR. In addition to the internal noise requirements, ENP-2018 also sets out noise criteria for external private open space for residences.

6.1.1 Camden Environmental Noise Policy 2018

The ENP indicates that for residential development adjoining sub-arterial and collector roads:

> *1. Development applications for residential development and other noise sensitive receivers must be accompanied by an acoustic report where the development is:*
>
> *- Adjacent to existing (or proposed arterial, sub-arterial roads, transit boulevards; or*
>
> *- Adjacent to collector road that is within a 100m radius of the centre of the intersection the above roads (Refer to Figure B3b in the ENP)*
>
> *Note: For all road developments the criteria should apply on the basis of the road traffic volumes projected for 10 years time.*
>
> *2. Residential dwellings adjacent to an existing (or proposed) railway line, arterial road, sub-arterial road or transit boulevards, or collector roads that are*

within 100m of the centre of the intersection of those roads, are to be designed to minimise the impact of noise.

Residential dwellings must comply with the internal noise criteria in 'Table 3.1' from the 'Department of Planning; Interim Guideline – Development Near Rail Corridors and Busy Roads'.

Ventilation Requirements: If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that the occupants can leave windows closed, and also to meet the ventilation requirements of the Building Code of Australia.

The residential internal noise criteria from the Department of Planning Interim Guideline are presented in Table 1 below.

Table 1: Residential Buildings 'Table 3.1 Noise Criteria' with windows closed

Type of occupancy	Noise Level, dBA	Applicable time period
Sleeping areas (bedroom)	35	Night 10pm to 7am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40	At any time

Note: Airborne noise is calculated as L_{eq} 9hr (night) and L_{eq} 15hr (day)

The ENP also sets out the following regarding noise criteria for the Principal Private Open Space of a residence:

3. The principle private open space or an equivalent area of useable open space of a dwelling within a new release area is not to exceed 57dBA LAeq (15hr) from 7am to 10pm.

Note: For clarification purposes, a new release area, includes land mapped as Urban Release Area within the Camden LEP 2010 and includes Growth Area Precincts that have been rezoned.

Council may consider an increased decibel level where it can be demonstrated that the objectives of this policy are met and the above criteria is not able to be reasonably or feasibly achieved.

Note: The residential noise level criterion includes + 2.5 dBA allowance for noise reflected from the façade ('facade correction').

6.2 Noise Modelling Procedures and Assumptions

6.2.1 3D Noise Modelling

Traffic noise levels across the site have been predicted with SoundPLAN v8.2, using the Calculation of Road Traffic Noise (CoRTN) method. The terrain used in the model is based on data provided by the URBIS.

Modelling assumptions used for calibration and future traffic noise predictions are presented in Table 2. These must be reviewed by the Client and any relevant consultants to ensure they are in line with expectations.

Table 2: Road traffic noise modelling assumptions

Variable	Assumed parameters used in noise modelling
Roads for assessment/traffic speed	The Northern Road: 80 km/h Greendale Road: 60 km/h Bringelly Rd: 60 km/h Belmore Rd: 60 km/h N-S sub-arterial: 60 km/h
Road surface types	Dense grade asphalt has been assumed for this proposal. This type of pavement has a 0 dB correction factor for tyre noise.
Gradient of roadway	As per the topographic information provided by URBIS
Ground topography	As provided by URBIS
Height of receivers	Two storey residential dwellings: Assessment height of 1.5 m and 4.5 m above ground terrain Residential outdoor area: assessment height of 1.5 m above ground terrain
Ground absorption	Ground absorption at 0.6
Corrections	Conversion from L_{A10} to L_{Aeq}: -3dB per NSW RMS guidance Australian Road Condition Correction factors: -1.7 dBA in accordance with Australian Road Research Board (ARRB) report (Saunders et al, 1983)

6.2.2 Traffic Volumes

Data prepared by SCT Consulting and provided to MDA by CKDI via email dated 1 March 2022, *"SIDRA modelling worksheet_v0.9_Issue to Noise Consultants with subarterials"* details whole period AADT volumes for both Day (15 hr) and Night (9 hr). A copy of the data as provided to MDA has been included in Appendix C.

The traffic data used for Greendale Road has not been updated since the issue of *Rp 001 20210119 – South Creek West – Bringelly – Noise and Vibration Impact Assessment.*

A summary of the traffic data used for modelling is presented in Table 3.

Note: Traffic data for construction and operation of Western Sydney Airport is not separately provided by the traffic consultant at this stage. However, MDA has been advised by SCT Consulting that the estimated future AADT (2041) traffic data would not be significantly impacted by the construction or operation traffic volumes associated with the proposed Western Sydney Airport.

Table 3: Future (2041) traffic data used for road model

Road/ Section	Direction	AADT per period			
		Day (7:00 am – 10:00 pm)		Night (10:00 pm – 7:00 am)	
		Total	Heavy Vehicle %	Total	Heavy Vehicle %
The Northern Road, Section 1-2[1]	Northbound	36,098	10%	5,518	10%
	Southbound	26,657	9%	4,075	9%
The Northern Road, Section 2-3[1]	Northbound	29,017	10%	4,436	10%
	Southbound	23,811	8%	3,640	8%
Greendale Road	Eastbound	4,535	5%	830	4%
	Westbound	36,098	10%	5,518	10%
Bringelly Rd, Between Wentworth Rd and The Northern Road Int 1	Eastbound	14,231	9%	2,175	9%
	Westbound	11,315	9%	1,730	9%
Belmore Rd, West of TNR Int 2	Eastbound	14,231	10%	1,687	10%
	Westbound	5,901	11%	902	11%
N-S Sub-arterial – between Bringelly Rd and Lowes Creek Link Rd	Northbound	15,827	6%	2,419	6%
	Southbound	9,510	9%	1,454	9%
N-S Sub-arterial – south of Lowes Creek Link Rd	Northbound	16,591	10%	2,536	10%
	Southbound	12,079	8%	1,846	8%

[1] Reflecting the distribution noted in Appendix C

6.2.3 Lot Layouts and Building Locations

At this stage, the ILP includes superlots within the SCW- Belmore Rd precinct without introducing detailed lot layouts. For the purposes of modelling MDA has placed individual lots generally in nominal locations within the superlots, however, in some instances the arrangement of dwellings within the superlot forms a critical aspect of noise control for the development. Further comments with respect to these requirements are provided in Section 6.4.

6.2.4 Building Construction

For the assessment of internal traffic noise, building forms have been modelled as free standing, two-storey buildings with a footprint of approximately 13 m x 7.5 m for medium density band 1 superlots and 13 m x 13 m for all low density and environmental living superlots.

Where medium density band 2 superlots are proposed, two-storey buildings are modelled with a footprint covering the entire superlot. These assumptions are for modelling purposes only, and housing heights and layouts will vary in practice. Building forms are included to approximate expected shielding effects.

Unless otherwise stated, the dwelling construction shown in Table 4 is assumed, and reflects a typical modern house construction:

Table 4: Assumed house construction

Building element	Construction
External walls	Double brick, brick veneer or lightweight system with minimum R_w45 acoustic rating
Roof	Either metal roofing with anticon or tiled with sarking
Ceiling insulation	R3.0 batts
Ceiling	Flush plasterboard

Calculation of internal noise levels is based on the typical room properties shown in Table 5.

In accordance with the EPA's NSW Road Noise Policy we have assumed that internal noise levels in conventional dwellings with operable windows opened sufficiently to provide adequate ventilation, will generally be 10 dB lower than external noise levels.

Table 5: Assumed room properties

Room	Floor area, m^2	Ceiling height, m	Reverberation time, s	Glazing area, m^2
Bedroom	12	2.7	0.4	2
Living	30	2.7	0.5	5

6.2.5 Receiver Heights

External noise levels representing Principal Private Open Spaces associated with the dwellings are calculated 1.5 m above the terrain level.

For the assessment of noise levels at building façades, building storeys are modelled as being 3 m i.e. a two-storey block would be 6 m in height. A 1.5 m high receiver is considered at each storey i.e. Level 1 being 4.5 m above local ground.

6.3 Noise Model Calibration

To validate the noise modelling method, two long-term noise data loggers were installed within the site boundary fronting The Northern Road from 26 February 2020 to 11 March 2020. The locations of the noise monitors are shown in Appendix D. Additional attended traffic noise measurements with concurrent traffic counting were carried out on 11 March 2020.

Noise logging measurements were conducted using the following calibrated noise measurement equipment:

Position 1

- 01dB Duo Smart Noise Monitor s/n 10498
- Calibrated with a Rion sound level calibrator Type NC-74

Position 2

- 01dB Duo Smart Noise Monitor s/n 10194
- Calibrated with a Rion sound level calibrator Type NC-74
- With a dedicated weather station

The logging instruments were calibrated prior to and after the logging measurements with no significant drift observed. Data adversely affected by periods of bad weather was excluded from the assessment. It is noted that during the period of long-term measurement, that The Northern Road was under construction and traffic restrictions were applied. Therefore, the measured traffic noise during this period may not represent the typical operation of The Northern Road prior or after the construction. The average single figure results of the noise survey are provided in Table 6.

Table 6: On-site noise survey results, dB

Logger Location	$L_{Aeq, 15hr}$, dB	$L_{Aeq, 9hr}$, dB
Noise Monitor 1	66	62
Noise Monitor 2	54	50

To validate the noise modelling method, a calibration noise model utilising factors listed in Table 2 was developed. The predictions arising from the calibration model were compared to noise levels measured on-site. Results of the calibration model were found to be within 1 dB of the measured traffic noise levels. Therefore, no calibration correction is applied to the modelling method.

6.4 Noise Control Recommendations

The results of the 2041 traffic noise modelling indicate that noise control measures will need to be incorporated into the future development plans of the site. Noise control recommendations will be required to be developed in detail at a later stage when individual internal lot layouts and subdivisions have been finalised to ensure that the development can achieve the applicable noise criteria.

As this assessment is limited to an evaluation of the superlots shown in the proposed ILP, the comments provided by MDA in relation to noise control considerations in the following subsections are general in nature and would be subject to revisions upon provision of detailed internal lot layouts.

6.4.1 Lot Setbacks

To minimise the impacts of noise from roads on residential acoustic amenity, the Camden ENP-2018 provides the following recommendations:

> *2. Where possible bedrooms, main living areas and principal private open spaces are to be located away from noise sources*
>
> *5. Physical noise barriers such as noise walls or solid fencing (other than earth mounds) are not generally supported along sub-arterial, transit boulevards or collector roads. Measures to attenuate noise through subdivision layout, building setbacks, building orientation, building design and materials selection should be implemented to achieve compliant noise levels*.

In some instances, superlots indicated by the updated ILP (Rev H) appear to be located directly adjacent to the sub-arterial roads modelled by MDA as part of this assessment. An example of this can be found in Figure 1.

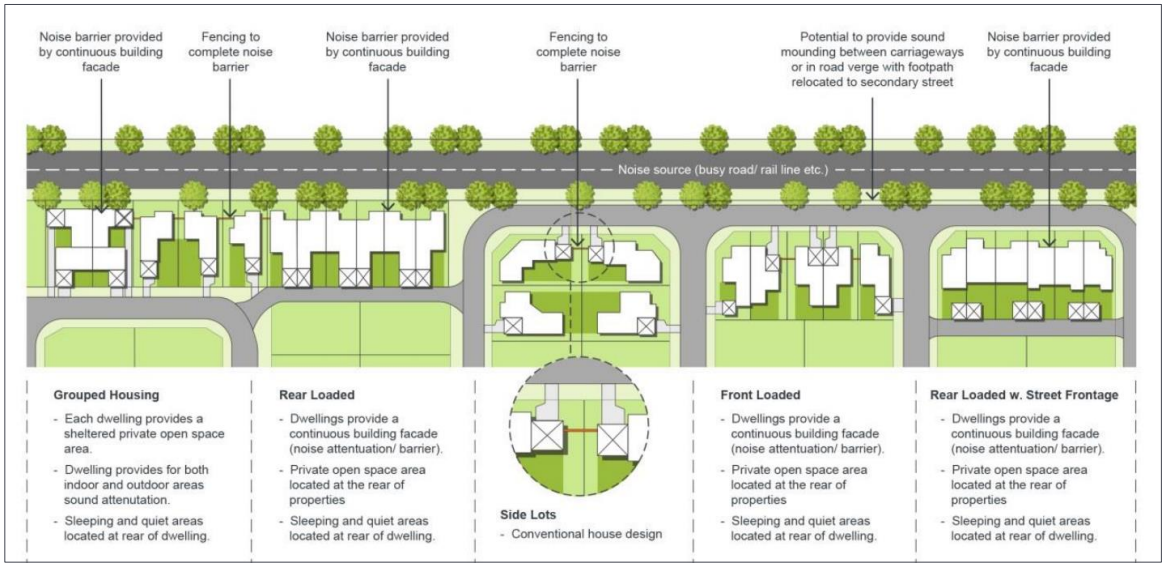
Based on the predicted noise levels at these locations, individual lot layouts will have to be considered to ensure that the Camden ENP Principal Private Open Space noise level requirements can be achieved. As shown above, the Camden ENP states that physical noise barriers are not generally supported along sub-arterial roads. To meet the ENP requirements it is recommended that the frontage of these lots be set back from the road to allow lot arrangements that maximise shielding to the private open spaces without the implementation of a noise wall.

Figure 1: Sub-arterial road lot setback example

6.4.2 Subdivision Layout and Building Orientation

To meet the Camden ENP recommendation described in Section 6.4.1, it is recommended that the layout of individual lots within the proposed superlots be such that the first-row of buildings (with a direct line of sight to the modelled traffic noise sources) provide maximum noise shielding to the Principal Private Open Spaces. Figure 2 (Figure B3a in the Camden ENP) shows several examples of recommended subdivision layouts that may be able to be utilised when developing the Belmore Rd Precinct subdivision layout to maximise shielding of Principal Private Open Spaces.

Figure 2: Camden ENP Road/Rail Noise Impact Mitigation Strategies



6.4.3 Intersections

At locations within the site at which two of the modelled roads intersect, predicted noise levels indicate that compliance with the ENP requirements for Principal Private Open Space noise levels will require careful consideration at subdivision stage. This should include consideration of the lot layout, building alignment, boundary fencing and dwelling design recommendations shown in Section 6.4.2. Specific examples of these lots can be found adjacent to the:

- The Belmore Rd and TNR intersection (shown in Figure 3); and
- The Belmore Rd and N-S Sub-arterial intersection (shown in Figure 4).

Figure 3: Belmore Rd/TNR Intersection

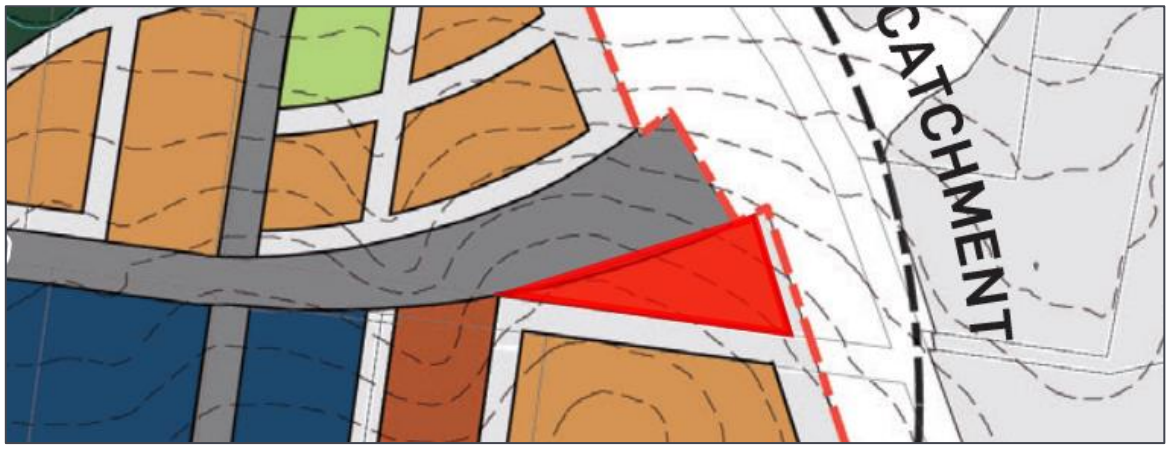
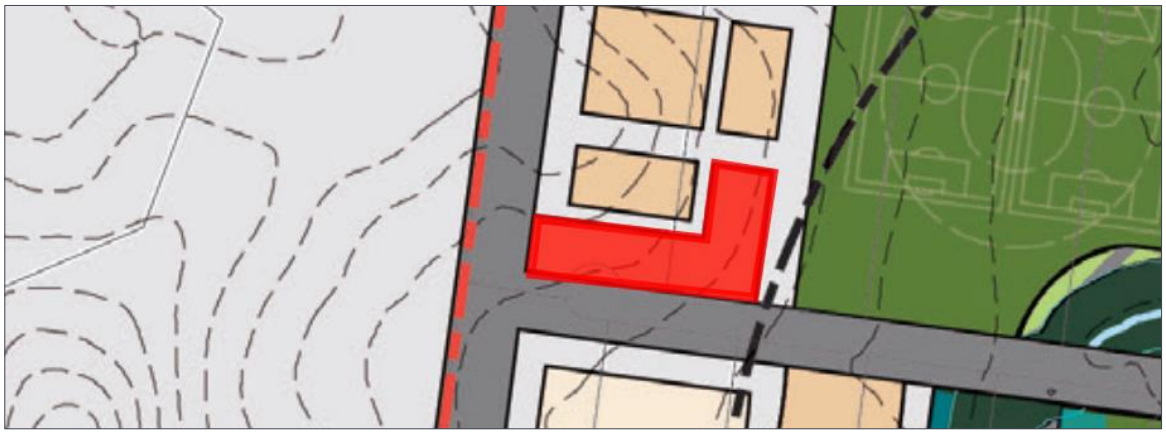


Figure 4: N-S Sub-Arterial Road/Belmore Rd Intersection



As an example, within the context of this assessment the layout of individual lots within the area shown in Figure 4 have been modelled such that the Principal Private Open Space is located at the back of the lot, which is considered to be a typical arrangement. However, this arrangement exposes the Principal Private Open Space to higher levels of traffic noise and would require a high acoustic fence to achieve the relevant criteria. This is not likely to be a feasible outcome and does not align with the recommendations of the Camden ENP.

An alternative solution may be positioning the buildings such that they front on to Belmore Rd to provide shielding to the Principal Private Open Space located at the rear. Additionally, as it is expected that acoustic fences of this height are not likely to desirable, comprehensive earthworks such as the formation of a topographical earth berm to the site boundary, alongside the road, may provide additional acoustic benefit and permit the acoustic fences in this area to be lower. As described above, specific consideration should be given to the Camden ENP recommendations shown in Section 6.4.2 during the development of the subdivision layout for these lots.

6.4.4 Physical Noise Controls (Fences)

While MDA has modelled dwellings within the superlots at nominal locations, it is expected that dwelling locations / lot layouts may be changed in the future development plans of the site. The proximity of some of the superlots to the assessed roads means that regardless of individual lot arrangement the provision of physical noise controls such as acoustic fences will likely be required to ensure noise targets for the Principal Private Open Space for each lot is achieved.

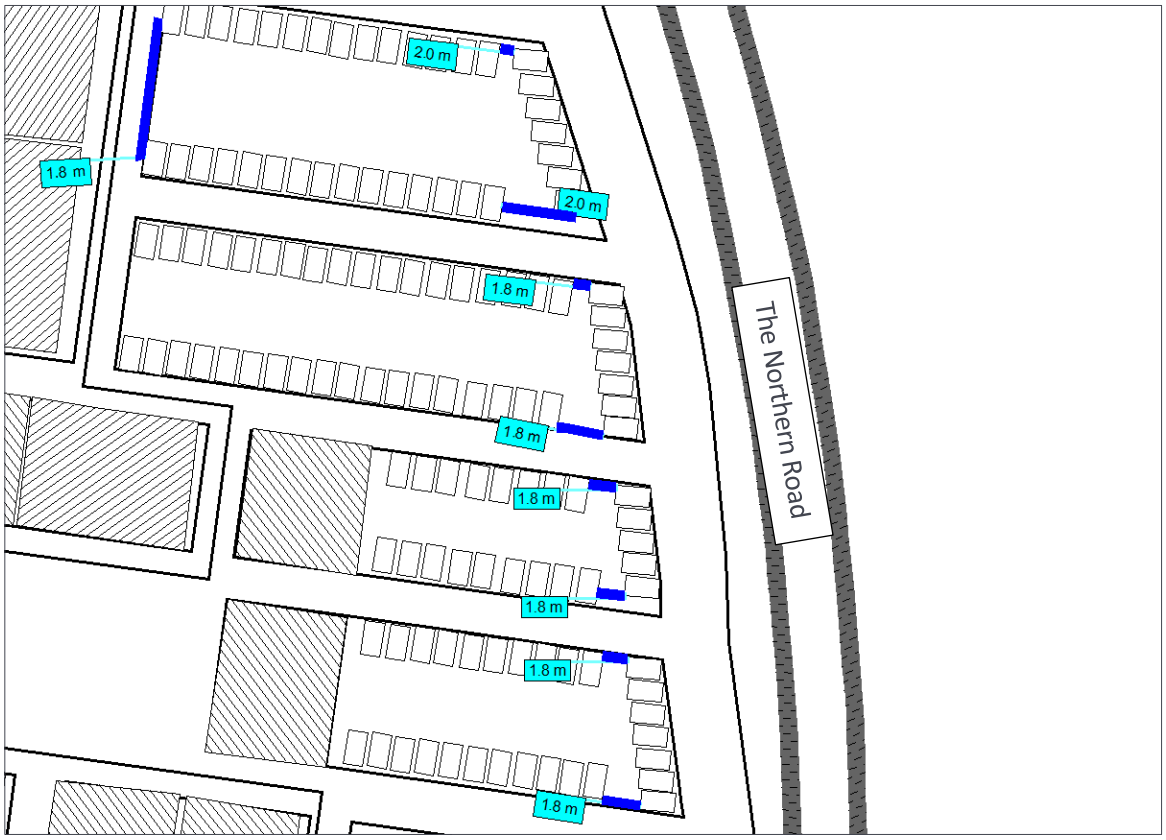
Acoustic fences are to comprise a continuous surface free from holes and gaps with a minimum surface mass of 14 kg/m^2. Examples include double lapped and capped timber (ensuring minimum 30 mm continuous thickness and no gaps between palings), proprietary fencing system, masonry or other construction approved by Marshall Day Acoustics.

Locations and heights of the required acoustic fencing will depend on the future development plans of the site, however, for the purposes of this assessment, lot boundary fences with heights ranging from 1.8 m to 2.4 m have been modelled at various exposed side openings.

This modelling indicates that the ILP is capable of complying with the required external noise criteria set out in the ENP, with finalised fencing alignments to be developed as part of future development plans of the site.

Figure 5 shows several examples of the locations and heights of the modelled acoustic fencing along the eastern side of the site. Where acoustic fences of a particular height are indicated the specified height is relative to the local ground.

Figure 5: Example of location and height of required acoustic fences – east of the site



6.4.5 Architectural Treatments to Dwellings

Noise levels have been predicted at Ground Floor (GF) and Level 1 (L1) heights to determine noise levels at building façades and resultant internal noise levels within dwellings.

Noise modelling indicates that architectural noise control elements will be required to be incorporated into the design of dwellings within areas close to the modelled traffic noise sources to ensure that target noise levels are achieved within internal spaces throughout the development.

Lots/façades with a direct line of sight to the roads may generally require some sort of architectural treatments. However, other façades of first-row houses may also require architectural treatments.

Noise contours provided in Appendix E denote the affected areas within the development. Contours are provided for both GF and L1.

The green region in these figures, show the extent of the proposed rezoning area that will be generally capable of satisfying the internal noise criteria with open windows and standard glazing and dwelling construction. No further architectural treatments are expected to be required for this region.

Regions identified in yellow and orange, are more adversely affected by traffic noise.

Where the internal noise criteria is expected to be exceeded by a small amount, the dwellings can comply with the internal limits simply by closing the windows (with standard glazing and construction). Based on Camden Council's ENP where windows are closed for the control of noise the design of the ventilation for these rooms should be such that the occupants can leave windows closed, while also meeting the ventilation requirements of the *Building Code of Australia*.

The required alternate ventilation may involve acoustically treated vents, mechanically driven fresh air systems, air-conditioning (incorporating fresh air, or window opening in a non-noise affected facade) or other design to provide fresh air to the space. This should be considered during the design

of the dwelling. The mechanical ventilation systems must comply with the ventilation requirements for the *Building Code of Australia* as well as *Australian Standard AS1668*. Any mechanical plant must also be designed to comply with Council's external limits for mechanical plant noise.

Where the external criteria are exceeded by a greater amount, upgraded architectural treatments in the form of alternative ventilation and upgraded single laminated glazing to some façades & rooms are likely required. A proprietary system typically comprising of up to 12 mm laminated glazing installed in an acoustic rated frame is expected to be required.

Specific treatment noise control suites for individual dwellings will be required to be developed as part of the future development plans of the site assessment however the noise contour plots in this report are provided for general guidance.

6.5 Noise Modelling Results and Discussion

6.5.1 Principle Private Open Space Assessment

Noise contours for ground level receiver heights (1.5 m) predicted considering 2041 traffic volumes are detailed in Appendix F.

The 57 dB $L_{Aeq(15hr)}$ noise contour zone is shown in dark green, the extent of which indicates compliances with the applicable external noise criteria.

These results include the effect of the acoustic fences described in Section 6.4.4.

The predicted noise contours show generally compliant noise levels in the rear yards across the site, with some areas of minor exceedance, i.e., less than 3 dB.

We note that the noise contours include a + 2.5 dBA 'facade correction' in accordance with the Camden ENP-2018. It should be noted that for areas away from façades (e.g. in the centre of yards) the actual noise levels experienced will generally be below the noise criteria as the contribution of the reflection from the local building façade to the overall noise level decreases.

With the incorporation of the general lot layout and physical noise control recommendations detailed in Section 6.4 it is expected that the Principal Private Open Space noise targets detailed in Camden Council's ENP can be achieved throughout the development.

6.5.2 Internal Noise Level Assessment

Figures in Appendix E show future (2041) noise contours at GF and L1 receiver heights for the entire site.

Results indicate that most of the site is capable of complying with the applicable noise criteria without additional noise control measures.

For some regions, close to the modelled traffic noise sources, additional architectural treatments may be required to ensure that acoustic criteria are achievable. These noise control recommendations have been discussed in detail in Section 6.4.5.

APPENDIX A GLOSSARY OF TERMINOLOGY

SPL or L_P	Sound Pressure Level A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.

APPENDIX B ILP (REV H) AND SITE PLAN

PART B: REVISED FINAL ILP

B.2 INDICATIVE LAYOUT PLAN

LEGEND

Belmore Road Precinct

Belmore Road Precinct has a total area of 196ha.

Primary Watercourse

The primary watercourse of the riparian corridor is categorised as Strathler stream order 2 and 3.

Riparian Corridor

This Riparian Corridor represents a provided buffer of 20-30m for the primary watercourse.

Playing Fields

There are three sporting fields located close to the riparian corridor. The size ranges between 5.0ha and 5.5ha. These sporting fields enhance the overall open space network and support the provision of double playing fields. One (1) of the double playing fields will be co-located with the village centre, south of Belmore Road.

Local Parks

Parks are distributed across the Precinct based on every 400m radius. These local parks ranges between 0.5ha and 3.7ha.

Open Space - Tree Retention

Village Centre

School

A government public school (approx. 2ha) is co-located with the playing fields and the village centre, where future multi-purpose community centre will be located.

Employment Precinct

The northern end of the Precinct is dedicated for employment generating uses to response to the Employment-based Precinct at Badgerys Creek.

Heritage Listed Site

The existing cottage on-site is identified as a heritage item of local significance, formerly known as the Fibro House (I2).

Bringelly Zone Substation

The operation of Bringelly Zone Substation will be retained, with an opportunity to expand in the future.

SP2 Drainage

Five (6) drainage basins have been proposed to appropriately manage water flows. Three (3) of these are integrated with the riparian corridor, with two (3) others located at the north and south-west of the Precinct.

These are designed with dual-use functionality, where it could support passive recreational uses and be treated as an open space.

Bio-retention Raingardens

Eleven (11) bio-retention raingardens are located across the Precinct to manage stormwater quality runoff.

Sub-Arterial Road

Belmore Road will be the main access route to Belmore Road Precinct. It will be upgraded as a sub-arterial road.

A new sub-arterial road is proposed along the western boundary to provide a north-south connection from Lowes Creek Maryland to Greendale Road.

Collector Road

Loftus Road will be upgraded as a collector road, servicing the northern portion of the Precinct. One (1) new north-south collector road is proposed at the east of the Precinct, connecting the southern sub-arterial road at Lowes Creek Maryland to Wentworth Road and Loftus Road.

Low Density Residential (LDR) Band 1

LDR-Band 1 (ranging between 10-20dw/ha) is located at the north and south of the Precinct.

Low Density Residential (LDR) Band 2

LDR-Band 2 (ranging between 20-25dw/ha) is located around high amenity area, e.g., along riparian corridor and around local parks or playing fields.

Medium Density Residential (MDR) Band 1

MDR-Band 1 (ranging between 25-35dw/ha) is distributed within 500m radius of the Local Centre. It acts as a transition zone between the MDR Band 2 and LDR areas.

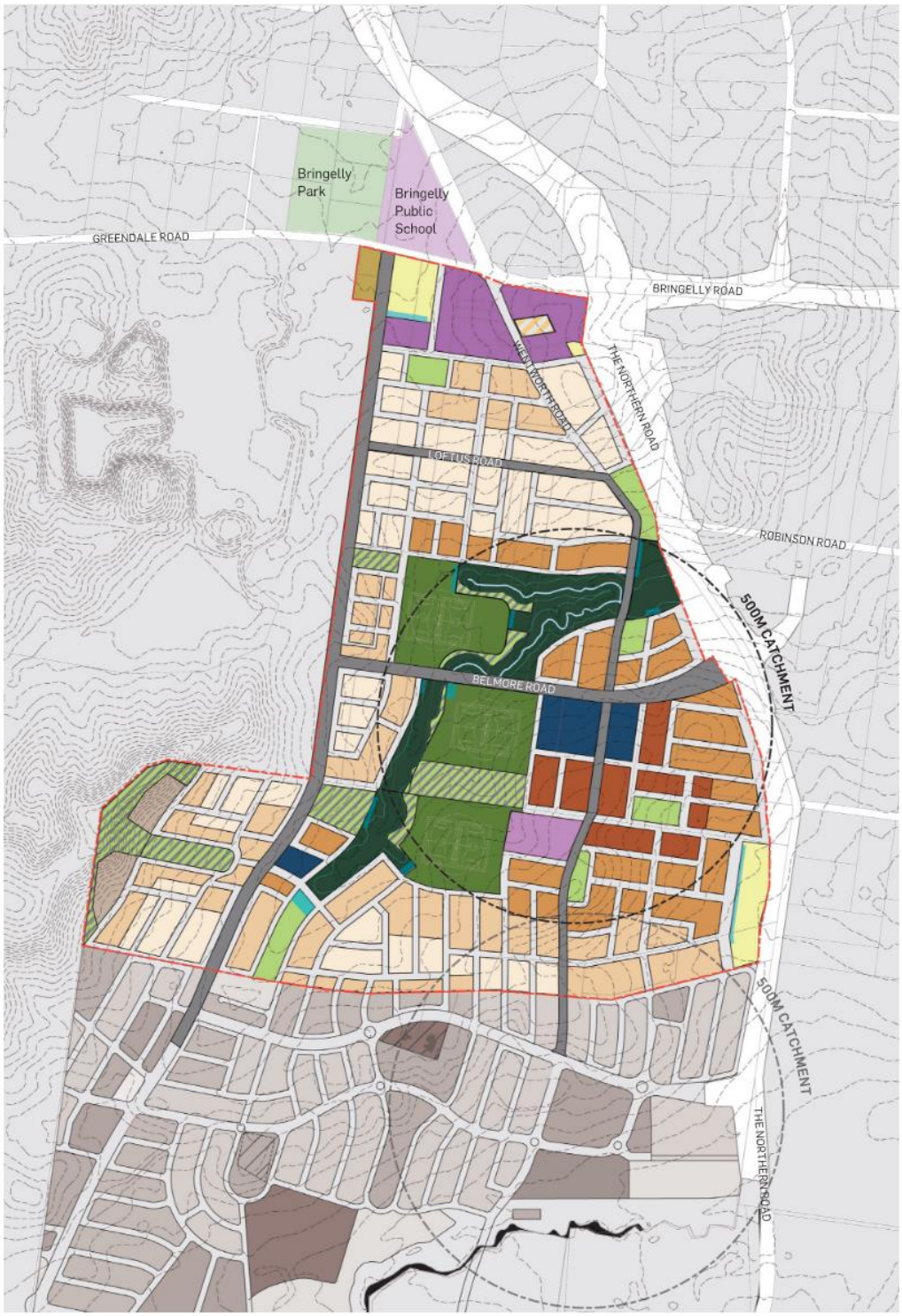
Medium Density Residential (MDR) Band 2

MDR-Band 2 is located around the local centre, typically within 200m radius. The density typically ranges between 35-60dw/ha.

Environmental Living

500m Village Centre Walking Catchment

48 **Belmore Road Precinct** Urban Design Report



Belmore Road Precinct Indicative Layout Plan (ILP)

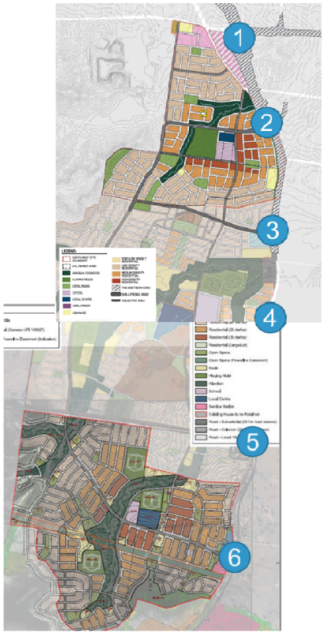
1:7,500 @ A4

0 100 200 300 400

Prepared by Urbis for CKDI Pty Ltd 49

APPENDIX C TRAFFIC VOLUME AND MAP

As supplied to MDA by CKDI via an email, dated 1 March 2022, *"SIDRA modelling worksheet_v0.9_Issue to Noise Consultants with subsrterials"*

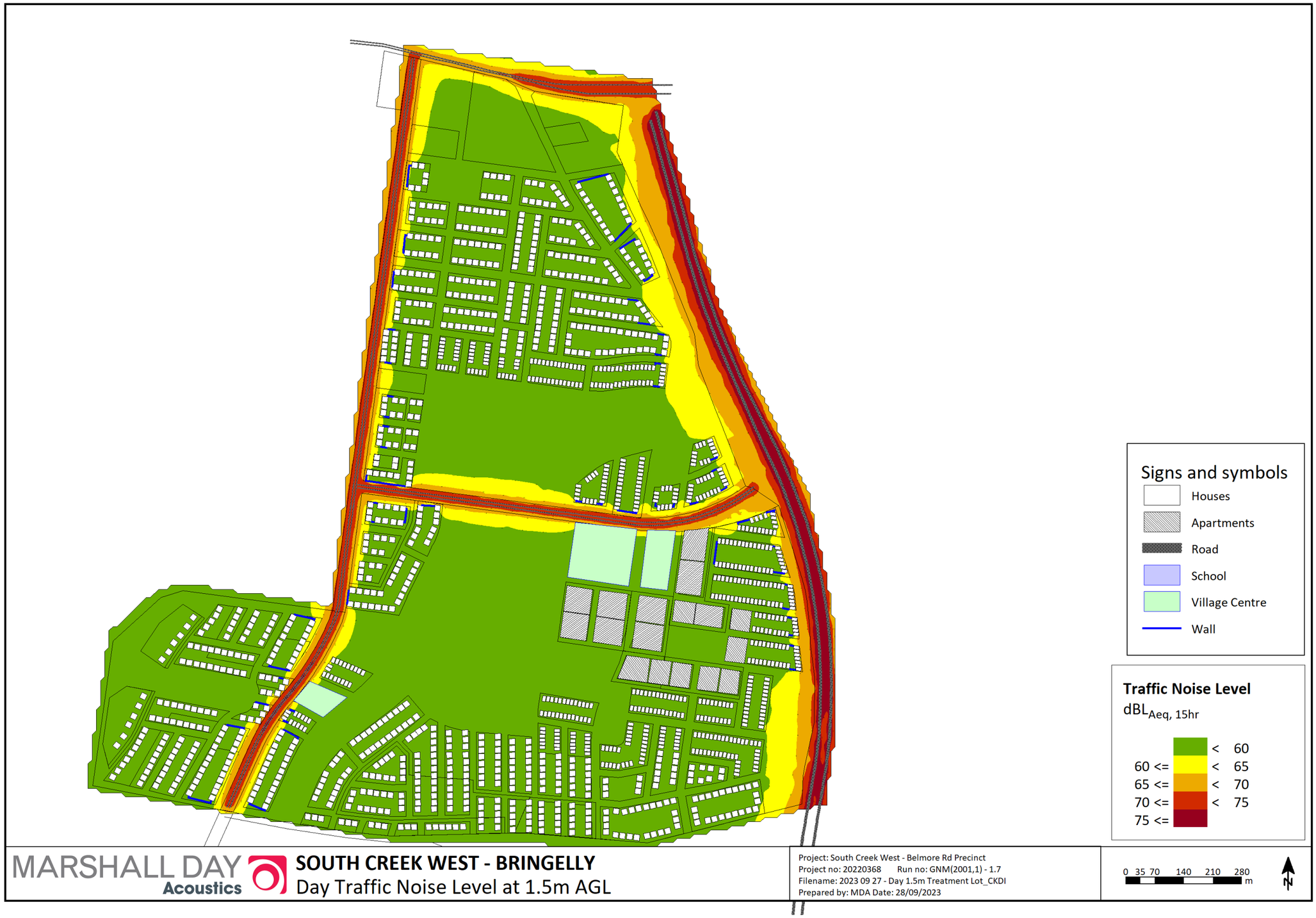


Location along TNR	2041 AADT							
	Northbound				Southbound			
	Light vehicles	Heavy vehicles	Total vehicles	% HV	Light vehicles	Heavy vehicles	Total vehicles	% HV
North of Int 2	37,614	4,001	41,616	10%	28,090	2,641	30,731	9%
Between Int 2 and 3	30,171	3,281	33,452	10%	25,129	2,321	27,450	8%
Between Int 3 and 4	24,169	2,721	26,890	10%	25,610	2,481	28,090	9%
Between Int 4 and 5	27,850	2,881	30,731	9%	28,811	2,801	31,612	9%
Between Int 5 and 6	27,450	2,481	29,931	8%	27,050	2,801	29,851	9%
South of Int 6	30,651	2,641	33,292	8%	28,891	2,881	31,772	9%
Location along TNR	**2041 Day (7000 hrs-2200 hrs)**							
	Northbound				Southbound			
	Light vehicles	Heavy vehicles	Total vehicles	% HV	Light vehicles	Heavy vehicles	Total vehicles	% HV
North of Int 2	32,627	3,471	36,098	10%	24,366	2,291	26,657	9%
Between Int 2 and 3	26,171	2,846	29,017	10%	21,797	2,013	23,811	8%
Between Int 3 and 4	20,964	2,360	23,325	10%	22,214	2,152	24,366	9%
Between Int 4 and 5	24,158	2,499	26,657	9%	24,991	2,430	27,420	9%
Between Int 5 and 6	23,811	2,152	25,963	8%	23,463	2,430	25,893	9%
South of Int 6	26,587	2,291	28,878	8%	25,060	2,499	27,559	9%
Location along TNR	**2041 Night (2200hrs-7000 hrs)**							
	Northbound				Southbound			
	Light vehicles	Heavy vehicles	Total vehicles	% HV	Light vehicles	Heavy vehicles	Total vehicles	% HV
North of Int 2	4,987	531	5,518	10%	3,725	350	4,075	9%
Between Int 2 and 3	4,000	435	4,436	10%	3,332	308	3,640	8%
Between Int 3 and 4	3,205	361	3,565	10%	3,396	329	3,725	9%
Between Int 4 and 5	3,693	382	4,075	9%	3,820	371	4,191	9%
Between Int 5 and 6	3,640	329	3,969	8%	3,587	371	3,958	9%
South of Int 6	4,064	350	4,414	8%	3,831	382	4,213	9%

Location along internal sub-arterials	2041 AADT							
	Northbound / Eastbound				Southbound / Westbound			
	Light vehicles	Heavy vehicles	Total vehicles	% HV	Light vehicles	Heavy vehicles	Total vehicles	% HV
Bringelly Road just west of TNR / Int 1	14,966	1,441	16,406	9%	11,924	1,120	13,045	9%
Belmore Road just west of TNR / Int 2	11,444	1,280	12,725	10%	6,082	720	6,803	11%
Lowes Creek Link Road just west of TNR / Int 3	13,605	1,361	14,966	9%	6,242	640	6,883	9%
N-S sub arterial just south of Bringelly Road	17,206	1,040	18,247	6%	9,924	1,040	10,964	9%
N-S sub arterial just south of Lowes Creek Link	17,286	1,841	19,127	10%	12,805	1,120	13,925	8%
Location along internal sub-arterials	**2041 Day (7000 hrs-2200 hrs)**							
	Northbound / Eastbound				Southbound / Westbound			
	Light vehicles	Heavy vehicles	Total vehicles	% HV	Light vehicles	Heavy vehicles	Total vehicles	% HV
Bringelly Road just west of TNR / Int 1	12,981	1,250	14,231	9%	10,343	972	11,315	9%
Belmore Road just west of TNR / Int 2	9,927	1,111	11,038	10%	5,276	625	5,901	11%
Lowes Creek Link Road just west of TNR / Int 3	11,801	1,180	12,981	9%	5,415	555	5,970	9%
N-S sub arterial just south of Bringelly Road	14,925	902	15,827	6%	8,608	902	9,510	9%
N-S sub arterial just south of Lowes Creek Link	14,994	1,597	16,591	10%	11,107	972	12,079	8%
Location along internal sub-arterials	**2041 Night (2200hrs-7000 hrs)**							
	Northbound / Eastbound				Southbound / Westbound			
	Light vehicles	Heavy vehicles	Total vehicles	% HV	Light vehicles	Heavy vehicles	Total vehicles	% HV
Bringelly Road just west of TNR / Int 1	1,984	191	2,175	9%	1,581	149	1,730	9%
Belmore Road just west of TNR / Int 2	1,517	170	1,687	10%	806	96	902	11%
Lowes Creek Link Road just west of TNR / Int 3	1,804	180	1,984	9%	828	85	913	9%
N-S sub arterial just south of Bringelly Road	2,281	138	2,419	6%	1,316	138	1,454	9%
N-S sub arterial just south of Lowes Creek Link Road	2,292	244	2,536	10%	1,698	149	1,846	8%

APPENDIX D NOISE MONITORING LOCATIONS

APPENDIX E TRAFFIC NOISE PREDICTIONS (EXCLUDING FAÇADE REFLECTION)



Signs and symbols
- Houses
- Apartments
- Road
- Village Centre
- Wall

Traffic Noise Level
$dBL_{Aeq, 15hr}$

	<	60
60 <=	<	65
65 <=	<	70
70 <=	<	75
75 <=		

MARSHALL DAY Acoustics

SOUTH CREEK WEST - BRINGELLY

Day Traffic Noise Level at 4.5m AGL

Project: South Creek West - Belmore Rd Precinct
Project no: 20220368 Run no: GNM(2002,1) - 1.7
Filename: 2023 09 27 - Day 4.5m Treatment Lot_CKDI
Prepared by: MDA Date: 28/09/2023

0 35 70 140 210 280 m

N

Signs and symbols
- Houses
- Apartments
- Road
- Village Centre
- Wall
- Base line

Traffic Noise Level
$dBL_{Aeq, 9hr}$

	<	55
55 <=	<	60
60 <=	<	65
65 <=	<	70
70 <=		

MARSHALL DAY Acoustics

SOUTH CREEK WEST - BRINGELLY
Night Traffic Noise Level at 1.5m AGL

Project: South Creek West - Belmore Rd Precinct
Project no: 20220368 Run no: GNM(2001,2) - 1.7
Filename: 2023 09 27 - Night 1.5m Treatment Lot_CKDI
Prepared by: MDA Date: 28/09/2023

0 35 70 140 210 280 m

N

Signs and symbols
- Houses
- Apartments
- Road
- Village Centre
- Wall

Traffic Noise Level
$dBL_{Aeq, 9hr}$

		<	55
55 <=		<	60
60 <=		<	65
65 <=		<	70
70 <=			

MARSHALL DAY Acoustics

SOUTH CREEK WEST - BRINGELLY
Night Traffic Noise Level at 4.5m AGL

Project: South Creek West - Belmore Rd Precinct
Project no: 20220368 Run no: GNM(2002,2) - 1.7
Filename: 2023 09 27 - Night 4.5m Treatment Lot_CKDI
Prepared by: MDA Date: 28/09/2023

0 35 70 140 210 280 m

N

APPENDIX F TRAFFIC NOISE CONTOURS FOR PRINCIPLE PRIVATE OPEN SPACE (INCLUDES +2.5DB FAÇADE REFLECTION)