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Proposed Residential Subdivision  
Bilambil Road, Hogans Road & Urliup Road, Bilambil

**ENVIRONMENTAL NOISE IMPACT REPORT**

Prepared for

Jackson International

**7 July 2009**

crgref: 08406a report



## **1.0 INTRODUCTION**

This report is in response to a request from Jackson International for an environmental noise impact assessment of a proposed residential development Bilambil Road, Hogans Road & Urliup Road at Bilambil.

In undertaking the above, noise monitoring was conducted for the site and through modelling, predictions of onsite and offsite commercial activity noise and future road noise immissions were produced. Based upon the predicted noise impact levels, recommendations regarding acoustic treatment to the development have been provided.

## **2.0 DESCRIPTION OF THE DEVELOPMENT**

The parcel of land proposed to be developed is bounded by Urliup Road to the north, Bilambil Road to the east, Hogans Road to the south and Bilambil Creek to the west.

The proposal is a 57 lot residential sub-division with a general store / ancillary residence premises located at the north east corner of the site; located adjacent to the existing community hall building.

Vehicle access to the site is proposed from both Urliup Road and Hogans Road. Direct access to the general store facility is proposed off Bilambil Road.

Future onsite residential dwellings are likely to be impacted by road traffic noise from Bilambil Road and increased traffic generated by the subdivision may impact upon dwellings along the surrounding road network. The road network adjacent to the subject site is subject to a 'Local Traffic Area' speed limit of 50km/hr. Urliup Road, Bilambil Road and Hogans Road are all two-way, two-lane roads.

Onsite commercial activity noise at the proposed general store (i.e. vehicle activities, deliveries, waste collection and mechanical plant) has the potential to impact upon onsite and surrounding noise sensitive receivers; and has been assessed within this report. The nearest offsite receivers are:

- Residential dwellings across Urliup Road to the north; and
- Relocatable dwellings (aged care) across Bilambil Road to the east.

There are commercial enterprises to the northeast of the site (petrol station) and to the southeast (Bilambil Sports Club), which have the potential to impact the future residential dwellings. Commercial activities occurring at these sites, such as waste collection, vehicle movements, loading activities and mechanical plant, have been assessed to determine likely acoustic treatments, to ensure the existing noise amenity of the area is maintained for the proposed noise sensitive receivers.

For site location refer to Appendix A of this report; and for development plans refer to Appendix B.

### 3.0 AMBIENT NOISE SURVEY

#### 3.1 Instrumentation

The following equipment was used to measure the existing noise environment at the site locale:

- Rion NC 73 Calibrator; and
- Rion NL 21 Sound Level Meter.

All instrumentation used in this assessment hold current calibration certificates from a certified NATA calibration laboratory.

#### 3.2 Unattended Measurement Methodology

The NL 21 sound level meter was located at the north-eastern end of the subject site fronting Bilambil Road. The microphone was in a free-field location, approximately 1.2m above ground level and 8m from the nearest lane of Bilambil Road.

The logger was set to record noise statistics in 15 minute blocks continually between Tuesday 22/07/08 to Thursday 24/07/08. The statistical interval was chosen to allow application of AS/NZS 2107:2000 'Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors'.

Road traffic noise measurements were conducted generally in accordance with Australian Standard AS2702: 1984 'Acoustics - Methods for the measurement of road traffic noise'.

The sound level meter was calibrated and checked at 94.0 dB(A) before and after the noise measurement, with no significant drift from the reference signal recorded.

Weather conditions during the survey were generally fine but overcast.

#### 3.3 Results

Noise levels recorded during the logger survey are presented below. Graphical presentation of the logger data is presented in Appendix C of this report.

Descriptor and period	Time period	Measured level
<b>Road Traffic Noise Descriptors (23/07/08)</b>		
$L_{A10\ 18hr}$	6am to midnight	58
$L_{Aeq\ 24hr}$	6am to 6am	57
$L_{eq\ 1hr}$ Daytime	3pm to 4pm	60
$L_{eq\ 1hr}$ Night time	5am to 6am	53
<b>Ambient Noise Descriptors (22/07/08 – 24/07/08)</b>		
RBL Daytime background $L_{A90}$	7am to 6pm	39
RBL Evening background $L_{A90}$	6pm to 10pm	34
RBL Night-time background $L_{A90}$	10pm to 7am	33

**Table 1:** Measured ambient SPL dB(A) recorded at the logger location.

## 4.0 NOISE ASSESSMENT CRITERION

### 4.1 Road Traffic Noise

Assessment of potential noise impacts resulting from road traffic are required to be conducted as per the New South Wales EPA 'Environmental Criteria for Road traffic Noise' as presented below. We note that Bilambil Road is considered as a Collector Road; and Urliup and Hogans Roads are considered Local Roads.

TYPE OF DEVELOPMENT	CRITERIA		
	DAY (7 am–10 pm) dB(A)	NIGHT (10 pm–7 am) dB(A)	WHERE CRITERIA ARE ALREADY EXCEEDED
5. New residential developments affected by collector traffic noise	$L_{Aeq(1hr)}$ 60	$L_{Aeq(1hr)}$ 55	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria via judicious design and construction of the development.  Locations, internal layouts, building materials and construction should be chosen so as to minimise noise impacts.
8. Land use developments with potential to create additional traffic on collector road	$L_{Aeq(1hr)}$ 60	$L_{Aeq(1hr)}$ 55	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments.  In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.
11. New residential developments affected by traffic noise from local roads	$L_{Aeq(1hr)}$ 55	$L_{Aeq(1hr)}$ 50	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria for occupants by judicious design and construction of the development.  Relevant strategies will include optimum location and orientation of buildings on the site; planning internal layouts carefully; choosing the most appropriate building materials; and using good construction techniques.
13. Land use developments with potential to create additional traffic on local roads	$L_{Aeq(1hr)}$ 55	$L_{Aeq(1hr)}$ 50	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments.  In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

**Table 2:** Noise limit criteria for road traffic noise.

Further to the above outdoor criteria, Council's typically accept that for developments that cannot achieve the outdoor criteria at all facades (e.g. at top floor level, above the relative level of the acoustic barriers), indoor criteria taken from AS/NZS 2107:2000 '*Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors*' is applied. The noise levels applicable to residential uses in the Standard are as follows:

These levels expressed as  $L_{Aeq}$  are presented in Table 3 below.

7. RESIDENTIAL BUILDINGS	Recommended Design Sound Level, $L_{Aeq}$ , dB(A)	
	Satisfactory	Maximum
Houses and apartments near minor roads –		
Living areas	30	40
Sleeping areas	30	35
Work areas	35	40

**Table 3:** Internal noise limits from Australian/New Zealand Standard AS/NZS 2107.

#### 4.2 Offsite and Onsite Commercial Activity Noise Impacts

Noise associated with the commercial premises is regulated by the NSW Industrial Noise Policy.

The assessment procedure has three components:

- Control of intrusive noise impacts – The limit criteria for this assessment is as follows:  
 $L_{Aeq, 15 \text{ min}} \leq \text{rating background level}^1 + 5 \text{ dB}$ ;
- Maintaining noise level amenity for residential premises. This is achieved by ensuring that the proposed development complies with the noise limit criteria set in Table 2.1 of the Policy. If we assume that the area is within an Rural area<sup>2</sup> (as defined in the Policy), the following limits apply:
  - Daytime (7 am – 6 pm Mon-Sat; 8 am – 6 pm Sun) 50 - 55 dB(A) Leq;
  - Evening (6 pm – 10 pm) 45 - 50 dB(A) Leq;
  - Night (remaining periods) 40 - 45 dB(A) Leq.

By considering the above criteria, the following noise limits apply to the proposed use:

- Daytime (7 am – 6 pm Mon-Sat; 8 am – 6 pm Sun) 44 dB(A) Leq;
- Evening (6 pm – 10 pm) 39 dB(A) Leq;
- Night (remaining periods) 38 dB(A) Leq.

Further to the above criteria, we recommend applying a design target of 45 dB(A)  $L_{10}$  inside living areas and bedrooms from short term noise events. This level is within sleep disturbance prevention criteria set by the World Health Organisation.

<sup>1</sup> The rating background level is the overall single figure background level representing each assessment period (day/evening/night over the whole monitoring period).

<sup>2</sup> The Urban amenity category applies to locations proximate to commercial or industrial premises.

### 4.3 Construction Noise Criteria

The NSW EPA's 'Environmental Noise Control Manual' prescribes the following noise criterion for construction activities (Chapter 171). It is noted that the Manual has been superseded; however, the criterion specified in the document is still relevant in providing guidance for assessment of construction noise.

#### Level Restrictions

- Construction period of 4 weeks and under: the  $L_{A10}$  level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).
- Construction period greater than 4 weeks and not exceeding 26 weeks: the  $L_{A10}$  level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 15 dB(A).

#### Time Restrictions

- Monday to Friday, 7am to 6pm.
- Saturday 8am to 1pm.
- No construction work to take place on Sundays or public holidays.

For construction periods longer than 26 weeks or construction operations occurring outside the above-mentioned time periods, Council typically require that the  $L_{A10}$  level when construction is being undertaken should not exceed the background level by more than 5 dB(A).

Based upon the noise criterion presented above and the measured background noise levels (refer to Section 3.3, Table 1), the following noise limits apply:

Period of Construction Activity	Noise Limit Criterion $L_{A10}$ dB(A)
Period of up to 4 weeks	59 (Background RBL 39 + 20 dB(A))
Period of 4 to 26 weeks	54 (Background RBL 39 + 15 dB(A))
Period of 40 or more weeks	44 (Background RBL 39 + 5 dB(A))
Operations outside the Time Restrictions (i.e. night operation)	38 (Background RBL 33 + 5 dB(A))

**Table 4:** Construction activity noise limits.

It is also noted that Australian Standard AS 2436 – 1981 'Guide to noise control on construction, maintenance and demolition sites' provides extra guidance for management of on-site noise.

For internal noise levels, we recommend applying a noise limit of 45 dB(A)  $L_{A10}$  (based upon previous similar projects).

Furthermore, vibration levels should not exceed 10  $\text{mms}^{-1}$  peak particle velocity. This is not an issue, due to the separation distances and the nature of the works planned.

## 5.0 PREDICTED NOISE IMPACTS

### 5.1 Road Traffic Noise Impacts

#### 5.1.1 Traffic Volumes: Bilambil Road

The existing traffic volumes for the local road network were obtained from the Traffic Section of Carter Rytenkild Group. We were advised that the data was obtained via attended counts and unattended tube counts at the subject site. To determine the 10 year traffic volume for Bilambil Road we have applied a 3.5% annual compound growth rate. The daily traffic volume for Bilambil Heights is as follows:

<b>2008 Surveyed Traffic Volume:</b>	1,820 vehicles per 24 hour, 6% heavy vehicles
<b>2019 Predicted Traffic Volume:</b>	2,660 vehicles per 24 hour, 6% heavy vehicles

#### 5.1.2 Modelled Road Traffic Noise Levels – Existing Situation

Road traffic noise predictions were conducted using PEN3D, a CoRTN based model acceptable under the Environmental Protection (Noise) Policy. To verify the road traffic noise prediction model, the 2008  $L_{Aeq\ 24hr}$  traffic noise levels were calculated and compared to the measured noise levels. For PEN3D point calculation sheets refer to Appendix C of this report.

The predicted  $L_{Aeq\ 24hr}$  existing noise level, 8m from the nearest lane of Bilambil Road is 57.0 dB(A). Compared with the measured  $L_{Aeq\ 24hr}$  level of 56.7 dB(A), the model is over-predicting by 0.3 dB(A), which is within the allowable 2 dB(A) deviation from measured levels. We note that the  $L_{Aeq\ 24hr}$  level is based on the measured differences between the  $L_{A10\ 18hr}$  level.

#### 5.1.3 Modelled Road Traffic Noise Levels – Ultimate Situation

Based upon ultimate traffic volumes, the PEN3D model predicts the following façade corrected traffic noise levels as detailed in Table 5 over the page.

The following parameters were used in the PEN3D model:

- 2.5 dB(A) façade correction.
- $L_{Aeq}$  levels based on the measured differences between the  $L_{A10\ 18hr}$  level (refer to Table 1).
- Recommended acoustic barriers as detailed in Section 6.1.
- 50 km/hr posted speed limit on Bilambil Road.
- Ground level receiver heights taken at 1.8m above ground level.
- First floor level receiver heights taken at 4.6m above ground level.

For PEN3D point calculation sheets refer to Appendix C of this report.

Receiver Location	Predicted Ultimate Traffic Noise: Façade Corrected dB(A)		
	L <sub>Aeq</sub> 24hr	L <sub>Aeq</sub> 1hr Daytime	L <sub>Aeq</sub> 1hr Night time
<b>Ground Floor Level Building Façades</b>			
Lot 13 nearest façade fronting road	56	59	52
Lot 13 nearest façade at 90° to road	53	56	49
Lot 15 nearest façade fronting road	56	59	52
Lot 15 nearest façade at 90° to road	53	56	49
Lot 17 nearest façade fronting road	56	59	52
Lot 17 nearest façade at 90° to road	53	56	49
Lot 19 nearest façade fronting road	56	59	52
Lot 19 nearest façade at 90° to road	53	56	49
Lot 21 nearest façade fronting road	55	58	51
Lot 21 nearest façade at 90° to road	52	55	48
Lot 23 nearest façade fronting road	56	59	52
Lot 23 nearest façade at 90° to road	53	56	49
Lot 25 nearest façade fronting road	55	58	51
Lot 25 nearest façade at 90° to road	52	55	48
Lot 27, 29, 31 nearest façade fronting road	55	58	51
Lot 27, 29, 31 nearest façade at 90° to road	52	55	48
<b>First Floor Level Building Façades</b>			
Lot 13 nearest façade fronting road	62	65	58
Lot 13 nearest façade at 90° to road	59	62	55
Lot 15 nearest façade fronting road	62	65	58
Lot 15 nearest façade at 90° to road	59	62	55
Lot 17 nearest façade fronting road	62	65	58
Lot 17 nearest façade at 90° to road	59	62	55
Lot 19 nearest façade fronting road	62	65	58
Lot 19 nearest façade at 90° to road	59	62	55
Lot 21 nearest façade fronting road	62	65	58
Lot 21 nearest façade at 90° to road	59	62	55
Lot 23 nearest façade fronting road	62	65	58
Lot 23 nearest façade at 90° to road	59	62	55
Lot 25 nearest façade fronting road	62	65	58
Lot 25 nearest façade at 90° to road	59	62	55
Lot 27, 29, 31 nearest façade fronting road	62	65	58
Lot 27, 29, 31 nearest façade at 90° to road	59	62	55
Lot 53 Residence façade fronting road	62	65	58
Lot 53 Residence façade at 90° to road	59	62	55
<b>External Noise Criterion</b>		<b>60</b>	<b>55</b>

**Table 5:** Predicted traffic noise impact levels at the proposed development.

We note that lots setback from Bilambil Road, which are not presented in Table 4 above, will have traffic noise impacts lower than those presented. Traffic noise impacts will be lower due to greater separation distance from the road and physical screening provided by acoustic barrier and those buildings fronting the road.

Further, noise impacts at first floor level façades at 90° to Bilambil Road of the lots fronting the road are predicted to be within 2 dB(A) of the noise criterion. As the average person cannot typically detect a 2 dB(A) variation in sound pressure level, such an exceedance is unlikely to cause annoyance and is considered an acceptable outcome. Hence, habitable rooms along first floor level façades at 90° to Bilambil Road (if first floor levels are constructed) of dwellings fronting Bilambil Road will not require acoustic treatments.

For PEN3D point calculation sheets refer to Appendix C of this report.

#### 5.1.4 Predicted Noise Impacts from Additional Traffic on the Existing Road Network

The existing traffic volumes for the local road network were obtained from the Traffic Section of Carter Rytenskiid Group. We were advised that the data was obtained via attended counts and unattended tube counts. Existing traffic volumes on the surrounding local roads is as follows:

<b>Bilambil Road Peak Hour Volume Average:</b>	212 vehicles per hour
<b>Urliup Road Peak Hour Volume Average:</b>	22 vehicles per hour
<b>Hogans Road Peak Hour Volume Average:</b>	36 vehicles per hour

The Traffic Section of Carter Rytenskiid Group has supplied the following traffic volumes for the surrounding local road network resulting from the proposed development:

<b>Bilambil Road Peak Hour Volume Average:</b>	16 vehicles per hour
<b>Urliup Road Peak Hour Volume Average:</b>	26 vehicles per hour
<b>Hogans Road Peak Hour Volume Average:</b>	18 vehicles per hour

Measurements from a similar previous site in NSW were taken of vehicles travelling along a local road with a posted speed limit of 50 km/hr. Table 6 below presents the measured noise levels.

Noise Level Descriptor	Measured Level at 10m from Passing Vehicles dB(A)
<b>Road Traffic Noise Measurements</b>	
Average $L_{Aeq, passbv}$	59
Average SEL $_{passbv}$	71 (15 sec.)

**Table 6:** Measured vehicles pass-bys on a locale street.

Predicted  $L_{Aeq, 1hr}$  daytime levels for the local roads have been determined by multiplying the measured SEL of a vehicle pass-by by the number of car passes for each time period. We note that night-time hourly traffic volumes would be negligible, due to the size of the development; hence we have assessed daytime  $L_{Aeq, 1hr}$  levels only.

We note that the above method has been applied due to the low traffic volumes anticipated upon the local road network, and to incorporate the local road environment (i.e. undertaking of attended measurements of vehicles using a local NSW road). The predicted  $L_{Aeq, 1hr}$  noise levels at existing offsite dwellings are as below.

Receiver Location	Predicted Traffic Noise at 10m: Façade Corrected dB(A)
	$L_{Aeq, 1hr}$ Daytime
<b>Existing Scenario</b>	
Dwellings along Bilambil Road	61
Dwellings along Urliup Road	51
Dwellings along Hogans Road	53
<b>Completed Development Scenario</b>	
Dwellings along Bilambil Road	61
Dwellings along Urliup Road	55
Dwellings along Hogans Road	55

**Table 7:** Predicted noise impacts at existing streets.

## 5.2 Offsite and Onsite Commercial Activity Noise Impacts

### 5.2.1 Assumed Noise Source Levels – Offsite Commercial Activities

All noise source levels used in the assessment have been collected from similar previous investigations. All noise levels have been corrected for impulsiveness or tonality as per Australian Standard AS 1055:1997 - 'Acoustics-Description and measurement of environmental noise'.

The following noise source levels are typically associated with the operation of service station and Bilambil Sports Club and have been assessed within this report:

Activity/Noise Source	Noise Level, SPL L <sub>A10</sub> dB(A) at 1m
Car door closure	83*dB(A)
Car bypass at 5km/hr	77 dB(A)
Bilambil Sports Club patrons at alfresco dining area	75 dB(A)
Band inside Bilambil Sports Club	99**dB(A)
Checking tyre pressure	80 dB(A)
Truck unloading (by hand)	87*dB(A)
Truck airbrake near bowser	93*dB(A)
Waste collection	97*dB(A)
Cluster of air-conditioning condenser plant	65 dB(A)
Bilambil Sports Club commercial A/C plant	70 dB(A)
Refrigeration plant	75**dB(A)

\* Denotes + 5 dB correction for impulsiveness in accordance with AS1055. \*\* Denotes + 5 dB correction for tonality in accordance with AS1055.

**Table 8:** Typical noise source levels associated with service station and Bilambil Sports Club developments.

### 5.2.2 Assumed Noise Source Levels – Onsite Commercial Activities

All noise source levels used in the assessment have been collected from similar previous investigations. All noise levels have been corrected for impulsiveness or tonality as per Australian Standard AS 1055:1997 - 'Acoustics-Description and measurement of environmental noise'.

The following noise source levels are typically associated with the operation of a general store and have been assessed within this report:

Activity/Noise Source	Noise Level, SPL L <sub>A10</sub> dB(A) at 1m
Car door closure	83*dB(A)
Car bypass at 5km/hr	77 dB(A)
Patrons at alfresco dining area	70 dB(A)
Truck unloading (by hand)	87*dB(A)
Waste collection	97*dB(A)
Commercial air-conditioning plant	70 dB(A)

\* Denotes + 5 dB correction for impulsiveness in accordance with AS1055. \*\* Denotes + 5 dB correction for tonality in accordance with AS1055.

**Table 9:** Typical noise source levels associated with a general store.

It should be stressed that mechanical plant selection have yet to be undertaken given that the development is at the development approval stage. For this reason, we have applied nominal noise levels. **Noise levels associated with mechanical plant are purely illustrative, and should be reviewed upon determination of types of plant.**

### 5.2.3 Predicted Offsite Commercial Noise Impacts at the Nearest Onsite Dwellings

Based upon the location of offsite commercial activities in relation to future onsite dwellings, we predict the following noise impact levels as presented in Table 10.

The predicted levels assume that the recommended treatments detailed in Section 6.2 are incorporated into the development.

Noise source	Predicted Noise Impact, SPL L <sub>A10</sub> dB(A)		
	Nearest Façade to Offsite Commercial Activity	Inside with Windows Open	Rw Rating To Achieve Criteria
<b>Ground Floor Façade</b>			
Station car door closure	39	32	N/A
Station car bypass	33	26	N/A
Checking tyre pressure	36	29	N/A
Station truck unloading	43	36	Refer Below
Truck airbrake near bowser	49	42	Refer Below
Station waste collection	53	46	Refer Below
Station A/C condensers	29	22	N/A
Club car door closure	39	32	N/A
Club car bypass	33	26	N/A
Club alfresco dining	31	24	N/A
Band inside Club	49	42	N/A
Club deliveries	43	36	Refer Below
Club waste collection	53	46	Refer Below
Club commercial A/C	33	26	N/A
Club refrigeration plant	38	31	N/A
<b>First Floor Façade</b>			
Station car door closure	47	40	N/A
Station car bypass	41	34	N/A
Checking tyre pressure	44	37	N/A
Station truck unloading	51	44	Refer Below
Truck airbrake near bowser	57	50	Refer Below
Station waste collection	61	54	Refer Below
Station A/C condensers	29	22	N/A
Club car door closure	47	40	N/A
Club car bypass	41	34	N/A
Club alfresco dining	39	32	N/A
Band inside Club	57	50	21
Club deliveries	51	44	Refer Below
Club waste collection	61	54	Refer Below
Club commercial A/C	33	26	N/A
Club refrigeration plant	38	31	N/A
<b>Criterion dB(A)</b>	<b>7am - 10pm: 44 / 10pm - 7am: 39</b>	<b>45</b>	

**Table 10:** Predicted noise impact levels at onsite noise sensitive dwellings.

Given that waste collection and delivery activities are likely to be infrequent occurrences and of short duration we have not based our Rw building shell requirements on these impact levels.

We note that an Rw rating lower than 24 is considered standard glazing. Rw ratings for standard external walls and roof / ceiling systems for residential dwellings are around Rw 33 to 35.

For point source calculations refer to Appendix C of this report.

#### 5.2.4 Predicted Onsite Commercial Noise Impacts at the Nearest Offsite and Onsite Dwellings

Based upon the location of onsite commercial activities in relation to surrounding offsite dwellings and future onsite dwellings, we predict the following noise impact levels as presented in Table 11.

The predicted levels assume that the recommended treatments detailed in Section 6.2 are incorporated into the development.

Noise source	Predicted Noise Impact, SPL L <sub>A10</sub> dB(A)		
	Nearest Façade to Onsite Commercial Activity	Inside with Windows Open	
<b>Dwellings due North</b>			
Car door closure	40	33	
Car bypass at 5km/hr	34	27	
Patrons at alfresco dining	38	31	
Truck unloading (by hand)	52	45	
Waste collection	55	48	
Commercial A/C plant	37	29	
<b>Dwellings due East</b>			
Car door closure	58	50	
Car bypass at 5km/hr	54	46	
Patrons at alfresco dining	47	39	
Truck unloading (by hand)	48	40	
Waste collection	58	50	
Commercial A/C plant	47	39	
<b>Onsite Dwellings - Ground</b>			
Car door closure	58	50	21
Car bypass at 5km/hr	52	44	N/A
Patrons at alfresco dining	35	28	N/A
Truck unloading (by hand)	58	51	Refer Below
Waste collection	68	61	Refer Below
Commercial A/C plant	39	32	N/A
<b>Onsite Dwellings - Upper</b>			
Car door closure	66	58	29
Car bypass at 5km/hr	60	52	23
Patrons at alfresco dining	43	36	N/A
Truck unloading (by hand)	66	59	Refer Below
Waste collection	76	69	Refer Below
Commercial A/C plant	47	40	N/A
<b>Criterion dB(A)</b>	<b>7am - 10pm: 44 / 10pm - 7am: 39</b>	<b>45</b>	

**Table 11:** Predicted noise impact levels at onsite and offsite noise sensitive dwellings.

We have not assessed the residence located above the general store as the dwelling would be the care takers dwelling for the general store, and is therefore not deemed noise sensitive.

Given that waste collection and delivery activities are likely to be infrequent occurrences and of short duration we have not based our Rw building shell requirements on these impact levels.

We note that an Rw rating lower than 24 is considered standard glazing. Rw ratings for standard external walls and roof / ceiling systems for residential dwellings are around Rw 33 to 35.

For point source calculations refer to Appendix C of this report.

### 5.3 Construction Activity Noise Impacts

#### 5.3.1 Assumed Noise Source Levels – Onsite Construction Activities

All noise source levels used in the assessment have been collected from similar previous investigations. All noise levels have been corrected for impulsiveness or tonality as per Australian Standard AS 1055:1997 - 'Acoustics-Description and measurement of environmental noise'.

The following noise source levels are typically associated with construction activities and have been assessed within this report:

Activity/Noise Source	Noise Level, SPL L <sub>A10</sub> dB(A) at 1m
Excavator	98 dB(A)
Front-end Loader	95 dB(A)
Truck unloading	85 dB(A)
Hammering scaffold	110* dB(A)
Compressed air nail gun	92* dB(A)
Jack hammering	103* dB(A)

**Table 12:** Typical noise source levels associated with construction works.

Based upon the location of onsite construction activities in relation to surrounding offsite dwellings, we predict the following noise impact levels as presented in Table 13.

Noise source	Predicted Noise Impact, SPL L <sub>A10</sub> dB(A)
<b>Dwellings due North</b>	<b>Nearest Façade to Onsite Construction Activity</b>
Excavator	69
Front-end Loader	66
Truck unloading	56
Hammering scaffold	81
Compressed air nail gun	63
Jack hammering	74
<b>Dwellings due East</b>	<b>Nearest Façade to Onsite Construction Activity</b>
Excavator	73
Front-end Loader	70
Truck unloading	60
Hammering scaffold	85
Compressed air nail gun	67
Jack hammering	78
<b>Criterion dB(A)</b>	<b>Up to 26 weeks: 54</b>

**Table 13:** Predicted noise impact levels at offsite noise sensitive dwellings.

For point source calculations refer to Appendix C of this report.

## 6.0 RECOMMENDED ACOUSTIC TREATMENTS

### 6.1 Recommended Acoustic Treatments for Road Traffic Noise

#### 6.1.1 Acoustic Barriers

We recommend construction of the 1.8m high acoustic barriers along the Bilambil Road frontage as detailed in Sketch 1 of Appendix A. Barriers are to be constructed above the finished adjacent building pad levels and be free of gaps and holes. Typical materials include earth berms, 19mm lapped timber fence (40% overlap), 6mm FC sheet, masonry, or a combination of the above (a minimum surface mass of 11kg/m<sup>2</sup> is required).

#### 6.1.2 Building Shell Treatments

Based upon noise modelling (Section 5.1.3), traffic noise is predicted to exceed the external noise criterion at the nearest first floor building façades directly fronting Bilambil Road (i.e. eastern façades); and will require further acoustic treatments.

Assessment of noise affected habitable rooms, to determine the required building shell treatments have been undertaken in accordance with Australian Standard AS3671:1989 'Acoustics – Road traffic noise intrusion – Building Siting and Construction'.

Based upon predicted impact levels, the TNR values (Traffic Noise Reduction) as defined in AS3671:1989 are as follows:

Receiver	Space	Impact dB(A)	Criteria dB(A)	TNR dB(A)
First Floor Levels of Dwellings fronting Bilambil Rd	Eastern living, dining kitchen areas facing road (A/C)	65.0	40	25.0
	Eastern Bedrooms facing road (A/C)	58.0	35	23.0

(A/C): Requires provision of air-conditioning or sealed mechanical ventilation.

**Table 14:** TNR values for noise affected habitable rooms.

TNR values between 10 and 25 are considered as Construction Category 2 within AS3671:1989, which is defined as follows:

*“Standard construction, except for lightweight elements such as fibrous cement or metal cladding or all glass façades.”*

Australian Standard AS3671:1989 also provides guidance on standard building construction:

Bilambil Road Space	Building Component	Rw	Indicative Acoustic Treatment **Verify with supplier proposed element achieves required Rw**
<b>Standard Building Construction:</b>			
Lots 14, 16, 18, 20, 22, 24, 25, 33 to 35 and Residence above the General Store: First Floor Habitable Rooms Facing Bilambil Road	Glazing	24	3mm glass in a standard grade frame
	External Wall	33 - 35	Conventional timber stud framed wall, clad externally with 9mm thick timber or hardboards or flat cellulose-cement sheets, and internally with 10mm thick plasterboard
	Roof/ Ceiling	33 - 35	Conventional pitched roof with tiles or corrugated metal, over 10mm thick plasterboard

Therefore, for noise affected habitable rooms along the eastern facing building façades at Lots fronting Bilambil Road (i.e. refer to tables above), provision of air conditioning or sealed mechanical ventilation is required to allow occupants to close windows. The installed plant should not reduce the acoustic performance of the building shell.

## **6.2 Recommended Acoustic Treatments for Onsite and Offsite Commercial Activity**

Based upon the assumed commercial noise source levels, the following acoustic treatments and management principles are recommended to mitigate offsite and onsite commercial noise impacts:

- Construction of the 1.8m high acoustic barriers as detailed in Sketch 1 of Appendix A. Barriers are to be constructed above the finished ground (adjacent building pad levels) or existing ground, whichever is higher and be free of gaps and holes. Typical materials include earth berms, 19mm lapped timber fence (40% overlap), 6mm FC sheet, masonry, or a combination of the above (a minimum surface mass of  $11\text{kg/m}^2$  is required).
- External glazing of first floor living areas and bedrooms (if constructed) along the north, east and south facing dwelling façades at Lots 11 to 13 (i.e. overlooking the general store) be constructed of a minimum of 6.38mm laminate glass in acoustic frames to achieve an  $R_w$  rating of 29. Habitable rooms of onsite units to have provision of air conditioning or sealed mechanical ventilation, to allow occupants to close windows and doors and still have a supply of fresh air.
- Provision of air-conditioning or sealed mechanical ventilation is recommended at first floor level living areas and bedrooms (if constructed) along the north, east and south facing dwelling façades at Lots 10 to 13, 15, 17, 19, 21, 23, 25, 27, 29 and 31 (i.e. overlooking the Bilambil Sports Club and petrol station) to allow occupants to close windows and doors and still have a supply of fresh air. The installed plant should not reduce the acoustic performance of the building shell.
- General store hours of operation be limited to 7am to 10pm.
- Waste collection and deliveries be limited to the daytime period of 7am to 6pm.
- Driveway and carpark areas of the general store be finished with surface coatings which prevent tyre squeal (an uncoated surface is acceptable). Drainage grating over trafficable areas be well secured to prevent rattling.
- Mechanical plant at the general store be designed and installed to comply with the noise criterion presented in Section 4.2. As final plant selection has not been completed, additional acoustic assessment/s should be undertaken once plant selections are finalised. Such assessments should be undertaken prior to Building Approval; and be conditioned within the Development Approval.

### 6.3 Recommended Acoustic Treatments for Construction Noise

We recommend that the construction works observe the following treatments and principles to manage potential noise emissions to surrounding dwellings:

- Ensuring that works are strictly limited to 7a.m. and 6p.m. Monday to Friday, and 8am to 1pm on Saturdays.
- Trucks and equipment should not arrive or queue outside the site before 7a.m. and 6p.m. Monday to Friday, and 8am to 1pm on Saturdays.
- Onsite equipment should not be started before 7am on Monday to Friday and 8am on Saturday.
- Commence earthworks in the mornings as far from the residential premises as is possible.
- Truck and equipment speeds be limited to 20km/hr at the site.
- Truck and equipment speeds be limited to 40km/hr through residential areas surrounding the site.
- All reasonable and feasible acoustic treatments (i.e. residential mufflers and plant enclosures) should be installed and maintained (refer to AS 2436 – 1981 ‘*Guide to noise control on construction, maintenance and demolition sites*’).
- No alarm bells/paging systems should be used. Cordless telephones are a suitable substitute.
- Vehicles have a modified beeper installed (commonly termed a “croaker”, as they sound similar to a frog croak).
- Drivers be instructed to operate equipment in a manner that does not generate unnecessary noise, through avoiding excessive revving, and avoidance of impact with solid objects.
- Maintenance of equipment. Regular maintenance of stationary and mobile equipment, including off-site vehicles. By maintaining equipment, noise emissions from older equipment will be similar to that of new equipment.
- Use and siting of equipment. By locating noisy equipment as far away from noise sensitive premises as is practical, distance separation will reduce potential noise impacts. Unloading building materials should be conducted as far away from noise sensitive premises as possible.
- Machines/equipment which discharge noise in a certain direction should be orientated away from residential properties to minimize noise annoyance.
- Machines/equipment should be turned off when not in use or throttled down to a minimum.
- All onsite roads be well maintained (no potholes) and levelled as required to minimise truck bounce as they move around the site.
- Drainage grating over trafficable areas be well secured to prevent them rattling when a vehicle traverses over the grate.
- Assign the task of managing noise emissions to a person (the ‘responsible person’) that is contactable at all times (e.g. 24 hours per day), and is likely to be present on-site most of the time that activity is occurring. This person would be responsible for handling noise complaints sensitively, and ensuring that work does not commence before the times specified above. The ‘responsible person’ should maintain a Noise Complaint Record, with an example recording form attached to this report.
- The ‘responsible person’ should also conduct regular observations of noise levels from the construction activities. Should any noise sources be identified as being able to be practically relocated further away from the residential area, the ‘responsible person’ should undertake to have the source relocated.
- Providing local residents with an indicative schedule of the works program, in particular, a clear notification of the times when new or noisy activities are to be conducted proximate to the residential premises. This notification should also include contact details of the ‘responsible person’ should residents wish to discuss the onsite activity.

## 7.0 CONCLUSIONS

### 7.1 Road Traffic Noise

Based upon ultimate traffic volumes on Bilambil Road, traffic noise levels are predicted to impact the proposed nearest building façades and recreation areas at levels above the external noise criterion; hence acoustic treatments are required.

For ground level building façades and recreation areas, we have recommended construction of 1.8m high acoustic barriers along the Bilambil Road frontage.

We note that lots setback from Bilambil Road, which are not presented in Table 4 above, will have traffic noise impacts lower than those presented. Traffic noise impacts will be lower due to greater separation distance from the road and physical screening provided by acoustic barrier and those buildings fronting the road.

Further, noise impacts at first floor level façades at 90° to Bilambil Road of the lots fronting the road are predicted to be within 2 dB(A) of the noise criterion. As the average person cannot typically detect a 2 dB(A) variation in sound pressure level, such an exceedance is unlikely to cause annoyance and is considered an acceptable outcome. Hence, habitable rooms along first floor level façades at 90° to Bilambil Road (if first floor levels are constructed) of dwellings fronting Bilambil Road will not require acoustic treatments.

To achieve compliance with the internal noise criterion at noise affected first floor habitable rooms directly fronting Bilambil Road, provision of air conditioning or sealed mechanical ventilation is required to noise affected first floor habitable rooms (if constructed). The plant should not reduce the acoustic performance of the building shell.

Increases in traffic volumes on the local roads, from the proposed development, are predicted to increase road traffic noise levels by less than 2 dB(A), with the exception of Urliup Road. However, the  $L_{Aeq\ 1hr\ daytime}$  level for Urliup Road, once the development is completed, is at 55 dB(A), which is the criterion for a Local Road within the New South Wales EPA 'Environmental Criteria for Road traffic Noise'. The  $L_{Aeq\ 1hr\ daytime}$  levels for both Bilambil and Hogans Road are within 1 dB(A) of the relevant noise criterion for a Collector Road (60 dB(A)) and a Local Road (55 dB(A)) respectively.

We note that night-time hourly traffic volumes would be negligible, due to the size of the development; hence we have assessed daytime  $L_{Aeq\ 1hr}$  levels only.

## **7.2 Onsite Commercial Activity Noise Impacts at Offsite Dwellings**

Based upon the assumed source levels and recommended acoustic treatments, impacts at the nearest offsite dwellings to the north are predicted to be within 1 dB(A) the evening external noise criterion and the adopted internal limit of 45 dB(A) with the exception of waste collection and deliveries. As the average person cannot typically detect a 3 dB(A) variation in sound pressure level, a 1 dB(A) exceedance is unlikely to cause annoyance and is considered an acceptable outcome.

As waste collection and deliveries are only likely to occur once or twice per week, and are generally of short duration; such activities are unlikely to cause annoyance. To minimise annoyance we have recommended that such activities be limited to the daytime hours between 7am and 6pm

Impacts at the nearest dwellings to the east are predicted to generally be above the external criterion due to limited separation distance and limited opportunities for acoustic barriers. We note however that outdoor recreation areas at these dwellings are located on the eastern side of the dwellings, therefore providing physical screening of noise impacts from the proposed commercial activities.

Noise impacts inside the nearest eastern dwellings are predicted to be within 1 dB(A) of the adopted limit of 45 dB(A) with the exception of waste collection and car door closures. Furthermore, vehicles traversing Bilambil Road are predicted to impact these dwellings at approximately 63 dB(A)  $L_{A10\ 18hr}$ , which is above the predicted  $L_{A10}$  impact levels from the car door closures and waste collection at the general store.

## **7.3 Offsite and Onsite Commercial Activity Noise Impacts at Onsite Dwellings**

With regards to the onsite residential dwellings impacted by onsite and offsite commercial activities; noise can be controlled to acceptable levels at indoor areas with upgraded glazing treatments at first floor level habitable rooms (if constructed) and the provision of air-conditioning or sealed mechanical ventilation. Given that waste collection and deliveries are likely to be infrequent occurrences and of short duration we have not based our building  $R_w$  requirements for onsite units on these impact levels.

As there should be an expectation of some noise if a person purchases a residential dwelling in a mixed use development, we submit that it is reasonable to allow noise control at the facades of the dwellings.

Further, we have recommended construction of acoustic barriers to mitigate noise impacts at ground floor level building façades and recreation areas.

We have provided an indication of potential noise impact levels, and required acoustic treatments, of likely onsite mechanical plant; although the levels are merely a guide as no plant selections have yet been completed. For this reason, further more detailed assessment/s should be conducted upon determination of plant. Such assessments should be undertaken prior to Building Approval; and be conditioned within the Development Approval.

#### 7.4 Construction Activity Noise

Based upon the assumed noise source levels, it is not possible to strictly comply with the “background + 15” criteria for all potential activities such as hammering, nor has any construction site within 200m of an existing residential premises ever complied with the criteria (assuming a noise limit of 54 dB(A), and an unobstructed line of sight from source to receiver).

The key to managing noise impacts is to ensure that all practical steps are taken to minimise noise from the site – if the residents adjacent are aware that the Builder is mindful of noise impacting upon their residential premises, they will tend to be less annoyed than if they feel no regard is made as to their amenity. Good communication is an important factor in managing noise from the site, as a good relationship between the Builder and the residents will further ensure that should an issue arise, it can be dealt with in a reasonable manner.

There are limited practical options for control of onsite activity noise, apart from the management principles listed in Section 6.3, above, but it must be noted that the recommended treatments are considered ‘best practice’ in terms of management of noise for building activities.

Further, it would be advantageous to keep surrounding residents and commercial operators abreast of the works progress; and give prior notice of any activities which may cause unexpected noise intrusion. In the unlikely event of a noise complaint, the complaint must be dealt with sensitively and respectfully, with the noise abated as soon as possible.

#### 8.0 CONCLUSIONS

This report is in response to a request from Jackson International for an environmental noise impact assessment of a proposed residential development Bilambil Road, Hogans Road & Urliup Road at Bilambil.

Overall, the proposed development will generally be within acceptable levels of the adopted criterion, subject to the acoustic treatments recommended in Section 6 being integrated into the design and construction of the development.

Report Reviewed By:



**JAY CARTER BSc**  
Director

Report Compiled by:



**Matthew Lopez BEng**  
Consultant

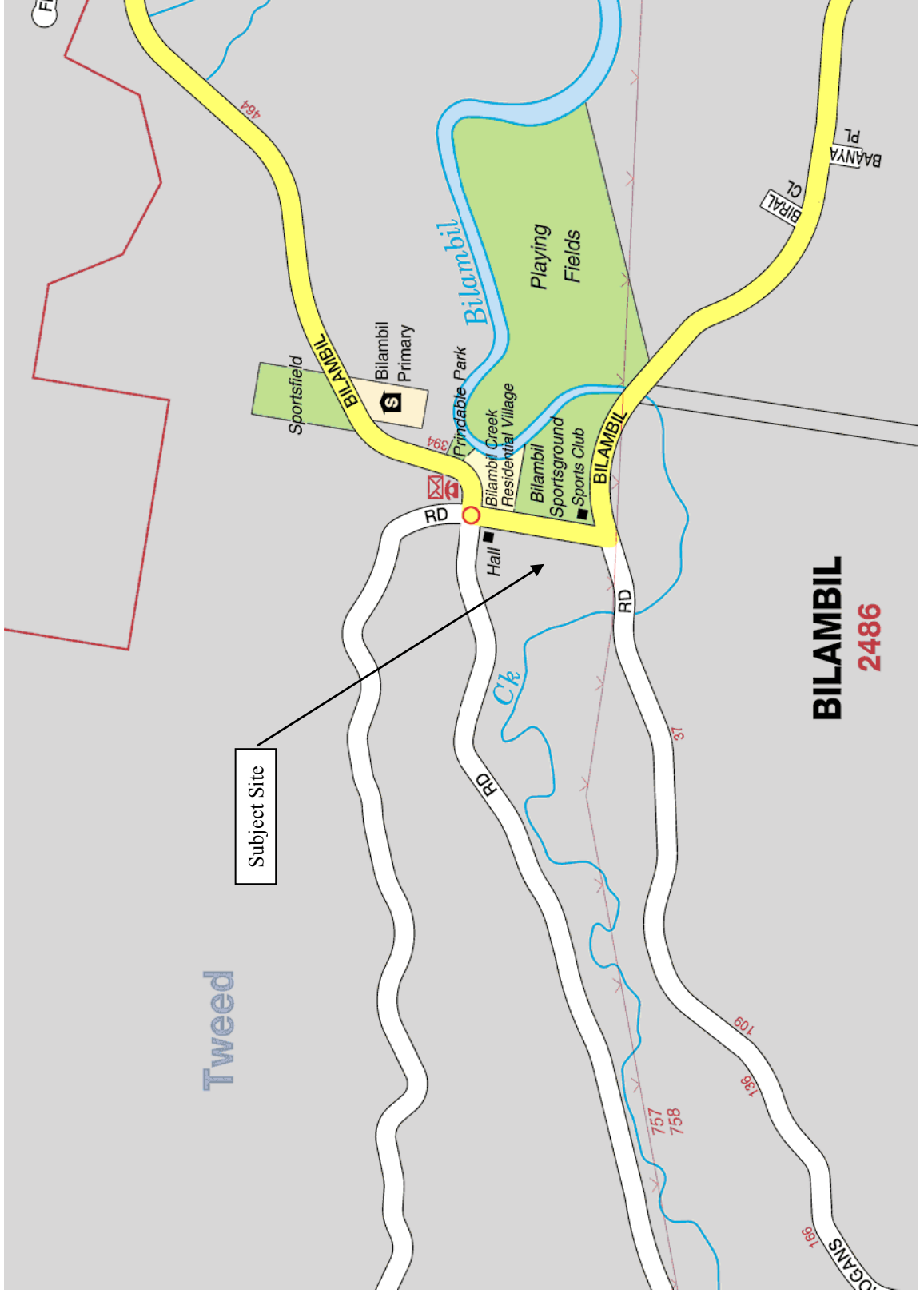


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**APPENDIX A**

Subject Site, Monitoring Locations and Recommended Acoustic Barrier Treatments

Figure No. 1: Subject Site Location

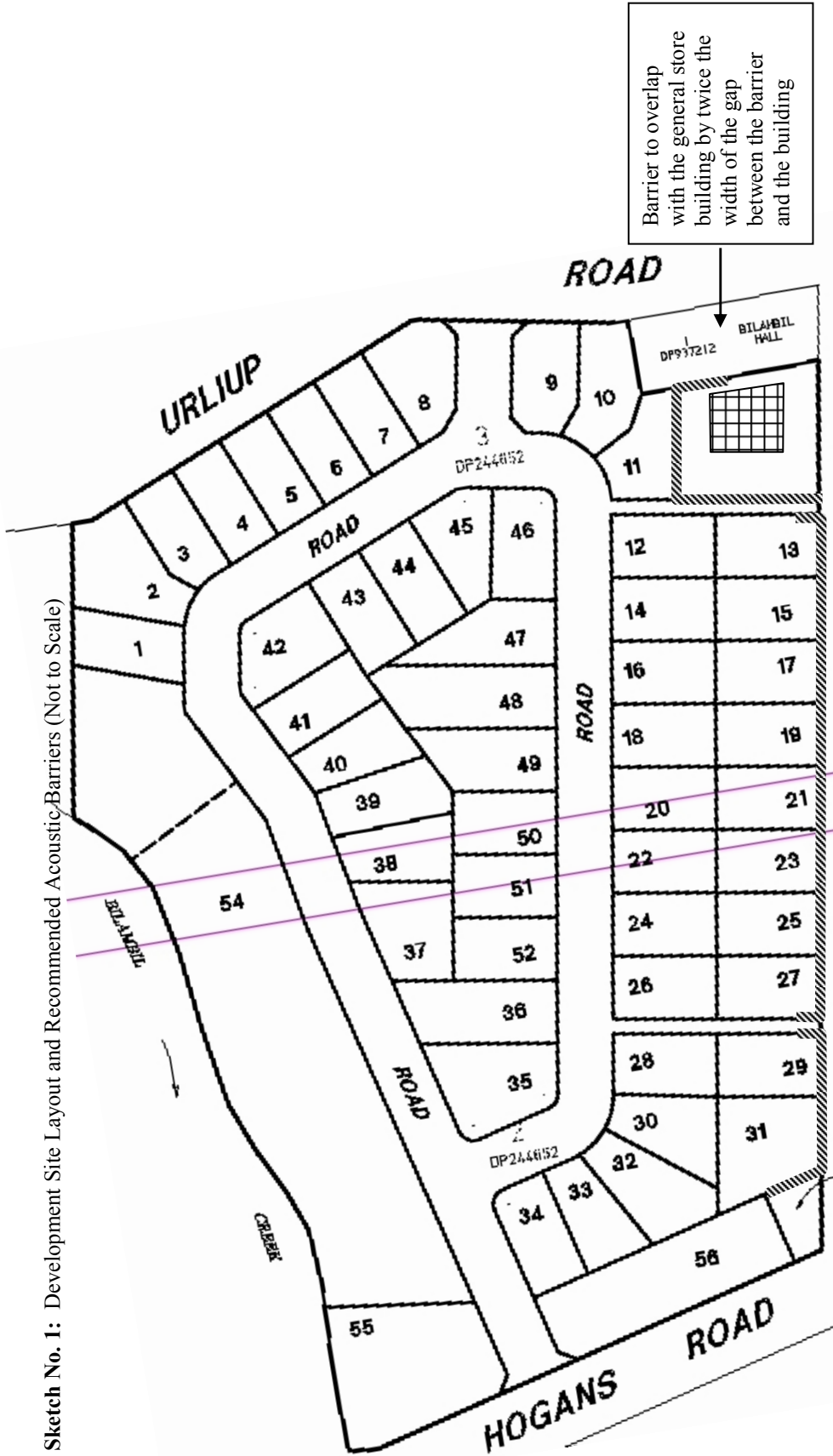


**Figure No. 2:** Subject Site, Logger Location and Surrounding Environs





Sketch No. 1: Development Site Layout and Recommended Acoustic Barriers (Not to Scale)



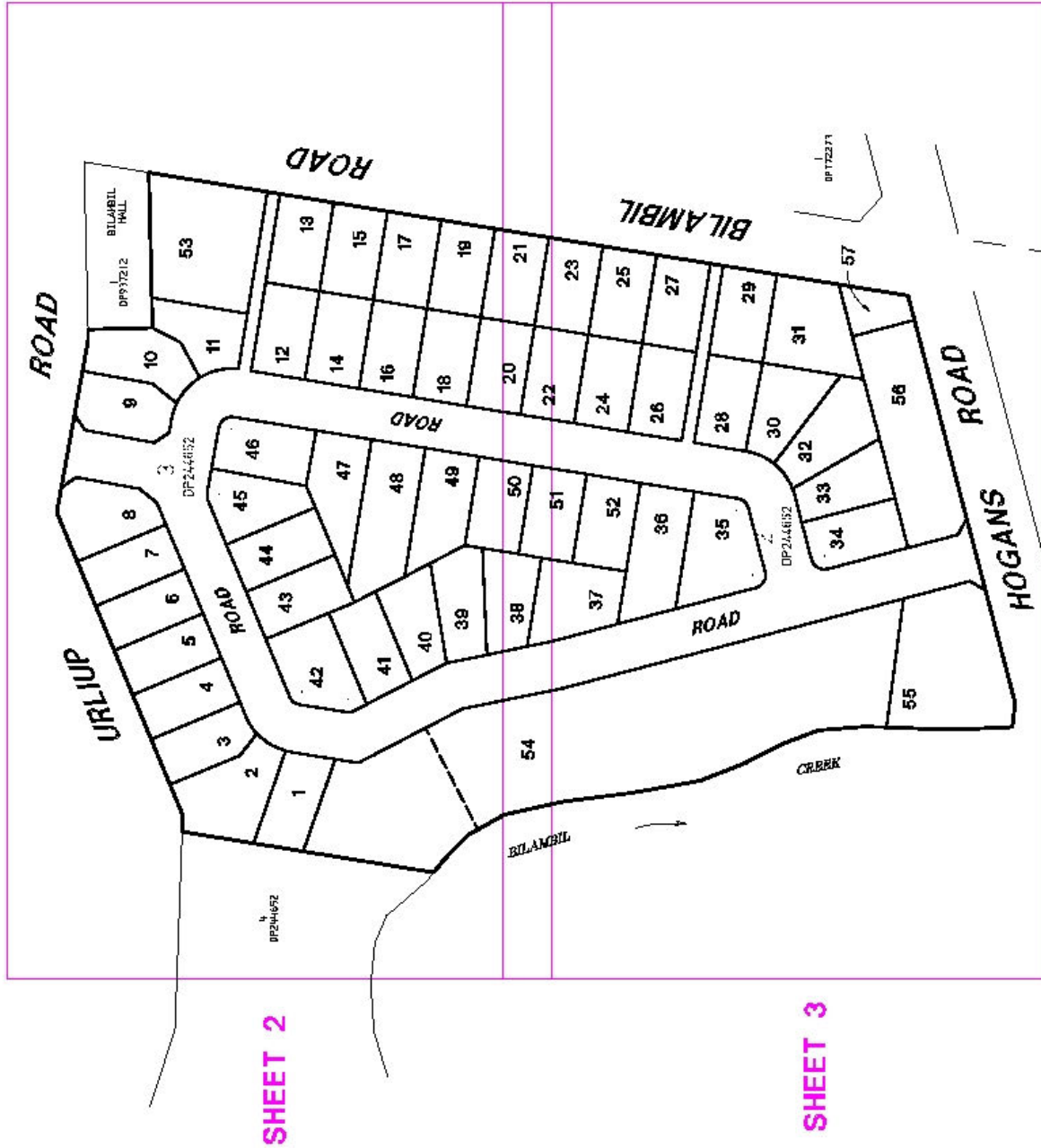
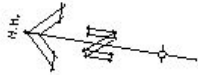
**ACOUSTIC BARRIER LEGEND**

Recommended 1.8m high acoustic barrier constructed above the finished ground (adjacent building pad levels) or existing ground, whichever is higher.

Barriers are to be constructed free of gaps and holes. Typical materials include earth berms, 19mm lapped timber fence (40% overlaid), 6mm FC sheet, masonry, or a combination of the above (a minimum surface mass of 11kg/m<sup>2</sup> is required).

## **APPENDIX B**

### Development Plans



**SHEET 2**

**SHEET 3**

Rev C - 16/03/09 - Amendments  
 Rev B - 12/03/09 - New Layout  
 Rev A - 04/08/08 - addition info  
 Revision  
 Registered Proprietors

Chk'd

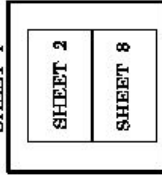
**JACKSON INTERNATIONAL PTY LTD**

**Important Notes:**

THE PROPOSED LOT BOUNDARIES, NUMBERS, AREAS AND DIMENSIONS AS SHOWN HEREON ARE PRELIMINARY ONLY AND ARE SUBJECT TO FINAL DESIGN, LOCAL AUTHORITY APPROVAL AND REGISTRATION IN THE DEPARTMENT OF LANDS NSW.

Sheet Layout

SHEET 1



IMPORTANT NOTE:



ALL UNDERGROUND SERVICES SHOULD BE LOCATED ONLINE BY RELEVANT AUTHORITIES BEFORE ANY WORK IS COMMENCED.

THIS NOTE IS AN INTEGRAL PART OF THIS PLAN.

**PROPOSED SUBDIVISION PLAN**

Of Lots 2 and 3 in DP244652  
 Bilambil Road, Bilambil Village

Parish of TERRANORA County of ROUS

**B & P SURVEYS**  
 CONSULTING SURVEYORS

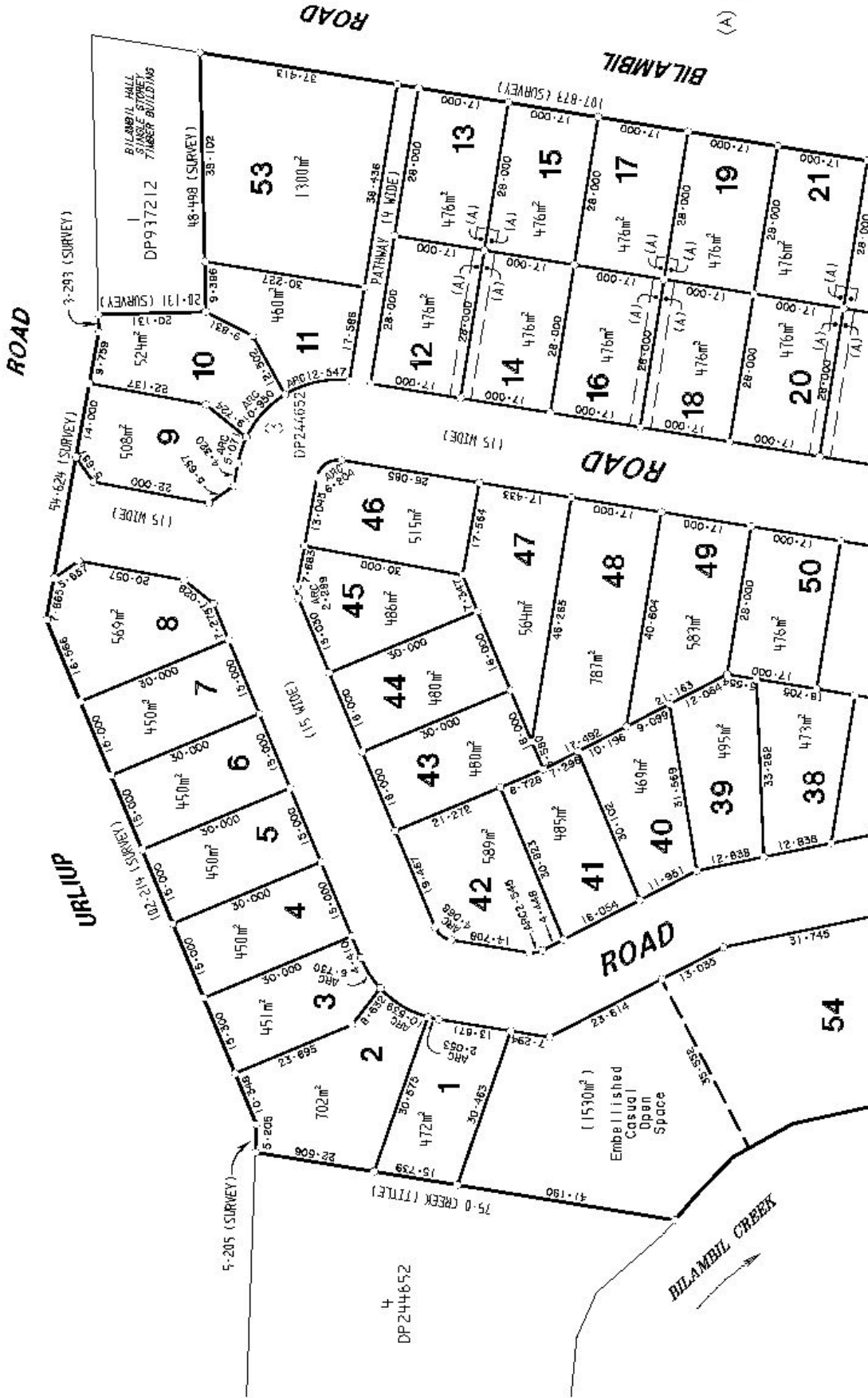
ABN: 66 60419242  
 30 Beryl Street  
 Tweed Heads, NSW, 2485, Australia  
 Telephone: (07) 5536 3611  
 Fax: (07) 5536 3701  
 Email: [tweed@bpsurveys.com.au](mailto:tweed@bpsurveys.com.au)  
 Webpage: [www.bpsurveys.com.au](http://www.bpsurveys.com.au)



Offices Also At:  
 Surfers Paradise Murwillumbah  
 Ph: (07) 66390499 Ph: (02) 66721924

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Scale	Level Datum	Drawn	Chk'd	FBK	LBK
1 : 1500	—	—	—	—	—
REF. No. T15337	Date 31/07/08	Drawing No./Site 17154 D	Rev. C		



(A) PROPOSED EASEMENT FOR ACCESS 2 WIDE

SHEET 2 of 3

**B & P SURVEYS**  
CONSULTING SURVEYORS  
A QUALITY ASSURED COMPANY

30 Beryl Street  
Tweed Heads, NSW, 2485, Australia  
Telephone: (07) 5536 3611  
Fax: (07) 5536 3701  
Email: twed@bpsurveys.com.au  
Webpage: www.bpsurveys.com.au

Offices Also At: Surfers Paradise, Murwillumbah  
Ph: (07) 55580499 Ph: (02) 6672 1924

Ref. No.	T15337
Date	31/07/08
Drawing No./Size	17154 D C

**PROPOSED SUBDIVISION PLAN**

Of Lots 2 and 3 in DP244652  
Bilambil Road, Bilambil Village  
Parish of TERRANORA County of ROUS

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Scale	1 : 800	Level Datum	-	Fbk	-	Lbk	-	Drawn	LES	CHK'd	CHK'd
	@ A3										

**Important Notes:** (THIS NOTE IS AN INTEGRAL PART OF THIS PLAN)  
THE PROPOSED LOT BOUNDARIES, NUMBERS, AREAS AND DIMENSIONS AS SHOWN HEREON ARE PRELIMINARY ONLY AND ARE SUBJECT TO FINAL DESIGN, LOCAL AUTHORITY APPROVAL AND REGISTRATION IN THE DEPARTMENT OF LANDS NSW.

**IMPORTANT NOTE:**  
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Sheet Layout

SHEET 2
SHEET 3

ALL UNDERGROUND SERVICES SHOULD BE LOCATED ON SITE BEFORE ANY WORK IS COMMENCED.

Rev C - 16/03/09 - Amendments  
Rev B - 12/03/09 - New Layout  
Rev A - 04/08/08 - addition info  
Revision

Registered Proprietors

**JACKSON INTERNATIONAL PTY LTD**

Chk'd

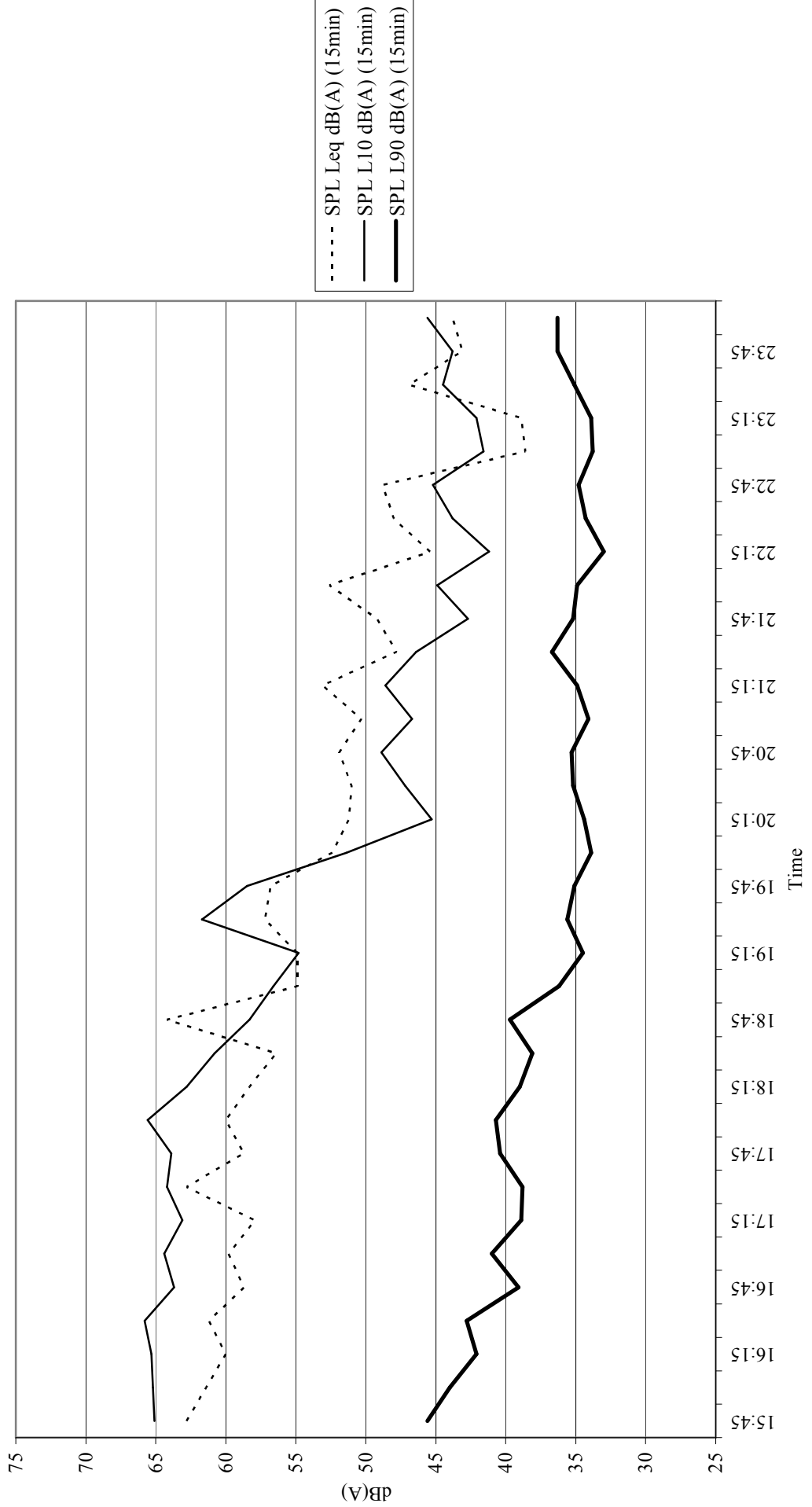


## **APPENDIX C**

Measurement Results and Model Calculations / Predictions

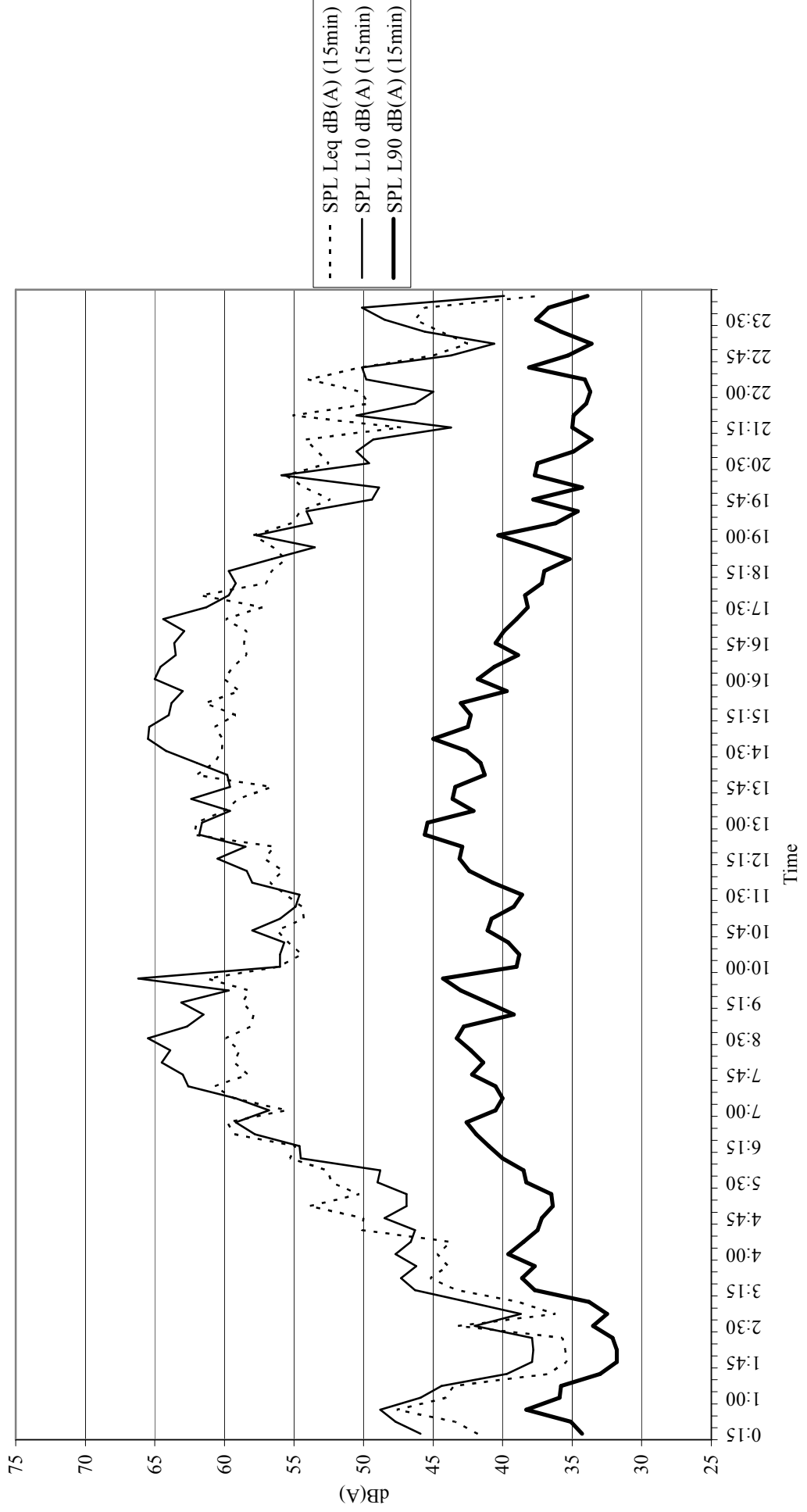


Ambient Noise: Bilambil Road, 22/07/08



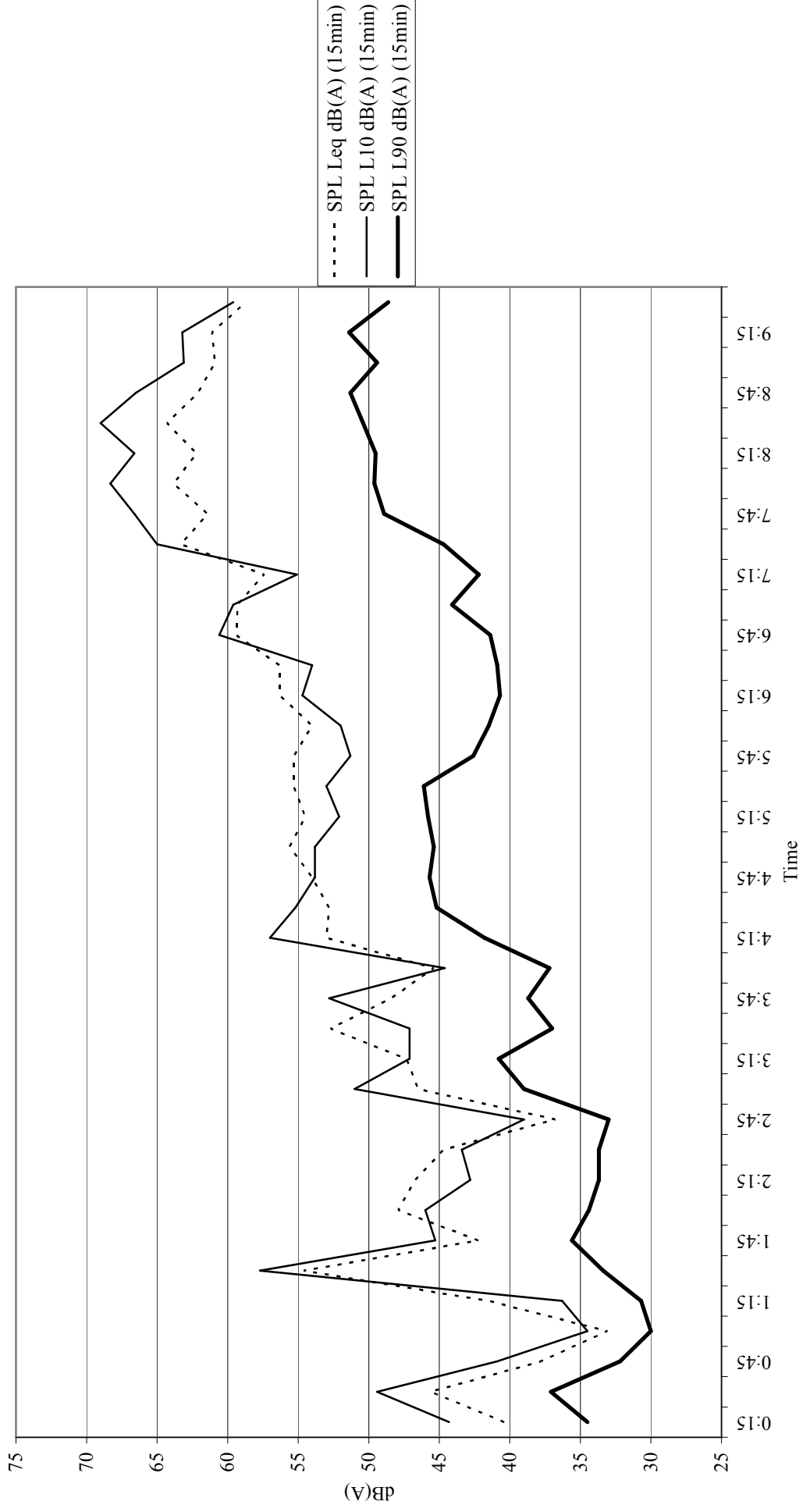


Ambient Noise: Bilambil Road, 23/07/08





Ambient Noise: Bilambil Road, 24/07/08





**POINT CALCULATIONS**

Pen3D2000 V1.9.8.1

Project Code:08406a

Project Description:Noise assessment of Bilambal Heights

File:Z:\ACOUSTICS\08406a Bilambal Heights Sub-division and Retail\08406a\_ultimate.PEN

File Description:Data file covering ultimate

Thursday 24 Jul, 2008 at 16:16:20

**CoRTN Calculations**

All road segments included. Segmentation angle: 10degrees. Road elevations apply.

Receptor	X Posn (m)	Y Posn (m)	Height (m)	Leq(24hour) (dB(A))
monitor	157.7	318.9	1.2	57.0 free-field

**POINT CALCULATIONS**

Pen3D2000 V1.9.8.1

Project Code:08406a

Project Description:Noise assessment of Bilambal Heights

File:Z:\ACOUSTICS\08406a Bilambal Heights Sub-division and Retail\08406a\_ultimate.PEN

Tuesday 07 Jul, 2009 at 12:06:55

**CoRTN Calculations**

All road segments included. Segmentation angle: 10degrees. Road elevations apply.

Receptor	X Posn (m)	Y Posn (m)	Height (m)	L10(18hour) (dB(A))
13	154.9	295.2	1.8	55.6
15	154.8	277.3	1.8	55.5
17	154.6	261.7	1.8	55.5
19	154.5	243.5	1.8	55.5
21	154.3	227.2	1.8	55.4
23	154.6	212.6	1.8	55.6
25	154.2	197.4	1.8	55.4
27	154.2	179.4	1.8	55.4
29	154.0	154.1	1.8	55.2
31	153.8	135.0	1.8	55.0
13	154.9	295.2	4.6	62.2
15	154.8	277.3	4.6	62.2
17	154.6	261.7	4.6	62.2
19	154.5	243.5	4.6	62.3
21	154.3	227.2	4.6	62.2
23	154.6	212.6	4.6	62.4
25	154.2	197.4	4.6	62.3
27	154.2	179.4	4.6	62.3
29	154.0	154.1	4.6	62.2
31	153.8	135.0	4.6	62.0
53	151.7	329.0	4.6	60.6

**ONSITE ACTIVITY NOISE IMPACTING DWELLING FAÇADES:**

**Dwellings Due North**

Car door closure	83	dB(A) @ 1m
Distance source to receiver	75	m
Distance attenuation	-37.5	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	40.0	dB(A)
Impact inside opern window	32.5	dB(A)

**Dwellings Due East**

Car door closure	83	dB(A) @ 1m
Distance source to receiver	25	m
Distance attenuation	-28.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	57.5	dB(A)
Impact inside opern window	50.0	dB(A)

Car bypass	77	dB(A) @ 1m
Distance source to receiver	75	m
Distance attenuation	-37.5	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	34.0	dB(A)
Impact inside opern window	26.5	dB(A)

Car bypass	77	dB(A) @ 1m
Distance source to receiver	20	m
Distance attenuation	-26.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	53.5	dB(A)
Impact inside opern window	46.0	dB(A)

Patrons at Alfresco Dining	70	dB(A) @ 1m
Distance source to receiver	30	m
Distance attenuation	-29.5	dB(A)
Building screening	-5	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	38.0	dB(A)
Impact inside opern window	30.5	dB(A)

Patrons at Alfresco Dining	70	dB(A) @ 1m
Distance source to receiver	20	m
Distance attenuation	-26.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	46.5	dB(A)
Impact inside opern window	39.0	dB(A)

Truck unloading by hand	87	dB(A) @ 1m
Distance source to receiver	30	m
Distance attenuation	-29.5	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	52.0	dB(A)
Impact inside opern window	44.5	dB(A)

Truck unloading by hand	87	dB(A) @ 1m
Distance source to receiver	40	m
Distance attenuation	-32.0	dB(A)
Building screening	-10	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	47.5	dB(A)
Impact inside opern window	40.0	dB(A)

Waste Collection	97	dB(A) @ 1m
Distance source to receiver	65	m
Distance attenuation	-36.3	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	55.2	dB(A)
Impact inside opern window	47.7	dB(A)

Waste Collection	97	dB(A) @ 1m
Distance source to receiver	40	m
Distance attenuation	-32.0	dB(A)
Building screening	-10	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	57.5	dB(A)
Impact inside opern window	50.0	dB(A)

A/C condensor unit	70	dB(A) @ 1m
Distance to dwelling	60	m
Distance attenuation	-36	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	0	dB(A)
Impact at Façade	36.9	dB(A)
Impact inside	29.4	dB(A)

A/C condensor unit	70	dB(A) @ 1m
Distance to dwelling	20	m
Distance attenuation	-26	dB(A)
Façade reflection	2.5	dB(A)
Onsite building screening	0	dB(A)
Impact at Façade	46.5	dB(A)
Impact inside	39.0	dB(A)

**ONSITE ACTIVITY NOISE IMPACTING DWELLING FAÇADES:**

**Nearest Onsite Dwellings - ground floor level**

Car door closure	83	dB(A) @ 1m
Distance source to receiver	10	m
Distance attenuation	-20.0	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	57.5	dB(A)
Impact inside opern window	50.0	dB(A)
Rw to achieve 40 dB inside	21.0	

Car bypass	77	dB(A) @ 1m
Distance source to receiver	10	m
Distance attenuation	-20.0	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	51.5	dB(A)
Impact inside opern window	44.0	dB(A)

Patrons at Alfresco Dining	70	dB(A) @ 1m
Distance source to receiver	30	m
Distance attenuation	-29.5	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	35.0	dB(A)
Impact inside opern window	27.5	dB(A)

Truck unloading by hand	87	dB(A) @ 1m
Distance source to receiver	15	m
Distance attenuation	-23.5	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	58.0	dB(A)
Impact inside opern window	50.5	dB(A)

Waste Collection	97	dB(A) @ 1m
Distance source to receiver	15	m
Distance attenuation	-23.5	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	68.0	dB(A)
Impact inside opern window	60.5	dB(A)

A/C condensor unit	70	dB(A) @ 1m
Distance to dwelling	18	m
Distance attenuation	-25	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	-8	dB(A)
Impact at Façade	39.4	dB(A)
Impact inside	31.9	dB(A)

**Nearest Onsite Dwellings - first floor level**

Car door closure	83	dB(A) @ 1m
Distance source to receiver	10	m
Distance attenuation	-20.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	65.5	dB(A)
Impact inside opern window	58.0	dB(A)
Rw to achieve 40 dB inside	29.0	

Car bypass	77	dB(A) @ 1m
Distance source to receiver	10	m
Distance attenuation	-20.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	59.5	dB(A)
Impact inside opern window	52.0	dB(A)
Rw to achieve 40 dB inside	23.0	

Patrons at Alfresco Dining	70	dB(A) @ 1m
Distance source to receiver	30	m
Distance attenuation	-29.5	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	43.0	dB(A)
Impact inside opern window	35.5	dB(A)

Truck unloading by hand	87	dB(A) @ 1m
Distance source to receiver	15	m
Distance attenuation	-23.5	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	66.0	dB(A)
Impact inside opern window	58.5	dB(A)

Waste Collection	97	dB(A) @ 1m
Distance source to receiver	15	m
Distance attenuation	-23.5	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	76.0	dB(A)
Impact inside opern window	68.5	dB(A)

A/C condensor unit	70	dB(A) @ 1m
Distance to dwelling	18	m
Distance attenuation	-25	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	0	dB(A)
Impact at Façade	47.4	dB(A)
Impact inside	39.9	dB(A)



**OFFSITE ACTIVITY NOISE IMPACTING OFFSITE DWELLING FAÇADES:**

**Petrol Station**

**Nearest onsite dwellings - ground floor level**

Car door closure	83	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	39.4	dB(A)
Impact inside open window	31.9	dB(A)

Car bypass	77	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	33.4	dB(A)
Impact inside open window	25.9	dB(A)

Checking Tyre Pressure	80	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	36.4	dB(A)
Impact inside open window	28.9	dB(A)

Truck unloading by hand	87	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Inside to outside attenuation	0	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	43.4	dB(A)
Impact inside open window	35.9	dB(A)

Truck airbrakes at bowser	93	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	49.4	dB(A)
Impact inside open window	41.9	dB(A)

Waste Collection	97	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	53.4	dB(A)
Impact inside open window	45.9	dB(A)

A/C condensor units	65	dB(A) @ 1m
Distance to dwelling	80	m
Distance attenuation	-38	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	0	dB(A)
Impact at Façade	29.4	dB(A)
Impact inside	21.9	dB(A)

**Tavern**

**Nearest onsite dwellings - ground floor level**

Car door closure	83	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	39.4	dB(A)
Impact inside open window	31.9	dB(A)

Car bypass	77	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	33.4	dB(A)
Impact inside open window	25.9	dB(A)

Patrons at Alfresco Dining	75	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	31.4	dB(A)
Impact inside open window	23.9	dB(A)

Band inside tavern	99	dB(A) @ 1m
Distance source to receiver	90	m
Distance attenuation	-39.1	dB(A)
Inside to outside attenuation	-5	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	49.4	dB(A)
Impact inside open window	41.9	dB(A)

Deliveries	87	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	43.4	dB(A)
Impact inside open window	35.9	dB(A)

Waste Collection	97	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	-8	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	53.4	dB(A)
Impact inside open window	45.9	dB(A)

Commercial A/C unit	70	dB(A) @ 1m
Distance to dwelling	90	m
Distance attenuation	-39	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	0	dB(A)
Impact at Façade	33.4	dB(A)
Impact inside	25.9	dB(A)

Refrigeration plant	75	dB(A) @ 1m
Distance to dwelling	90	m
Distance attenuation	-39	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	0	dB(A)
Impact at Façade	38.4	dB(A)
Impact inside	30.9	dB(A)

**OFFSITE ACTIVITY NOISE IMPACTING OFFSITE DWELLING FAÇADES:**

**Petrol Station**

**Nearest onsite dwellings - first floor level**

Car door closure	83	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	47.4	dB(A)
Impact inside open window	39.9	dB(A)

Car bypass	77	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	41.4	dB(A)
Impact inside open window	33.9	dB(A)

Checking Tyre Pressure	80	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	44.4	dB(A)
Impact inside open window	36.9	dB(A)

Truck unloading by hand	87	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Inside to outside attenuation	0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	51.4	dB(A)
Impact inside open window	43.9	dB(A)
Rw to achieve 40 dB inside	14.9	

Truck airbrakes at bowser	93	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	57.4	dB(A)
Impact inside open window	49.9	dB(A)

Waste Collection	97	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	61.4	dB(A)
Impact inside open window	53.9	dB(A)

A/C condensor units	65	dB(A) @ 1m
Distance to dwelling	80	m
Distance attenuation	-38	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	0	dB(A)
Impact at Façade	29.4	dB(A)
Impact inside	21.9	dB(A)

**Tavern**

**Nearest onsite dwellings - first floor level**

Car door closure	83	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	47.4	dB(A)
Impact inside open window	39.9	dB(A)

Car bypass	77	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	41.4	dB(A)
Impact inside open window	33.9	dB(A)

Patrons at Alfresco Dining	75	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	39.4	dB(A)
Impact inside open window	31.9	dB(A)

Band inside tavern	99	dB(A) @ 1m
Distance source to receiver	90	m
Distance attenuation	-39.1	dB(A)
Inside to outside attenuation	-5	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	57.4	dB(A)
Impact inside open window	49.9	dB(A)
Rw to achieve 40 dB inside	20.9	

Deliveries	87	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	51.4	dB(A)
Impact inside open window	43.9	dB(A)

Waste Collection	97	dB(A) @ 1m
Distance source to receiver	80	m
Distance attenuation	-38.1	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	61.4	dB(A)
Impact inside open window	53.9	dB(A)

Commercial A/C unit	70	dB(A) @ 1m
Distance to dwelling	90	m
Distance attenuation	-39	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	0	dB(A)
Impact at Façade	33.4	dB(A)
Impact inside	25.9	dB(A)

Refrigeration plant	75	dB(A) @ 1m
Distance to dwelling	90	m
Distance attenuation	-39	dB(A)
Façade reflection	2.5	dB(A)
Barrier Screening	0	dB(A)
Impact at Façade	38.4	dB(A)
Impact inside	30.9	dB(A)



**ONSITE CONSTRUCTION ACTIVITY NOISE IMPACTING DWELLING FAÇADES:**

**Dwellings Due North**

Excavator	98	dB(A) @ 1m
Distance source to receiver	40	m
Distance attenuation	-32.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	68.5	dB(A)

Front end loader	95	dB(A) @ 1m
Distance source to receiver	40	m
Distance attenuation	-32.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	65.5	dB(A)

Truck unloading	85	dB(A) @ 1m
Distance source to receiver	40	m
Distance attenuation	-32.0	dB(A)
Building screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	55.5	dB(A)

Hammering scaffold	110	dB(A) @ 1m
Distance source to receiver	40	m
Distance attenuation	-32.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	80.5	dB(A)

Compressed air nail gun	92	dB(A) @ 1m
Distance source to receiver	40	m
Distance attenuation	-32.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	62.5	dB(A)

Jack hammering	103	dB(A) @ 1m
Distance source to receiver	40	m
Distance attenuation	-32.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	73.5	dB(A)

**Dwellings Due East**

Excavator	98	dB(A) @ 1m
Distance source to receiver	25	m
Distance attenuation	-28.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	72.5	dB(A)

Front end loader	95	dB(A) @ 1m
Distance source to receiver	25	m
Distance attenuation	-28.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	69.5	dB(A)

Truck unloading	85	dB(A) @ 1m
Distance source to receiver	25	m
Distance attenuation	-28.0	dB(A)
Building screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	59.5	dB(A)

Hammering scaffold	110	dB(A) @ 1m
Distance source to receiver	25	m
Distance attenuation	-28.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	84.5	dB(A)

Compressed air nail gun	92	dB(A) @ 1m
Distance source to receiver	25	m
Distance attenuation	-28.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	66.5	dB(A)

Jack hammering	103	dB(A) @ 1m
Distance source to receiver	25	m
Distance attenuation	-28.0	dB(A)
Barrier Screening	0	dB(A)
Façade reflection	2.5	dB(A)
Impact at façade	77.5	dB(A)



## Bilambil Road

15 seconds

car pass LAeq 59.0 794328.2347 11914923.5 70.8 SEL

794328.2347

LAeq (pass) = 59.0 dB(A) 15 sec LAeq

Existing	SEL x number of cars =	2525963786	94.0242712	3600 seconds per hour
Additional	SEL x number of cars =	190638776.3	82.8021124	212 number of cars per hour
				16 number of cars per hour

### Existing Scenario

Existing LAeq 1hr = 61.0 dB(A) at 10m façade corrected

### Completed Development Scenario

Completed LAeq 1hr = 61.3 dB(A) at 10m façade corrected

**0.3 difference**

## Urliup Road

15 seconds

car pass LAeq 59.0 794328.2347 11914923.5 70.8 SEL

794328.2347

LAeq (pass) = 59.0 dB(A) 15 sec LAeq

Existing	SEL x number of cars =	262128317.5	84.1851394	3600 seconds per hour
Additional	SEL x number of cars =	309788011.5	84.9106461	22 number of cars per hour
				26 number of cars per hour

### Existing Scenario

Existing LAeq 1hr = 51.1 dB(A) at 10m façade corrected

### Completed Development Scenario

Completed LAeq 1hr = 54.5 dB(A) at 10m façade corrected

**3.4 difference**

## Hogans Road

15 seconds

car pass LAeq 59.0 794328.2347 11914923.5 70.8 SEL

794328.2347

LAeq (pass) = 59.0 dB(A) 15 sec LAeq

Existing	SEL x number of cars =	428937246.8	86.3239376	3600 seconds per hour
Additional	SEL x number of cars =	214468623.4	83.3136376	36 number of cars per hour
				18 number of cars per hour

### Existing Scenario

Existing LAeq 1hr = 53.3 dB(A) at 10m façade corrected

### Completed Development Scenario

Completed LAeq 1hr = 55.0 dB(A) at 10m façade corrected

**1.8 difference**

