MARSHALL DAY Acoustics

FLEMINGTON DEVELOPMENT
ASSESSMENT OF NOISE EFFECTS REPORT

Rp 002 R01 20180955 | 29 July 2019

MARSHALL DAY Acoustics

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Project: **FLEMINGTON DEVELOPMENT**

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Report No.: **Rp 002 R01 20180555**

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EXECUTIVE SUMMARY

Lincoln Developments Limited has engaged Marshall Day Acoustics (**MDA**) to assess operational and construction noise effects arising from a proposed new integrated retail and residential development on Birchs Road, Lincoln.

The development consists of a supermarket, a preschool and associated car parking. These facilities will be accompanied by a new residential area to the east of the site.

The proposed development will result in operational noise generated by heavy goods vehicle deliveries, customer car park movements, the preschool outdoor area and rooftop mechanical/refrigeration plant.

We have made several recommendations intended to mitigate noise which may be incorporated as conditions of consent including:

- Service vehicles (rubbish, recycling etc) are to be restricted to daytime hours only (0700-2200hrs);
- Supermarket deliveries are to be restricted to daytime hours only (0700-2200hrs);
- Prior to the issue of a building consent, the applicant will submit a report from a suitably qualified person demonstrating that the mechanical services design for the facility will ensure compliance with the night-time noise standards applicable to the surrounding Living Zones;
- A 2.0 m high noise control fence is to be provided at the supermarket loading bay and a minimum 1.8 m high noise control fence to the preschool outdoor play area and vehicle access;
- The preschool is to be designed to ensure noise levels are kept at reasonable levels, especially in areas designated for sleep or rest; and
- Noise from construction activities should be measured and assessed in accordance with New Zealand Standard NZS 6803: 1999 “Acoustics – Construction Noise”.

Cumulative noise level calculations during both peak and off-peak hours are demonstrated to comply with the proposed daytime noise criteria at nearby assessment locations.

It is our view that any potential adverse noise effects will be acceptable in nature.

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1.0 INTRODUCTION

Lincoln Developments Limited has engaged Marshall Day Acoustics (**MDA**) to assess operational and construction noise effects arising from a proposed new integrated retail and residential development on Birchs Road, Lincoln.

This report provides:

- An overview of the operation with regards to noise generation;
- Details of the existing noise environment;
- A summary of appropriate noise assessment criterion;
- Predicted noise levels for the activity; and
- An assessment of the potential adverse noise effects at nearby noise sensitive receivers.

A glossary of acoustic terminology used in this report can be found in Appendix A.

1.1 Site Description

1.2 Location and Zoning

The site is located on Birchs Road in Lincoln as depicted in Figure 1.

The application site is within the Living Zone (LZ) in the Selwyn District Plan with land further to the north and east zoned Inner Plains (IP).

Figure 1: Site Location and Land Use Zoning

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1.1 The Proposed Activity

The proposal includes a supermarket, preschool and associated car parking. These facilities will be accompanied by a new residential area at the east end of site comprising approximately 41 residential sections (17 lots and the remainder dependant on a future comprehensive development).

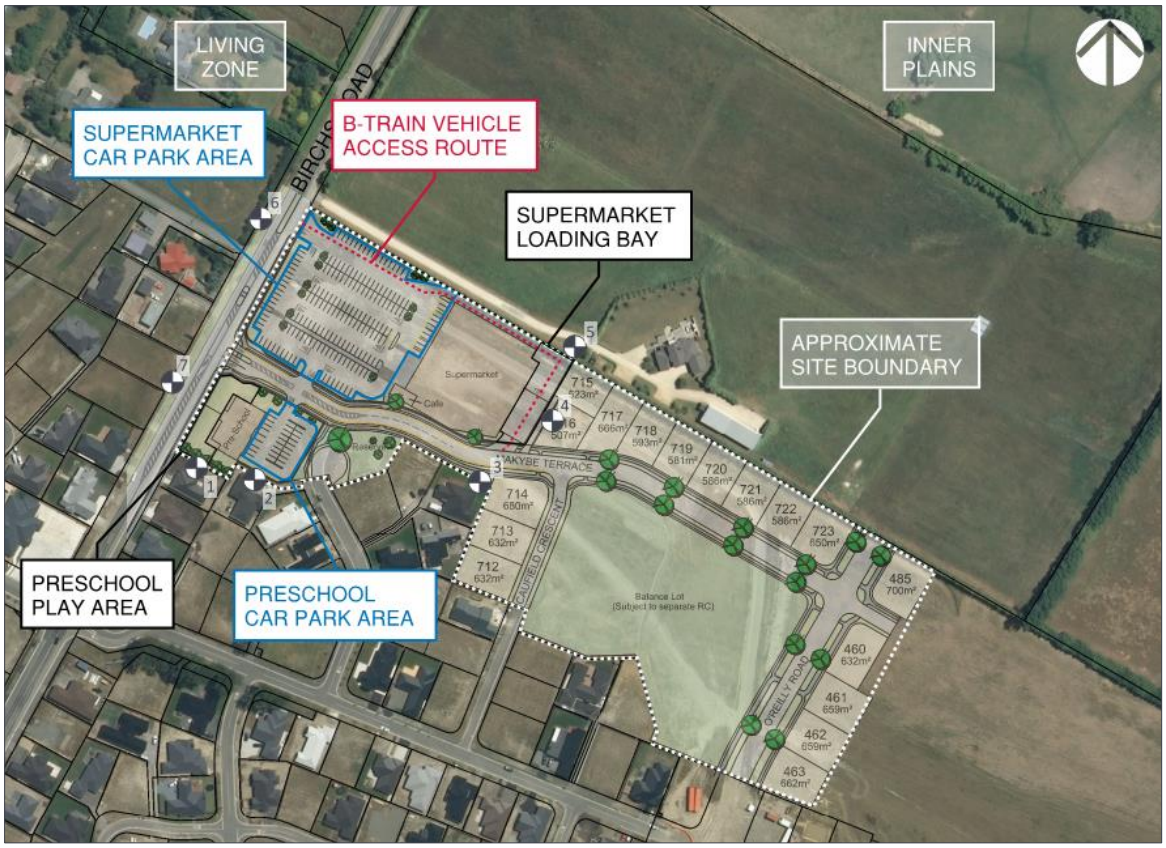
Plans showing the layout of both the supermarket and preschool can be seen in Appendix B and Appendix C.

We understand that noise generating aspects of the proposal include the following:

- Heavy vehicle movements (deliveries and service vehicles to the supermarket);
- Light vehicle movements (staff and customer vehicles for both supermarket and preschool);
- Rooftop mechanical/refrigeration plant (including supermarket emergency generators); and
- Preschool associated noise sources i.e. children playing outdoors (preschool only).

Approximate activity routes/areas and assessment locations can be seen in Figure 2.

Figure 2: Site layout and assessment locations



1.2 Supermarket Operation

We understand that the supermarket is proposed to be 2,975m^2 GFA (including ancillary offices).

1.2.1 Hours of Operation

Details of the exact opening hours are currently unknown, however we anticipate that the supermarket will only be in use between 0700 – 2200 hours, daily.

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1.2.2 Light Vehicles and Carparking

The Stantec Traffic Assessment Report (dated 25 July 2019) predicts 335 light vehicle movements during peak hour trips (trips include both inward and outbound travel) for the supermarket and associated retail.

This peak hour traffic flow is equivalent to 84 vehicle movements per 15 minute period. Peak hour will typically occur between 1700 to 1800 hours during the daytime.

Off-peak traffic movements are based on 50 vehicle movements per 15 minute period, or 200 vehicles per hour.

Outside of the supermarket's operational hours, we understand there will be a small number of light vehicle movements associated with night-fill and cleaning staff. We expect that noise from those vehicle movements will be insignificant due to the small number of movements and because parking will occur close to the building, rather than the residential boundary. We have not discussed this further.

1.2.3 Heavy Vehicles and Deliveries

In terms of heavy vehicle activity, we understand that a total of four B-train deliveries are anticipated to service the site on a daily basis. Delivery and service vehicles will be required to visit the site between 0700 – 2000 hours only. Delivery vehicles will not coincide with peak-hour traffic movements.

1.2.4 Mechanical Plant and Emergency Generator

Whilst details of any proposed mechanical plant have not yet been finalised, a discussion of mechanical plant noise effects is included in Section 4.3.

1.3 Preschool Operation

We understand that the preschool is expected to have a role size of up to 100 children.

1.3.1 Hours of Operation

Details of the exact opening hours are currently unknown however, we anticipate that the preschool will only be in use between 0700 – 1800 hours on weekdays only.

We note that staff may be present on-site outside these hours to carry out administrative tasks or prepare in advance of children arriving at the facility.

1.3.2 Light Vehicles and Carparking

The Stantec Traffic Assessment Report (dated 25 July 2019) estimates 60 light vehicle movements during peak hour. Due to the relatively small number of vehicle movements we have used 25 vehicle movements per 15 minutes to and from the Preschool as a conservative estimate during peak hour.

1.3.3 Outdoor Play Area

Use of the outdoor play area will occur at various times throughout the day. The exact times of use for the play area are currently unknown but we anticipate that the play area can only be used between 0700 – 1800 hours.

Typical noise generated will be from children playing outdoors.

1.3.4 Mechanical Plant

Whilst details of any proposed mechanical plant have not yet been finalised, a discussion of mechanical plant noise effects is included in Section 4.3.

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1.3.5 Preschool Noise Exposure

Noise levels both within the preschool building and in outdoor play areas should be designed to ensure that the proposed preschool provides adequate protection from high levels of noise exposure. This is especially important in areas which are designated for sleep or rest. This can be achieved during the design phase of the project. World Health Organisation (WHO) guidelines should be considered as maximum noise exposure levels for the preschool.

2.0 EXISTING NOISE ENVIRONMENT

2.1 Attended Noise Survey

A survey was carried out on 21 May 2018 commencing at approximately 0700 hours - 0800 hours, during which existing ambient noise levels were measured. The measurement position is shown in Figure 1 above.

It should be noted that measurements were undertaken prior to the proposed reduction in speed limit to 50 kph. It is acknowledged that traffic speed and associated noise levels are likely to reduce gradually as the development intensifies.

Results of the survey are summarised in Table 1. Further details of the survey are provided in Appendix D.

Table 1: Measured ambient noise levels

Time	Measured Level (dB)			Comments
	L_{A10}	$L_{Aeq\ (15\ min)}$	L_{Amax}	
0708	76	71	86	Dominated by constant traffic
0724	76	72	84	Dominated by constant traffic
0740	76	71	83	Dominated by constant traffic

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3.0 NOISE PERFORMANCE STANDARDS

We have considered noise arising from the construction and operation of this development against the provisions of the District Plan and other relevant standards and guidance as described below.

We understand that Selwyn District Council have recently initiated a plan review process. Any proposed changes are yet to be notified. We have therefore not considered any future amendments to the District Plan.

3.1 Selwyn District Plan

The operative Selwyn District Plan provides noise standards for activities within the Living Zone in Chapter 10.6 of the Township Volume and provides noise standards for activities within the Rural Zone in Chapter 9.16 of the Rural Volume.

We have summarised noise standards for activities in both zones in Table 2 and Table 3.

Table 2: Living Zone noise limits

Time Period	Noise Limits
Daytime (0730 – 2000 hrs)	55 dB L_{A10} 85 dB L_{Amax}
Night-time (2000 – 0730 hrs)	35 dB L_{A10} 70 dB L_{Amax}

Note: Sound levels are to be assessed at any point beyond the boundary of the site from which the source of any noise is situated.

Rule 10.6.1 of the District Plan excludes noise from educational activities from the noise limits within the *Living Z* zone.

Rule 10.6.3 of the District Plan states that any activity which is *not* residential, spiritual or educational which does not comply with Rule 10.6.1 shall be a discretionary activity.

Table 3: Rural Zone noise limits

Time Period	Noise Limits	
	Any Living Zone Boundary	Other Locations*
Daytime (0730 – 2000 hrs)	55 dB L_{A10} 85 dB L_{Amax}	60 dB L_{A10} 85 dB L_{AFmax}
Night-time (2001 – 0729 hrs)	40 dB L_{A10} 70 dB L_{Amax}	45 dB L_{A10} 70 dB L_{AFmax}

Noise limits assessed at the notional boundary[1] of any dwelling, rest home, hospital, or classroom in any educational facility except where that dwelling, rest home, hospital or classroom is located within a Living Zone.

Both the Living and Rural Zone rules require noise to be measured in accordance with New Zealand Standard NZS 6801:1999 *"Acoustics - Measurement of Environmental Sound"* and assessed in accordance with the provisions of New Zealand Standard NZS 6802:1991 *"Assessment of Environmental Sound"*.

[1] The notional boundary is defined in the Township volume of the Selwyn District Plan as 'a line 20m from any side of a rural dwelling or the legal boundary where this is closer to the dwelling'.

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The rules further stipulate that '*adjustments for special audible characteristics, if present, as provided for in Clause 4.3 and 4.4 of the Standard shall apply and will have the effect of imposing a numerical noise limit 5 dBA more stringent than the L_{10} numerical limits stated in the rules*'.

Beyond these rules, we have not found any specific guidance within the Plan with respect to exemptions or restrictions that would apply to the proposed development.

3.2 Review of Selwyn District Plan Noise Standards

We understand that the current Selwyn District Plan is under review. Although no confirmation of the proposed Plan's approach to noise has yet been published, we also understand that the adoption of best practice guidance is likely.

Current accepted best practice guidance is based around a combination of

- New Zealand Standard NZS 6802:2008 "Acoustics - Environmental Noise"; and
- The World Health Organisation (WHO) Guidelines for Community Noise (Berglund, Lindvall and Schwela, 1999).

3.3 NZS 6802:2008 Desirable Upper Limits

New Zealand Standard NZS 6802:2008 *"Acoustics - Environmental Noise"* refers to the following desirable upper limits of sound exposure at or within the boundary of any residential land:

- Daytime: 55 dB $L_{Aeq\,(15\,min)}$
- Night-time: 45 dB $L_{Aeq\,(15\,min)}$ and 75 dB L_{AFmax}

3.4 World Health Organisation (WHO)

World Health Organisation Guideline Values for Community Noise (Berglund, Lindvall and Schwela, 1999) give guidelines for environmental noise exposure. For community or environmental noise, the critical health effects (those effects which occur at the lowest exposure levels) are: sleep disturbance; annoyance; and speech interference/communication disturbance.

The WHO guideline values for these three critical health effects for community or environmental noise are presented in Table 4. These guideline values are the exposure levels that represent the onset of the effect for the general population. That is, at these noise levels, critical health effects only begin to appear in a small number of vulnerable or sensitive groups.

Table 4: WHO Guideline Values for the critical health effects of community or environmental noise

Specific Environment	Critical health effect(s)	dB L_{Aeq}	Time base (hours)	dB L_{AFmax}
Outdoor living area	Serious annoyance, daytime & evening	55	16	-
	Moderate annoyance, daytime & evening	50	16	-
Dwellings, indoors Inside bedrooms	Speech intelligibility and moderate annoyance, daytime & evening	35	16	-
	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values) night-time	45	8	60

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3.5 NZS 6803:1999 Construction Noise Standard

While there is no reference to construction in the District Plan, compliance with the noise limits of NZS 6803:1999 (Tables 2 and 3) is considered best practice. The relevant sections of the Standard are provided in Appendix E for reference.

We consider that noise from construction activities both assessed and managed in accordance with New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"* will result in acceptable adverse noise effects. We recommend addressing construction noise in a condition of consent and have suggested appropriate wording in Section 6.0.

3.6 National Planning Standards (NPS)

National Planning Standards (NPS) were introduced as part of the 2017 amendments to the Resource Management Act 1991 (RMA). The NPS aim to help provide more consistency in the creation, structure, form, content, metrics, definitions and delivery of district and regional plans and policy statements.

The latest National Planning Statements, which were introduced in April 2019, must be implemented by regional and unitary councils in any new plans or within 10 years (whichever is earlier). The default timeframes are set out in sections 58I and 58J of the RMA.

The NPS requires the use of L_{Aeq} over L_{A10} as an assessment metric for noise levels as well as the adoption of both New Zealand Standards NZS 6801:2008 "Acoustics – Measurement of Environmental Sound" and NZS 6802:2008 *"Acoustics - Environmental Noise"*.

3.7 Discussion of Noise Criteria

3.7.1 Assessment Metrics (L_{Aeq} vs L_{A10})

The operative District Plan references New Zealand Standards NZS 6801:1999 and NZS 6802:1991. The noise performance standards include a statistical noise percentile level ($L_{A10,\,t}$) as the main noise descriptor against which both compliance and the assessment of noise effects is based.

These referenced standards have since been superceded by NZS 6801:2008 and NZS 6802:2008 which use the L_{Aeq} as the main descriptor of sound in replacement to L_{A10}. This change to L_{Aeq} is consistent with international practice and supported by research relating noise level to amenity and, as discussed above, is required by the National Planning Standards that Selwyn District must implement during the District Plan review.

In terms of compliance with the operative District Plan noise levels, the difference between L_{A10} and L_{Aeq} varies for specific sources of noise. For example, for steady state mechanical plant noise such as a fan or electric motor, the L_{10} and L_{eq} typically differ by less than 1dB, whereas for traffic noise a 3 dB difference is more typical.

3.7.2 Prescribed Time Frame (Daytime / Night-time)

The operative District Plan defines 0700 - 0730 hrs and 2000 - 2200 hours as part of the night-time period. However, these are not considered within the night-time when assessing noise using NZS 6802:2008 or WHO guidelines.

3.7.3 Assessment Criteria

Based on the above we recommend that noise criteria consistent with NZS 6802:2008 and WHO guidelines are adopted for this site, in line with current best practice.

We consider the following noise levels, shown in Table 5 overleaf, will result in acceptable noise effects at any Living Zone boundary.

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Table 5: Assessment Noise Criteria

Time Period	Noise Limits Living Zone Boundary
Daytime (0700 – 2200 hrs)	55 dB $L_{Aeq\ (15\ min)}$
Night-time (2000 – 0700 hrs)	45 dB $L_{Aeq\ (15\ min)}$ 75 dB L_{Amax}

Whilst the measured ambient noise levels are considerably higher than the permitted activity noise limits, this is not justification for the proposed activity to exceed the noise standards. However, even allowing for ambient noise dominated by traffic to decrease somewhat as vehicle speed on Birchs Road decreases, this does suggest that any potentially adverse noise effects generated by vehicles associated with the proposed activity are likely to be masked and therefore mitigated to some degree by existing vehicle noise.

Therefore, we consider that noise effects arising from the application will be acceptable, such that the noise limits of Table 5 are achieved.

4.0 PREDICTED NOISE LEVELS

4.1 Operational Scenarios

The operational scenarios for both the supermarket and preschool used for this assessment are based on a typical worst-case 15 minute period.

We understand that supermarket B-train deliveries will be scheduled so that deliveries do not coincide with peak hours.

Noise sources which are part of our assessment for each operational period (e.g. supermarket delivery or preschool drop offs) are detailed in Table 6 and Table 7.

Table 6: Supermarket Operation (typical worst case 15-minute)

Noise source	No. of (Daytime)
Heavy vehicle (e.g. B-Train Movement)	2 deliveries
Peak light vehicle movement (e.g. car)	85 vehicle movements
Off-peak light vehicle movement (e.g. car)	50 vehicle movements

Table 7: Preschool Operation (typical worst case 15-minute)

Noise source	No of (Daytime)
Light vehicle movement (e.g. car)	25 vehicle movements
Preschool breaktime	Inclusion of groups of children under and over two years old.

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4.2 Noise Sources

Source data has been derived from standard data gathered by MDA over several years. We have used the noise levels detailed in Table 8 for the basis of our predictions.

No adjustments for special audible characteristics (SAC) have been applied to any noise sources.

Table 8: Noise levels of plant and equipment

Noise source	Source Location	Noise Level dB		Measurement Reference Distance (m)
		L_{Aeq}	L_{AE}	
Heavy vehicles (B-train)	Supermarket loading dock area and access route	-	88	10
Light vehicles (customer and staff cars)	Vehicle access routes / light vehicle parking	-	70	10
Children between 2 and 5 years old	Preschool outdoor area	59	-	10
Children under 2 years old	Preschool outdoor area	49	-	10

Noise prediction locations and approximate noise generating activity locations can be seen in Figure 2.

4.3 Mechanical Plant

4.3.1 Mechanical Plant (Supermarket and Preschool) and Emergency Generator (Supermarket)

Noise from external mechanical plant can be designed to achieve appropriate noise levels. As some plant may be at roof level, this will likely require a parapet wall or other noise attenuating screen.

We understand that, although the exact details are not confirmed at this stage, the proposed plant for both the supermarket and preschool are likely to be similar to the equipment used on other recent developments with which we have been involved. In our experience, noise from such plant can be adequately controlled through engineering means and / or running fans at lower duty during the night-time period where required.

An emergency generator set is proposed, which we understand will be within a dedicated plant room.

Given the separation distances to nearby noise sensitive receivers, we are confident that appropriate noise control can be provided.

We recommend that an appropriately worded condition of consent be included to ensure that, when considered cumulatively, noise levels from mechanical services plant and emergency genset are appropriately controlled. Provided this plant achieves the required noise levels, we expect noise emissions will be acceptable.

4.4 Calculation Methodology

Computer noise modelling was undertaken to calculate noise levels from the Supermarket (deliveries and light vehicle movements) and Preschool (light vehicle movements) using the SoundPLAN v8.1 suite of noise modelling software. This software implements calculation procedures described in International Standard ISO 9613-2:1996 *"Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation"*. This Standard assumes "supportive" propagation conditions such as moderate downwind (from source to receiver) or under a temperature inversion.

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This is a worst-case propagation scenario and effectively represents the wind blowing in all directions simultaneously.

This method also considers a range of factors affecting the sound propagation including:

- The magnitude of the noise sources; and
- The distance between source and receiver.

4.5 Predicted Noise Levels

Based on the noise source levels discussed in Section 4.2 we have predicted noise levels at nearby site boundary locations. Noise level predictions can be found in Table 9, Table 10 and Table 11.

No duration adjustments have been applied to representative sound levels as per NZS 6802:2008 where sounds are not present for the whole of the prescribed time frame.

As the operation of the proposed activities is understood to occur during the daytime hours, no assessment against night-time noise criteria has been undertaken.

Table 9: Predicted Daytime Noise Levels (off-peak) - Supermarket Heavy Goods Deliveries

ID	Property Address	Heavy Good Vehicles
		dB $L_{Aeq\ (15\ min)}$
1	587 Birchs Road	45
2	11 Caulfield Crescent	46
3	12 Caulfield Crescent	53
4	26 Caulfield Crescent	53
5	555 Birchs Road	54
6	560 Birchs Road	53
7	570 Birchs Road	47

In summary, the results in Table 9 demonstrate that heavy goods vehicle deliveries to the site comply with the proposed daytime noise criteria at nearby assessment locations.

Table 10: Predicted Daytime Noise Levels (peak and off-peak) – Supermarket Light Vehicle Movements

ID	Property Address	Peak	Off-peak
		dB $L_{Aeq\ (15\ min)}$	dB $L_{Aeq\ (15\ min)}$
1	587 Birchs Road	46	<45
2	11 Caulfield Crescent	46	<45
3	12 Caulfield Crescent	<45	<45
4	26 Caulfield Crescent	<45	<45
5	555 Birchs Road	<45	<45
6	560 Birchs Road	52	50
7	570 Birchs Road	48	46

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In summary, the results in Table 10 demonstrate that light vehicle movements during peak hours comply with the proposed daytime noise criteria at nearby assessment locations.

Table 11: Predicted Daytime Noise Levels (peak) - Preschool

ID	Property Address	Light Vehicles	Children Playing Outdoors
		dB $L_{Aeq\ (15\ min)}$	dB $L_{Aeq\ (15\ min)}$
1	587 Birchs Road	<45	47
2	11 Caulfield Crescent	<45	<45
3	12 Caulfield Crescent	<45	<45
4	26 Caulfield Crescent	45	<45
5	555 Birchs Road	45	<45
6	560 Birchs Road	<45	<45
7	570 Birchs Road	<45	47

In summary, the results in Table 11 demonstrate that light vehicle movements and children playing in outdoor areas during peak hours comply with the proposed daytime noise criteria at nearby assessment locations

4.6 Cumulative Noise Discussion

We have assessed two scenarios, a typical peak scenario including peak traffic from both the supermarket and preschool and use of the outdoor play area, and a typical off-peak scenario including B-train deliveries, off-peak traffic for the supermarket and use of the outdoor play area.

Noise levels for the two scenarios are summarised in Table 12 below.

Table 12: Calculated Daytime Noise Levels – Cumulative Noise (peak and off-peak)

Property Address	Peak	Off-peak	Noise Criteria
	dB $L_{Aeq\ (15\ min)}$	dB $L_{Aeq\ (15\ min)}$	dB L_{Aeq}
587 Birchs Road	50	50	55
11 Caulfield Crescent	49	49	55
12 Caulfield Crescent	46	53	55
26 Caulfield Crescent	45	53	55
555 Birchs Road	46	54	55
560 Birchs Road	53	55	55
570 Birchs Road	51	51	55

As can be seen in Table 12, worst case cumulative noise level calculations during both peak and off-peak hours are demonstrated to comply with the proposed daytime noise criteria at nearby assessment locations.

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5.0 ASSESSMENT OF NOISE EFFECTS

With the adoption of the recommendations identified below, we consider that noise from the proposed new integrated retail and residential development will result in acceptable noise effects at nearby residential dwellings.

During the daytime, our predicted noise levels indicate that noise from the activity will comply with the acceptable noise criteria identified in Section 3.6.

On the basis of the above, we do not anticipate any adverse noise effects at any dwellings from the activity.

6.0 RECOMMENDATIONS

To ensure that noise effects will be acceptable we make the following recommendations to control and mitigate noise. These can be formulated into conditions of consent if desired.

- Service vehicles (rubbish, recycling etc) are to be restricted to daytime hours only (0700-2000hrs).
- Supermarket deliveries are to be restricted to daytime hours only (0700-2000hrs).
- Prior to the issue of a building consent, the applicant will submit a report from a suitably qualified person demonstrating that the mechanical services design for the facility will ensure compliance with the night-time noise standards applicable to the surrounding Living Zones.
- As a minimum, 2.0m and 1.8m high noise control fences are to be provided as indicated respectively in Appendix F and Appendix G. (Noise control fence should be constructed in general accordance with MDA standard fence detail shown in Appendix H).
- The preschool is to be designed such that internal noise levels are kept at or below appropriate levels, especially in areas designated for sleep or rest.
- Noise from construction activities should be measured and assessed in accordance with New Zealand Standard NZS 6803: 1999 “Acoustics – Construction Noise”.

These recommendations assume that the noise criteria proposed in Table 5 of Section 3.7 above are applied to the application.

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APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
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)
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
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.
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the 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.
$L_{A10\,(t)}$	The A-weighted noise level equalled or exceeded for 10% of the measurement period. This is commonly referred to as the average maximum 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.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
NZS 6801:2008	New Zealand Standard NZS 6801:2008 *"Acoustics – Measurement of environmental sound"*
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics – Environmental Noise"*
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*

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APPENDIX B SUPERMARKET SITE LAYOUT

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APPENDIX C PRESCHOOL SITE LAYOUT

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APPENDIX D NOISE SURVEY DETAILS

The key details of the noise survey are as follows:

Date:	21 May 2018, 0700 - 0755 hrs
Personnel:	Alex West, Marshall Day Acoustics
Weather:	5-6 °C, Broken cloud, <3 m/s wind
Instrumentation:	Brüel & Kjær Type 2250 analyser, serial 2683036, calibration due 04/10/2018 Brüel & Kjær Type 4231 calibrator, serial 2574264, calibration due 05/10/2018
Calibration:	Field calibration of the equipment was carried out before measurements, and the calibration checked after measurements. Observed change less than 0.1 dB.

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APPENDIX E NZS 6803:1999 TABLES 2 AND 3

NZS6803:1999 sets out the following noise limits:

"Residential zones and dwellings in rural areas:

Table 2 – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas

Time of week	Time period	Duration of work					
		Typical duration (dBA)		Short-term duration (dBA)		Long-term duration (dBA)	
		L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

"Industrial or commercial areas:

Table 3 – Recommended upper limits for construction noise received in industrial or commercial areas for all days of the year

Time period	*Duration of work*		
	Typical duration	*Short-term duration*	*Long-term duration*
	L_{eq} (dBA)	*L_{eq} (dBA)*	*L_{eq} (dBA)*
0730-1800	*75*	*80*	*70*
1800-0730	*80*	*85*	*75*

Notes in the standards to the tables above:

7.2.5

The night time limits in Table 2 shall apply to activities carried out in industrial or commercial areas where it is necessary to prevent sleep interference, specifically where there are residential activities, hospitals, hotels, hostels, or other accommodation facilities located within commercial areas. The limits in Table 2 may also be used to protect other specific noise sensitive activities at certain hours of the day.

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7.2.6

One major factor which should be considered is whether there is a relatively high background sound level (L_{90}) due to noise from sources other than construction work at the location under investigation. In such cases limits should be based on a determination of the existing level of noise in the area (a "background plus" approach).

7.2.7

Where there is no practicable method of measuring noise outside a building, the upper limits for noise measured inside the building shall be the levels stated in tables 2 and 3 minus 20 dBA. This is considered to be a typical value for the sound reduction normally achieved in New Zealand buildings with doors and windows closed."

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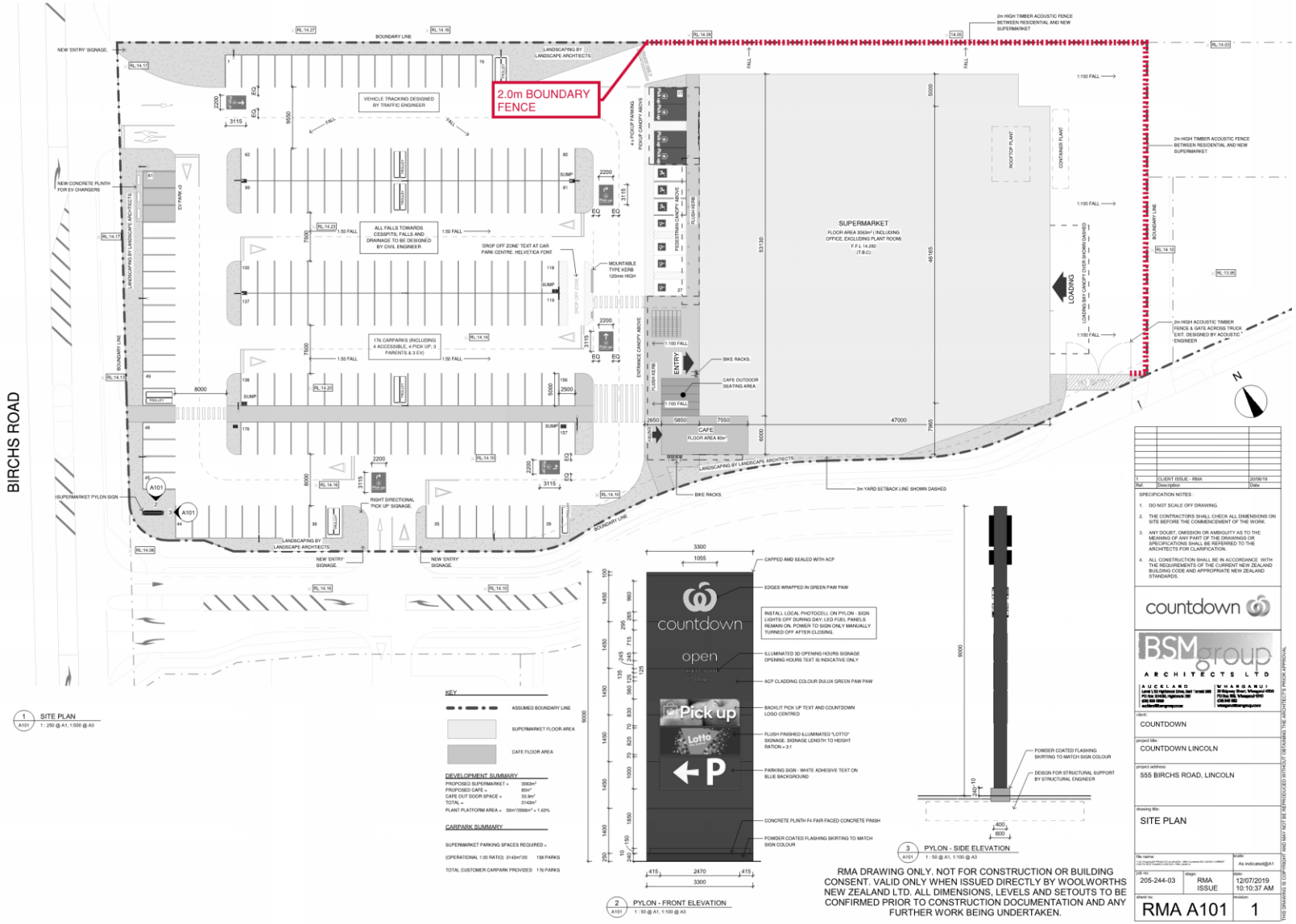
APPENDIX F SUPERMARKET BOUNDARY FENCE



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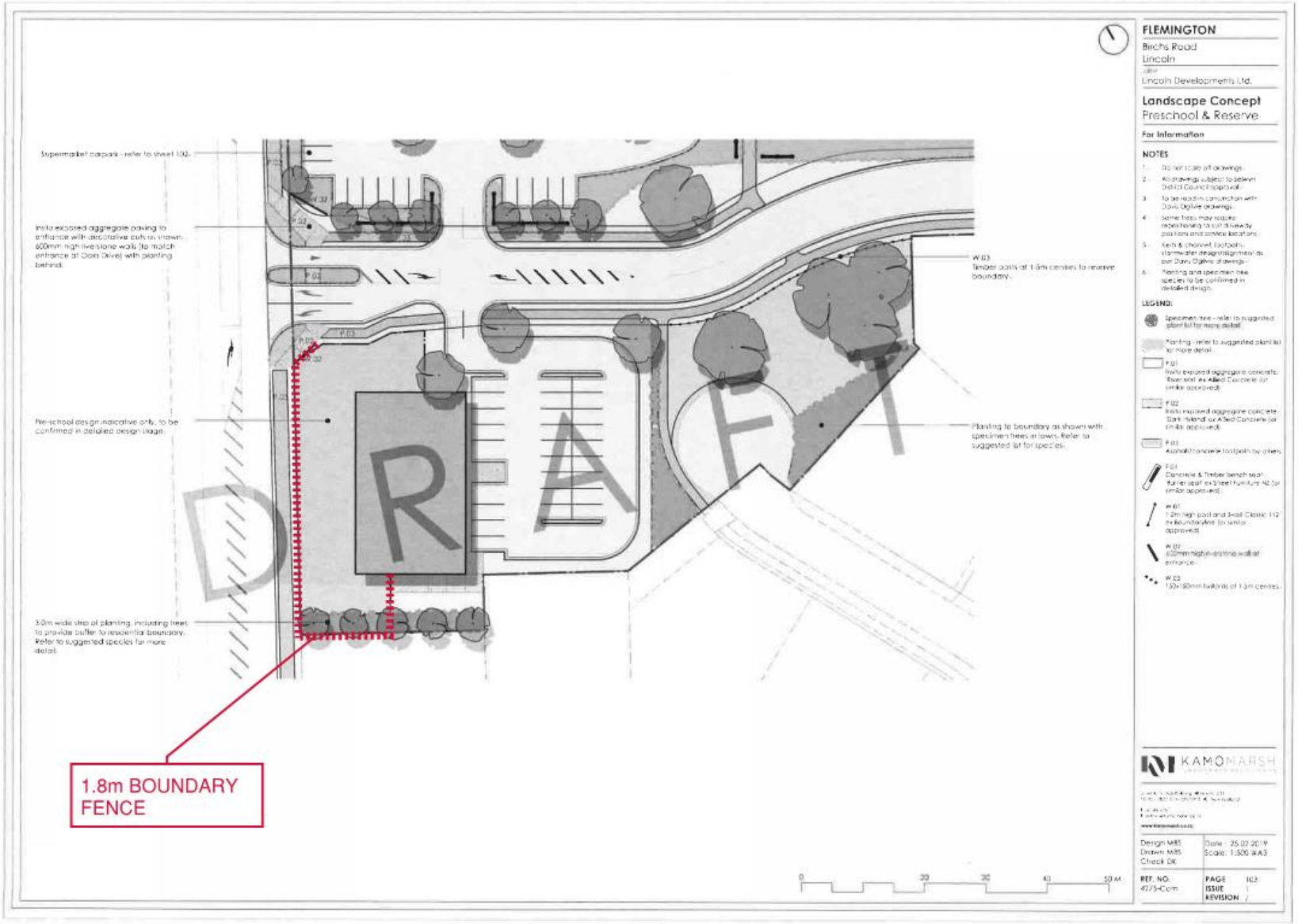
APPENDIX G PRESCHOOL BOUNDARY FENCE



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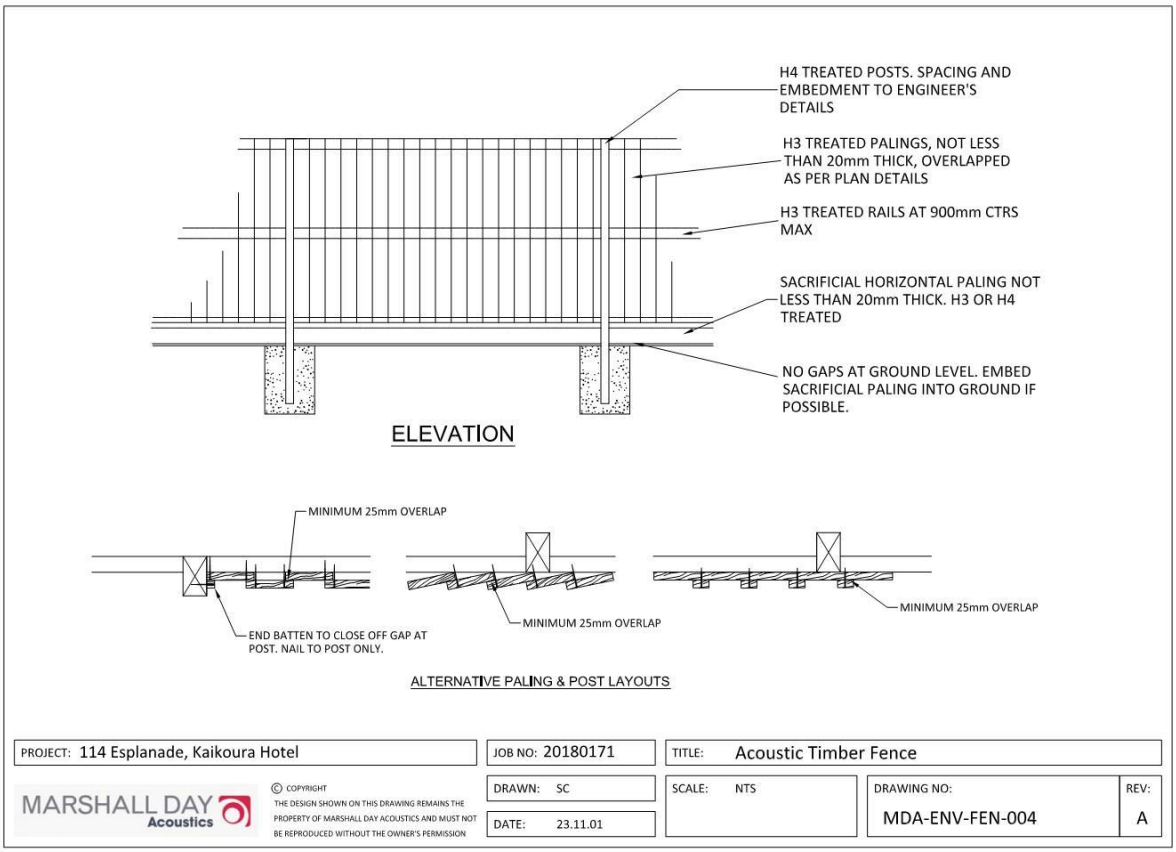
APPENDIX H ACOUSTIC FENCE DESIGN



Type	**Constructions** [Refer to Notes (1) to (4) below]	
Timber [6]	Supporting Structure:	Timber, steel or aluminium posts and rails.
	Cladding Option 1:	*Plywood* panelling [5] with a minimum surface mass of 10 kg/m^2 (18mm minimum thickness).
	Cladding Option 2:	*Timber Palings* (minimum thickness of 20-25mm) either overlapped or close-boarded with battens over gaps between palings [6].

Notes:

(1). Any proposed acoustic screen shall be designed and certified by a suitably qualified structural engineer and relevant consents sought from the local council and other interested parties prior to its construction

(2). Acrylic and glass sections can be used to provide an acoustic screen while retaining visual transparency

(3). For all fence constructions, ensure that there are no gaps in the screen or between the ground and the bottom of the screen

(4). Any proposed acoustic screen shall be designed with input from a suitably qualified acoustic consultant

(5). Grooved plywood, manufactured to resemble a timber paling fence design, can be used to achieve a similar look to a close boarded fence design

(6). Plywood panelling is preferred to a close boarded fence design for long term durability

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