URS

Report

Acoustics Assessment

NEW ZEALAND

Memorial Avenue

Private Plan Change

6 August 2014
42197100/001/F

Prepared for:
Memorial Avenue Investments Ltd

Prepared by URS New Zealand Limited

DOCUMENT PRODUCTION / APPROVAL RECORD				
Issue No.	**Name**	**Signature**	**Date**	**Position Title**
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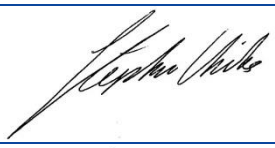
Checked by	Dr Stephen Chiles		8/8/14	Principal, Acoustics Engineer
Approved by	Dr Stephen Chiles		8/8/14	Principal, Acoustics Engineer

Report Name:
Memorial Avenue
Private Plan Change
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Report No.
42197100/001/F

Status:
Final

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DOCUMENT REVISION RECORD		
Issue No.	**Date**	**Details of Revisions**
D	27/11/2009	Issued under URS job no. 42170687
E	6/8/2014	Draft issued with updated ODP, existing environment, and regulatory framework
F	8/8/2014	Final issued

Document Delivery.
URS New Zealand provides this document in electronic format and requests that the client ensures the integrity of this electronic information is maintained. Storage of this electronic information should at a minimum comply with the requirements of the Electronic Transactions Act 2002.

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APPENDICES

1 INTRODUCTION

URS has been appointed to assess the potential noise effects that may arise from the proposed rezoning of the Memorial Avenue Investment Limited (MAIL) land, the McVicar/Canterbury Trustees land and the International Motor Inn land, collectively the 'plan change area', all bounded by Memorial Avenue (north), Russley Road (west) and Avonhead Road (south). Within the Christchurch City Plan the land is currently zoned Rural 5, which is described as a rural zone with airport influences. The proposed plan change is to create an Industrial Park zone that would allow for a mix of activities including industrial, commercial, retail, and travellers' accommodation. Permanent residential activity would not be permitted in the proposed zone.

Section 2 of this report describes the existing acoustic environment on the land and Section 3 goes on to consider the proposed activity on the land in terms of noise both to and from neighbouring activities.

The noise assessment report has considered development in the areas shown in the outline development plan. The noise assessment report does not consider a specific layout but is investigating the framework required to enable a range of different activities on the land. To this end, the City Plan already provides a detailed system for noise assessment and control which is discussed in Section 4 of this report. This report discusses how the proposed zone could fit within that existing assessment system and considers the resulting noise effects. This report also considers the potential for reverse sensitivity effects for State Highway 1 and Christchurch International Airport. Such effects are considered in Section 5 of this report.

Our conclusions relating to the proposed zone are given in Section 6.

2 EXISTING ENVIRONMENT

2.1 Location

The land is located approximately eight kilometres north-west of the Christchurch city centre and is zoned Rural 5 (airport influences), as are areas to the north and south. There is an airport zone to the west, travellers' accommodation zone to the east and living and various business zones beyond.

With regard to local sound sources, the land is bounded by:

- Memorial Avenue to the north, which is a Major Arterial Road under the City Plan.
- Russley Road (State Highway 1) to the west, which is also a Major Arterial Road. Russley Road is in the process of being widened to four lanes as part of the "Christchurch Motorways Western Corridor" Roads of National Significance projects. As of 2014, the four-laning has been completed between Yaldhurst and Avonhead Roads. The designation has been confirmed[1] for the remaining section north of Avonhead Road to Harewood Road, which includes an over-bridge at Memorial Avenue.
- Avonhead Road, a local collector road, is adjacent to the southern boundary. Previously the intersection of Avonhead and Russley Roads allowed movements in all directions, however as part of the four-laning has been restricted to left-in / left-out, and will be completely closed when the over-bridge at Memorial Avenue is constructed. Traffic on Avonhead Road is not a significant sound source

Christchurch International Airport is approximately 500 metres west of the land and the approach path to the Runway 11/29 (cross-wind runway) is just south of the proposed zone. The entire site is within the 50 dBA L_{dn} Christchurch International Airport noise contour, with parts of the land within the 55 dBA L_{dn} contour.

The Copthorne Hotel Commodore bounds the land to the east and there are also dwellings on the opposite side of Avonhead Road to the south.

The MAIL land itself is currently used to graze horses, and there are three existing houses which would be demolished as part of future development. There are also houses on the McVicar/Canterbury Trustees land and the International Motor Inn land.

[1] As of August 2014 there is one appeal outstanding

Figure 2-1 Site plan and sound measurement locations

2.2 Noise survey

A survey was undertaken using a noise logger deployed for over a week at a central location (A) within the plan change area, together with spot measurements at two locations (B and C) to confirm the influence of the two major road traffic sound sources. Figure 2-1 shows the measurement locations. Full survey details and results are given in Appendix A.

The average daytime and night-time sound levels measured in the centre of the land are 55 dB $L_{Aeq(1h)}$ and 53 dB $L_{Aeq(1h)}$ respectively.

The relatively high night-time sound level can be explained by analysis of the trend of the background sound 'L_{A90}' displayed in Figure A-1. This figure displays sound levels in the period between 2200 hours on the 12/05/09 to 2200 hours on 13/05/09. This shows that sound levels drop at approximately 2300 hours but only remain low until approximately 0300 hours. Background sound levels then rise from 0300 hours until a morning rush-hour peak at approximately 0800 hours. This unusual trend can be attributed to airport activity. Christchurch International Airport generally only has airline freight activity between 0000 hours and 0300 hours. After 0300 hours, international and domestic flights start to increase, which bring increases in sound from both airport road traffic (entering and leaving the airport) and the aircraft themselves. The morning rush-hour begins at approximately 0700 hours as shown by the time-average 'L_{eq}' data in Figure A-1.

Both Memorial Avenue and Russley Road (State Highway 1) significantly influence the acoustic environment on the land. Daytime levels measured by each of these roads were 65 dB and 72 dB $L_{Aeq(15min)}$ respectively. Russley Road is particularly significant given the relatively high percentage of heavy vehicles.

During times when the airport is operating on the north-east/south-west runway, the acoustic environment is dominated by road traffic sound. During times of north-west operations, the sound levels at the centre of the land increase slightly. At these times both road traffic and aircraft sound significantly contribute to the acoustic environment. Near to the roads (up to approximately 300 metres of Russley Road and 90 metres of Memorial Avenue), sound from road traffic is always dominant.

The survey was conducted prior to the Canterbury Earthquakes. Since that time road-traffic around the site has increased and therefore the current sound levels are expected to be slightly higher than those reported above. If anything, this results in the following assessment of noise effects being slightly conservative.

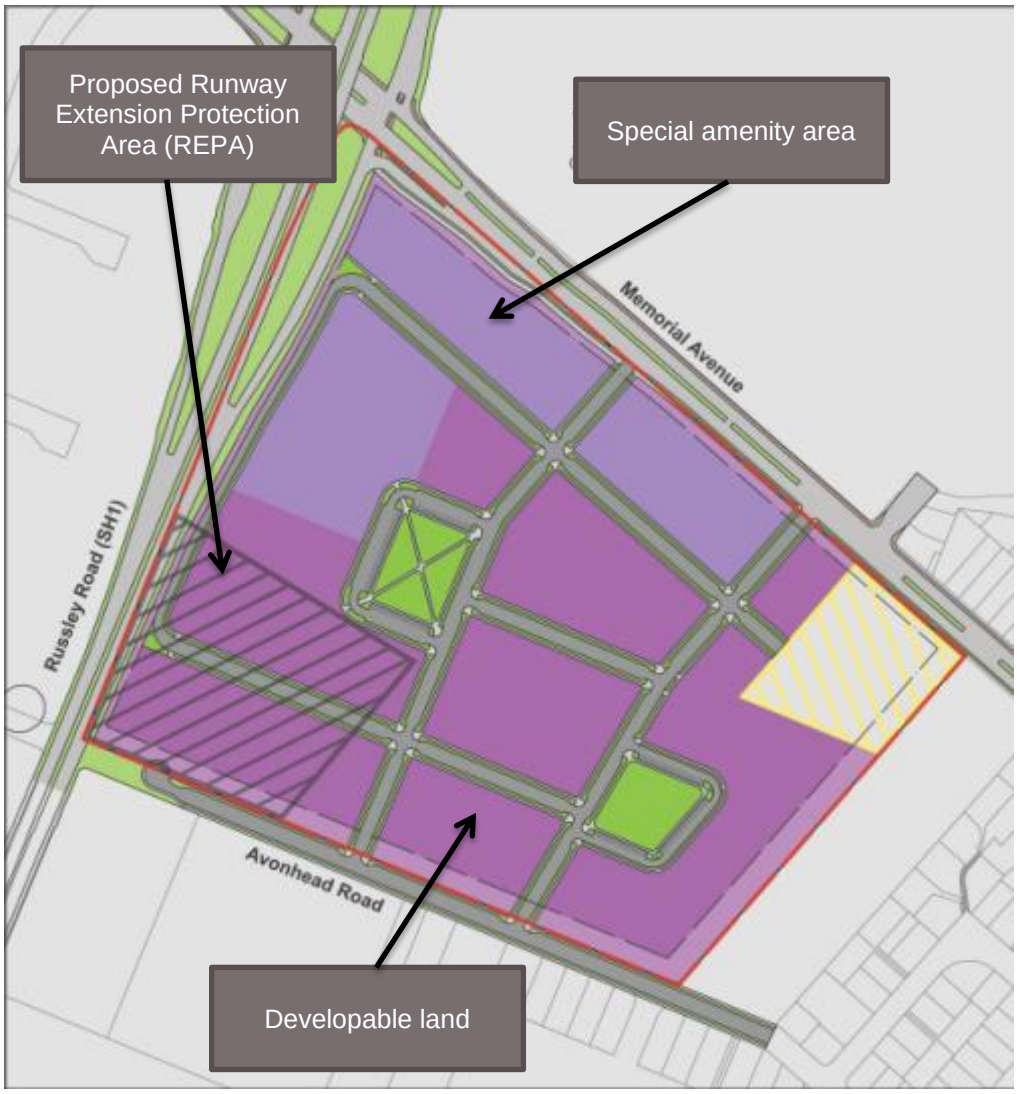
3 PROPOSED ACTIVITY

3.1 Outline Development Plan

The overall layout from the outline development plan is shown in Figure 3-1, which also shows the proposed changes to Russley Road (not part of this project). The main access is from Memorial Avenue with secondary access from Avonhead Road. There is no direct access onto Russley Road.

The plan change will permit a mix of industrial, commercial, and retail development. Travellers' accommodation will only be restricted to the Special Amenity Area shown on the ODP. On-grade parking is provided throughout the development and there is also potential for parking buildings/floors.

Figure 3-1 Outline development plan – Land use and development diagram



3.2 Noise sources

General

The proposed activities would generate sound from numerous sources including, for example: the movement of vehicles onsite, loading bays, building services plant, and people outside cafés/restaurants. The table below presents typical sound levels for these sources, but it should be noted that there is substantial variation in these levels. The values in the table are only a guide.

Table 3-1 Indicative sound levels

Activity	Indicative $L_{Aeq(1h)}$ at 10 metres
Retail unit car park	45 dB
Loading bay	70 dB
Light industry (storage / warehouse)	60 dB
Medium Industry (light workshop)	70 dB
Heavy industry (manufacturing)	80 dB
Outdoor area of a café	60 dB
Small building services e.g. condenser unit	40 dB

Road traffic

In addition to noise generated within the development, there are potential noise effects from traffic generated by the development on local roads. The majority of vehicles will access the development from Memorial Avenue, with a secondary access from Avonhead Road.

Road-traffic noise was predicted as part of the assessment of effects[2] for the Russley Road four-laning between Avonhead and Harewood Roads. An extract of noise contours in the area is shown in Figure 3-2. The project site will be subject to noise levels up to 65 dB.

In 2026, the traffic volumes on Memorial Avenue without the project will be in the order of 23,000 vpd[3]. Traffic modelling for the plan change site is currently in progress, however a significant increase in traffic would be required to generate a meaningful increase in road-traffic noise. Table 3-2 shows the relationship between increasing traffic volumes and noise levels, assuming the proportion of cars and heavy vehicles remains the same.

Table 3-2 Indicative sound levels

Increase in traffic	Increase in noise
5000 vpd	0.9 dB
10,000 vpd	1.6 dB
15,000 vpd	2.2 dB

[2] URS (2013). NZTA 62185 Harewood Road to Avonhead Park, Road-traffic noise assessment. Revision D, 31/7/13
[3] Based on modelling performed by Flow as part of the Russley Road 4-laning project

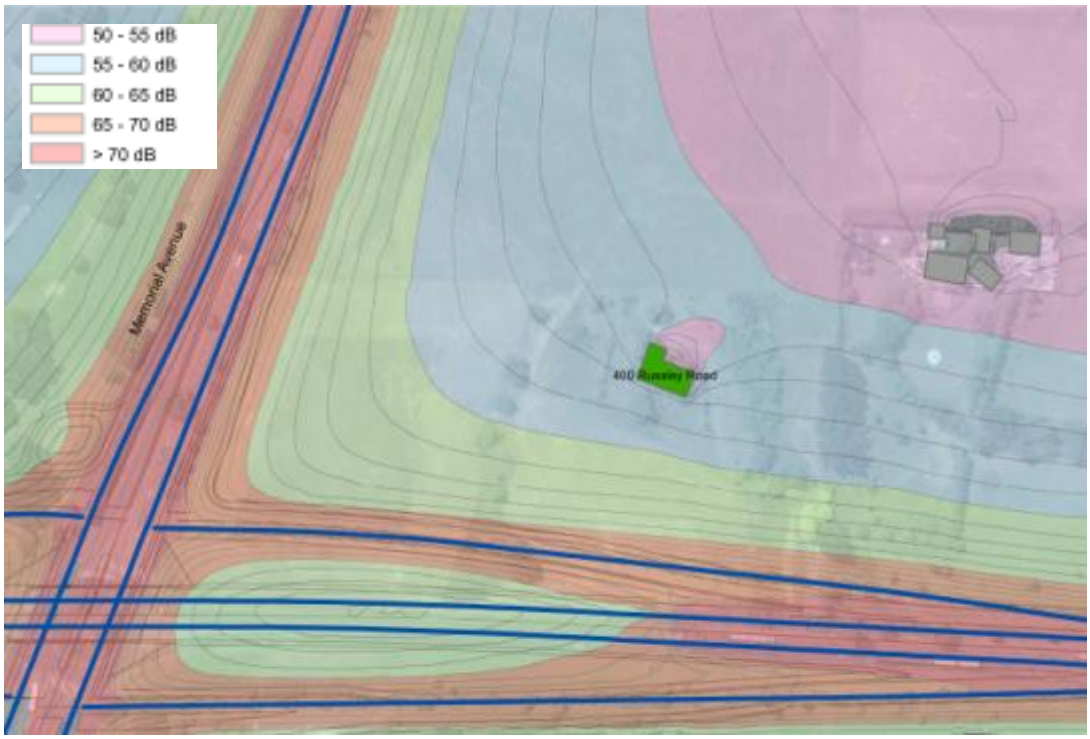


Figure 3-2 Road-traffic noise contours for the year 2026 without the plan change, $L_{Aeq(24h)}$

Due to the progressive closure of the intersection of Avonhead and Russley Roads, future traffic volumes on Avonhead Road without the plan change will be lower than those which occur at present due to the elimination of through traffic. However in time this reduction will be offset by the traffic generated by the plan change area. In view of this, Carriageway Consulting has not carried out any detailed traffic modelling of Avonhead Road, but considers that the traffic flows with the plan change in place will be comparable to those that occur at present, and accordingly, that Avonhead Road will have sufficient capacity to accommodate the generated traffic.

3.3 Noise sensitivity

In addition to consideration of sound generated by the development, it is necessary to consider the sensitivity of proposed activities to the existing environment, due to the relatively high levels of road traffic and aircraft sound.

Internal levels

AS/NZS 2107:2000 '*Recommended design sound levels and reverberation times for building interiors'* provides criteria for different types of space. The table below presents the key criteria from this standard relating to activities proposed in the new zone. If external noise can be attenuated to meet these internal design levels then the proposed activities could operate successfully on this land. We will discuss later how these levels are already used in the City Plan for aircraft sound, and correspond with levels recommended by NZS 6806:2010 '*Acoustics – Road-traffic noise – New and altered roads'* for road-traffic noise.

Table 3-3 Internal design sound levels

Activity	Room type	Internal design sound level, L_{AeqT}	
		Satisfactory	Maximum
Travellers' accommodation	Sleeping Areas Near Major Roads	35 dB	40 dB
	Sleeping Areas Near Minor Roads	30 dB	35 dB
	Conference Areas up to 50 Persons	35 dB	40 dB
	Conference From 50 to 250 Persons	30 dB	35 dB
Office	Board and Conference Rooms	30 dB	40 dB
	General Offices	40 dB	45 dB
	Private Offices	35 dB	40 dB
Retail	Department Stores Main Floor	50 dB	55 dB
	Department Stores Upper Floor	45 dB	50 dB
	Supermarkets	50 dB	55 dB

External levels

The outline development plan does include extensive landscaping, but this is mainly for visual purposes. The development is not dependent on the outdoor acoustic amenity in these landscaped areas. While most of the areas will be accessible, none of the activities in the development will be reliant on people using the landscaped areas. The outline development plan also includes extensive external pedestrian circulation areas. These are likely to be partly screened from road traffic by new buildings. However, these spaces are mainly for circulation and do not require a high degree of acoustic amenity. Retail (and commercial and travellers' accommodation) areas are commonly located along or adjacent to busy roads. Moderate levels of noise are generally accepted by people using outside circulation spaces.

In summary, none of the outdoor areas in the development are considered to be overly noise sensitive. As such, the key issue to consider for all buildings within the new zone is the internal sound levels as discussed above.

4 ASSESSMENT OF EFFECTS

4.1 City Plan

Noise rules in the Christchurch City Plan are managed by organising the numerous planning zones into three noise groups. These range from Group 1, which is for the most noise-sensitive areas such as residential zones, to Group 3 which is for the least noise sensitive areas such as industrial zones.

Unless a resource consent is obtained, all activities located in the development are required to meet the noise limits of the neighbouring zones at the boundary, regardless of whether or not the land is rezoned. Whatever the zoning of the land, under the existing City Plan rules, the same noise limits always apply at the neighbouring sites.

The neighbouring zones are a Special Purpose Airport Zone at the west boundary, a Living 5 Zone at the east boundary, and Rural 5 Zone at all other boundaries. The City Plan defines these as Group 3, Group 2 and Group 1 zones respectively, as shown on the following figure.

Figure 4-1 City Plan noise groups

Volume 3, Part 11, Section 1.3.3 of the City Plan sets the following limits for noise received at the boundary of sites within each of the noise groups. For clarity, only the time-average $L_{Aeq(1h)}$ limits are shown here but there are also L_{A10}, L_{dn} and L_{Amax} limits in the Plan. For most sound sources associated with this development, the L_{Aeq} will be the controlling limit.

Table 4-1 City Plan $L_{Aeq(1h)}$ noise limits

Noise Group	Development Standards		Critical Standard	
	Daytime (0700-2200)	Night-time (2200-0700)	Daytime (0700-2200)	Night-time (2200-0700)
Group 1	50 dB	41 dB	57 dB	49 dB
Group 2	-	-	57 dB	49 dB
Group 3	57 dB	49 dB	-	-

4.2 External boundaries

In this section we will assess the resulting noise level at each of the neighbouring sites on the basis of the existing environment and the worst-case scenario of activities in the development operating at the City Plan noise limits.

At the Group 3 airport zone to the west of the development, there is not a development standard but the critical standard daytime noise limit from any activity in the development is 57 dB $L_{Aeq(1h)}$. The existing daytime sound measured in this area by Russley Road was 72 dB $L_{Aeq(15min)}$. This existing level is considerably above the noise limit and indicates that if activities in the development comply with the 57 dB $L_{Aeq(1h)}$ noise limit from the City Plan, there would be a negligible change in the overall noise level currently experienced in the airport zone.

The travellers' accommodation east of the development is categorised as a Group 2 zone which has a daytime noise limit of 57 dB $L_{Aeq(1h)}$. Daytime measurements of 55 dB $L_{Aeq(15h)}$ undertaken at the centre of the plan change area are considered to be representative of the central and southern parts of the boundary with this zone. Compliance with the 57 dB $L_{Aeq(1h)}$ noise limit could therefore result in an increase of up to approximately 4 dB at the travellers' accommodation zone. However, towards the northern part of the boundary with the travellers' accommodation zone the existing sound levels increase up to 65 dB $L_{Aeq(15min)}$ due to the effect of Memorial Avenue. There is also a 20m setback proposed within the plan change area and restrictions on business activity along the eastern boundary. As such, compliance with the City Plan noise limits will result in negligible change on this side of the plan change area.

At all other boundaries, defined by Group 1 zones, the daytime noise limit for any activity in the development would be 50 dB $L_{Aeq(1h)}$. At the golf course and dwellings to the north of the development, the existing daytime sound level is around 65 dB $L_{Aeq(15min)}$. If activities in the development comply with the 50 dB $L_{Aeq(1h)}$ development standard or even the 57 dB $L_{Aeq(1h)}$ critical standard, there would be negligible change in the overall sound level currently experienced. At the other 'Group 1' boundaries of the development, the 55 dB $L_{Aeq(15h)}$ daytime level measured at the centre of the MAIL land is considered to be representative of the existing environment. Compliance with the 50 dB $L_{Aeq(15hr)}$ development standard noise limit from the City Plan would result in the overall levels increasing by only 1 dB.

The above discussion relates to daytime limits. The acoustic survey has indicated that existing night-time sound levels are not substantially lower than the daytime levels, due to the influence of the airport and traffic patterns. Therefore as City Plan noise limits decrease by a higher margin (at least 8 dB) at night than existing sound levels decrease, our analysis also holds true for the night-time period.

All of the changes in noise exposure discussed above could occur at the moment from permitted activities on the land. However, while the level would be the same, the nature and character of the sound permitted at these levels could change as a result of the proposed rezoning. We have discussed the anticipated sound sources from the outline development plan in Section 3 of this report. We do not consider that any of these sources have any inherent characteristics that would give rise to particular annoyance beyond that indicated by the sound levels.

On the basis of the existing noise environment we predict that the potential noise effects of activity in the proposed zone would be no more than minor at all neighbouring sites, given that the existing noise control provisions of the City Plan provide appropriate protection.

4.3 Internal boundaries

Within the development, there will need to be controls so that noise from individual activities does not adversely affect other activities in the proposed zone. We recommend utilising the standard provisions set in the City Plan as discussed above in relation to neighbouring sites.

It is anticipated that the proposed zone may have different activities/buildings operating under separate leases on the same legal sites. Volume 3, Part 11, Section 1.2.1 of the City Plan states that the noise limits apply at any point on or beyond the boundary of the site containing an activity generating noise. Under the City Plan, a 'site' in this context can be defined by boundaries '*of any lease or other agreement with the land owner*'. This means that the noise limits would still apply between different activities in the development even if they were on the same legal site. Therefore, the existing structure of the City Plan noise rules can be adopted for use within the proposed zone without modification.

Within the City Plan, most categories of business zone are Group 2 zones, although a couple are Group 3 zones (the least noise sensitive zones). Although the development is subject to significant existing road and aircraft sound, we recommend that to maintain reasonable amenity within the proposed zone, the new zone should be in Group 2. The more stringent Group 1 limits would not provide any a significant benefit due to the existing environment.

4.4 Sound sources

As described above, activities in the development would have to meet Group 1 noise limits at most of the development boundaries. We have proposed they would also have to meet Group 2 limits within the development. To assess whether it is practicable for the proposed activities to comply with these limits, we have considered the indicative sound levels from Table 3-1.

It can be seen from Table 3-1 that car parking areas and small building services plant could be located 10 metres from other sites and meet Group 2 (and 3) noise limits with no special noise control measures required. For daytime operation, this would also be the case for Group 1 noise limits. However, for night-time operation, car parking areas would require greater separation (e.g. 25 metres) from neighbouring Group 1 sites or would require acoustic screening, typically in the form of a 2 metre high close-boarded timber fence or an earth bund. Sound levels from building services plant are highly variable and this initial analysis is based on small-scale plant. However, there are standard attenuation measures available for most building services plant and it would still be practicable for larger or noisier plant to comply with these limits given appropriate design.

On the basis of the indicative sound levels of people outdoors at a café, for daytime operation, it would be necessary to either maintain separation of in the order of 50 metres from Group 1 sites or provide acoustic screening, either by buildings or by a specific fence/wall. For night-time operation, it would be necessary to provide both screening and separation. Within the development (Group 2), an outdoor area of a café would either need line-of-sight screening from neighbouring sites or separation in the order of 20 metres.

Loading bays are significant potential sound sources on the site. To comply with the daytime noise limit at neighbouring Group 1 zones a loading bay in the development would either need to be partially enclosed or have a separation distance in the order of 100 metres from the boundary. To operate at night would require either full enclosure or both partial enclosure and separation. Within the development, to comply with the Group 2 daytime limits, would require either screening or in the order of 45 metres separation. To comply with the night-time limits within the Group 2 zone would require in the order of 100 metres separation or partial enclosure.

Sound emissions from numerous other activities occurring inside buildings in the development could be controlled through standard design of the buildings' sound insulation.

We consider that for all anticipated sound sources within the development it would be practicable to comply with the adopted City Plan noise limits.

4.5 Road traffic

There is no National Environmental Standard for road-traffic noise, and most district plans (including Christchurch City) exclude road-traffic noise from zone noise limits and do not provide alternate criteria. Vehicles on roads are also excluded from the excessive noise provisions in section 326 of the Resource Management Act. The exceptions are required as it would be difficult to enforce a limit where the noise producer could not be identified (noise from roads is due to a large number of different vehicles). However, when assessing the effect of rezoning this land, the significant potential increase in noise due to vehicles travelling to and from the land should be considered.

In the absence of other criteria, virtually all significant state highway projects prior to 2010 were subject to noise assessment under the Transit New Zealand's *Guidelines for the management of road traffic noise* ('Transit Guidelines'). In 2010 a New Zealand Standard for road-traffic noise NZS 6806 was published, and the Transport Agency and other road controlling authorities have adopted it as an assessment standard in place of the Transit Guidelines. NZS 6806 sets criteria for reasonable road-traffic noise levels taking into account health issues associated with noise and other matters. These are presented in the form of exposure categories: A (quietest), B, and C (noisiest), and are listed in Table 4-2 for 'altered roads' or other areas with significant existing transportation noise.

Table 4-2 NZS 6806 noise criteria ($L_{Aeq(24h)}$)

Category	Criterion	Altered roads
A	Primary	64 dB $L_{Aeq(24h)}$
B	Secondary	67 dB $L_{Aeq(24h)}$
C	Internal	40 dB $L_{Aeq(24h)}$

Existing road-traffic noise levels at residential dwellings on Memorial Avenue are in the order of 65 dB $L_{Aeq(24)}$ which is within NZS 6806 Category B. With any additional traffic generated by the plan change, noise levels are likely to remain within Category B.

For both Memorial Avenue and Avonhead Road we consider that any increase in traffic will have a minor noise effect.

5 REVERSE SENSITIVITY

5.1 Introduction

The development is adjacent to both an airport and major arterial roads. To ensure adequate protection is provided to future occupants of the proposed zone and to minimise any reverse sensitivity issues for Christchurch International Airport Limited and the NZ Transport Agency, both aircraft and road traffic noise must be appropriately mitigated.

5.2 Aircraft

The purpose of City Plan Policy 6.3.7: Airport Operations is to discourage noise-sensitive activities within the 50 dBA L_{dn} airport noise contour. The development is within this area, but the only activity that could occur in the proposed zone that could potentially be 'noise-sensitive' under the Regional Policy Statement definition is travellers' accommodation. Travellers' accommodation is restricted to the Special Amenity Area in the north west of the site, as shown on the Outline Development Plan. The Regional Policy Statement as amended by the Land Use Recovery Plan, and Policy 6.3.7 of the City Plan, state that travellers' accommodation that is *'designed, constructed and operated to a standard to mitigate the effects of aircraft noise on occupants'* is not considered noise-sensitive. As such, if rules for the proposed zone require travellers' accommodation to be appropriately designed, constructed and operated, then reverse sensitivity effects for the airport will be mitigated.

The City Plan provides the following indoor design sound levels with respect to aircraft noise for travellers' accommodation in Volume 3, Part 4 Appendix 1 (there is also a similar table in Part 8, Appendix 11). These are consistent with the recommended internal design sound levels presented in Table 3-3 from NZS 2107:2000, and therefore we consider them appropriate for travellers' accommodation in the proposed zone.

Table 5-1 Indoor design sound levels for hotels

Activity	Indoor Design Sound Levels	
	L_{AE} (SEL)	L_{dn}
Relaxing or Sleeping	65 dB	40 dB
Conference Meeting Rooms	65 dB	40 dB
Service Activities	75 dB	60 dB
Gymnasia	85 dB	60 dB

The Special Amenity Area with the proposed travellers' accommodation is located between the 50 and 55 L_{dn} contours. On this basis, the internal noise levels in Table 5-1 can be achieved using standard construction techniques.

5.3 Road Traffic

The NZ Transport Agency has a reverse sensitivity policy[4] which seeks that reverse sensitivity is efficiently managed by local authorities in district plans using a number of methods. The NZ Transport Agency has a road noise effects area of 100 metres which would be an appropriate

[4] Appendix 5D of Planning policy manual - for integrated planning & development of state highway. Available online: http://www.nzta.govt.nz/resources/planning-policy-manual/ppm.html

trigger for the requirements. The methods include providing environmental buffer zones and requiring design standards to achieve appropriate internal noise levels as defined in NZS 6806 and AS/NZS 2107. These are the same standards we have proposed in Section 3 of this report.

Travellers' accommodation is considered to be the most sensitive activity with regards to road-traffic noise. For amenity reasons, a 10 m set-back from Russley Road (State Highway 1) is already proposed, and additionally, there will be an internal road at the perimeter of the site that will further increase the separation. A rule requiring that internal noise levels for bedrooms of travellers' accommodation meets 40 dB $L_{Aeq(24h)}$ would also adequately address road-traffic noise effects from Russley Road and Memorial Avenue to the travellers' accommodation.

For commercial buildings, private offices have the same internal noise requirements as travellers' accommodation bedrooms. As such, if private offices were facing Russley Road or Memorial Avenue, similar set-backs and constructions would be required as with the travellers' accommodation. For other office or commercial uses, the requirements are less stringent and the set-back or construction requirements could be reduced. No setback or construction requirements are anticipated for retail units.

In summary, we consider that it would be practicable and straightforward to design, construct and operate all buildings near State Highway 1 and Russley Road in accordance with the internal design standards. A rule should be included in the district plan specifying appropriate internal noise levels for bedrooms of travellers' accommodation within 100 m of Russley Road and Memorial Avenue.

6 CONCLUSIONS

URS has conducted an acoustic assessment for a proposed plan change for the MAIL land, McVicar/Canterbury Trustees land and the International Motor Inn land, to create an Industrial Park zone. We have considered sound from the site, within the site, and to the site from road traffic and aircraft. In all instances we have concluded that with appropriate rules, the development could occur in the proposed zone with no more than minor noise effects.

7 LIMITATIONS

URS New Zealand Limited (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Memorial Avenue Investments Ltd.

It is prepared in accordance with the scope of work and for the purpose outlined in the contract dated 6 August 2014. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Report.

Where this Report indicates that information has been provided to URS by third parties, URS has made no independent verification of this information except as expressly stated in the Report. URS assumes no liability for any inaccuracies in or omissions to that information.

This Report was drafted between May and November 2009 and updated in August 2014 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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APPENDIX A NOISE SURVEY

Survey details

Personnel:	Daniel Pratley, URS
Times/dates:	1330 11/05/09 – 1115 20/05/09 Location A (central on the land)
	1350 11/05/09 – 1405 11/05/09 Location B (Memorial Avenue)
	1415 11/05/09 – 1430 11/05/09 Location C (Russley Road)
Instrumentation:	ARL EL-316 Environmental noise logger, serial number 16-707-025, calibration date 03/10/08
	Brüel and Kjær Type 2250L hand-held sound analyser serial number 2638850, calibration date 04/04/08
	Rion NC-74 Acoustic calibrator, serial number 34483805, calibration date 31/10/08
Microphone position:	1.2 m high, free-field
Procedure	The noise logger was installed at a central location on the MAIL land (Location A), and set to record the $L_{Aeq(15min)}$ and other acoustic parameters for sequential 15 minute periods. A calibration check was performed at the end of the measurement. The hand-held analyser was installed at Locations B and C for 15 minutes and set to record the $L_{Aeq(15min)}$.
Weather	Meteorological data was obtained from the Christchurch International Airport weather station. Measurements during the majority of the second half of the survey between 0000 hours on 15 May and the end of the survey were affected by wind beyond that allowed by the measurement standard NZS 6801:2008 (> 3 m/s). These results have not been included in this report.

Results

The sound levels recorded include significant fluctuation. While individual events cannot be assigned to specific sources for these unattended measurements, the fluctuation is attributed to several factors, including the following:

- Local activity such as due to livestock.
- Birdsong in close proximity to the measurement location.
- Aircraft movements whilst the north-west runway is in operation.

Location A is approximately 170 metres from Memorial Avenue and 354 metres from Russley Road. This location receives sound from road traffic using both roads, and sound from aircraft movements. The sound environment is subject to increases due to the operation of the north-west runway. However, due to the nature of north-west winds in Christchurch, the north-west runway operates mainly during periods of stronger winds when sound measurements are not valid. However, some of the measurement data discussed below has been used to illustrate the effects of north-west operations.

In our analysis we have only assumed the north-west runway to be operating during periods of significant north-west winds exceeding three hours in duration. The results during such a period are presented in Table A-2.

Table A-3 presents the measured sound levels at Locations B and C in close proximity to Memorial Avenue and Russley Road. Location B is six metres from the edge of Memorial Avenue. The sound environment was dominated by road traffic, with minor contributions from aircraft using Christchurch International Airport. Location C is four metres from Russley Road. The sound environment was dominated by road traffic from this road.

Table A-1 Sound at Location A during normal airport operations

Date	Measurement Period, T	L_{AeqT}	Max $L_{Aeq(1h)}$	Min $L_{Aeq(1h)}$	Wind Direction
11/05/2009	1345h – 2200h	51 dB	53 dB	48 dB	south/west
11/05/2009	2200h – 0700h	54 dB	57 dB	48 dB	west
12/05/2009	0700h – 2200h	54 dB	59 dB	48 dB	south/south-west/occasional north-west
12/05/2009	2200h – 0700h	53 dB	58 dB	46 dB	west
13/05/2009	0700h – 2200h	55 dB	58 dB	49 dB	south/west/north-east
13/05/2009	2200h – 0700h	52 dB	55 dB	47 dB	north/occasional north-west
14/05/2009	0700h – 2200h	58 dB	64 dB	52 dB	north/occasional north-west

Table A-2 Sound at Location A during north-west runway operations

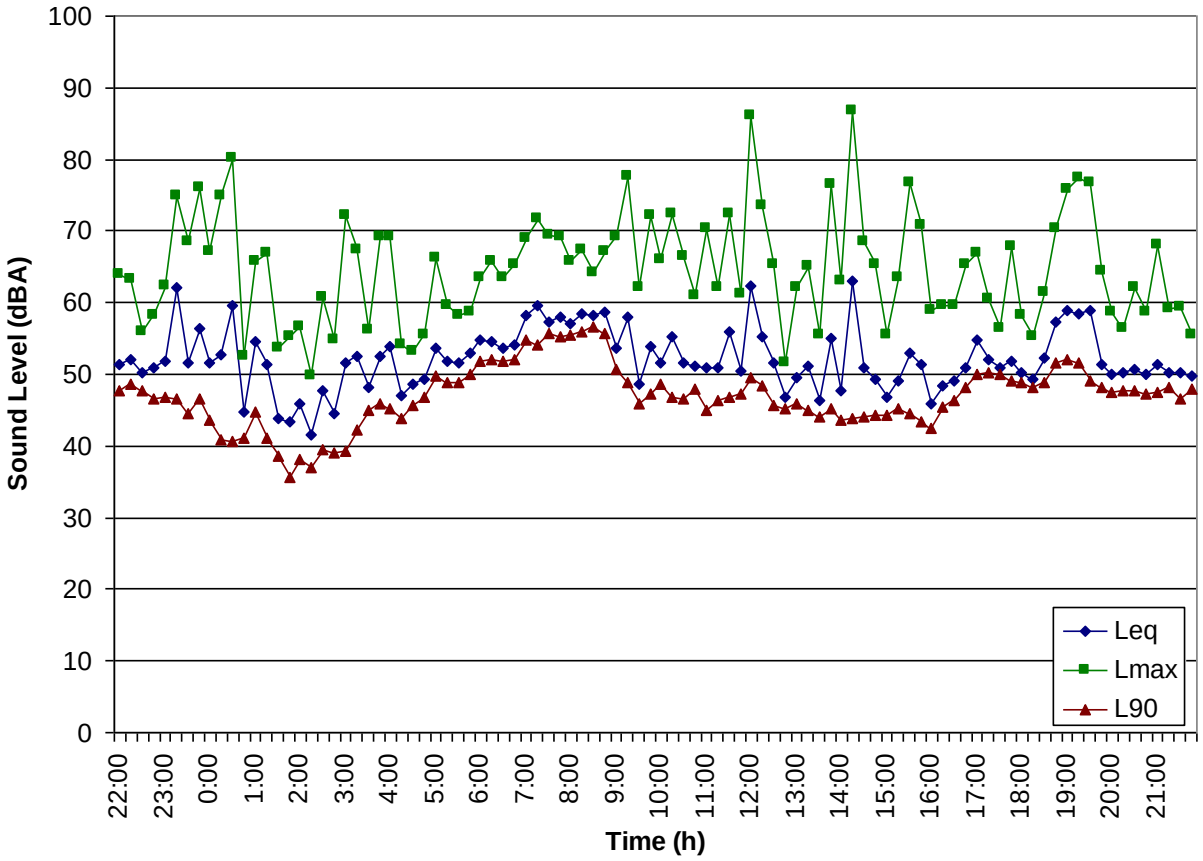
Date	Measurement Period	$L_{Aeq(1h)}$	Wind Direction	Wind Speed
15/05/09	1100h – 1200h	57 dB	north-west	5.1 m/s
15/05/09	1200h – 1300h	54 dB	north-west	3.5 m/s
15/05/09	1300h – 1400h	55 dB	north-west	3.2 m/s

During times when the north-west runway was considered to be operational wind speeds were above the 3 m/s limit specified by NZS 6801, and as such measured sound levels are likely to have been affected by wind induced noise on the microphone and from vegetation. However, L_{AFmax} levels of specific events are considered to be unaffected.

Table A-3 Sound at Locations B and C

Measurement Location	Date	Measurement Period	$L_{Aeq(15min)}$
B (Memorial Avenue)	11/05/2009	1450h – 1505h	65 dB
C (Russley Road)	11/05/2009	1515h – 1530h	72 dB

Figure A-1 Measured sound levels (12/05/09 - 13/05/09)



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