

Sanctuary Acoustics

Acoustic Consultancy

NOISE ASSESSMENT FOR LADBROKES PLC

A BACKGROUND NOISE ASSESSMENT CONDUCTED AS PART OF A PLANNING APPLICATION TO INSTALL AIR CONDITIONING UNITS AT THE REAR OF 304-306 OXFORD ROAD, MANCHESTER

DOCUMENT 001

BY

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EXECUTIVE SUMMARY

Sanctuary Acoustics was asked by Ladbrokes Plc to assess the noise levels at the rear of their new betting shop located at 304-306 Oxford Road, Manchester. Planning approval was previously granted to Ladbrokes Plc thereby allowing the refit and renovation of the existing ground floor premises to proceed, but that initial approval did not extend to the installation of an air-conditioning system on the premises. This noise assessment which included two days of on-site noise measurements aims to assess the existing background noise levels to the rear of 304-306 Oxford Road where the proposed air-conditioning units would be installed and, if any what affect the proposed air-conditioning units would have on the existing background and ambient noise levels. The optimum sound pressure level produced by the air-conditioning units should also be compared with the measured background noise levels (L_{A90}) with further reference made to criteria in *BS 4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas*. Dwellings, (flats) are located on the first and second floors of the building hence the need for an accurate noise assessment.

To summarise:

1. The noise measurements were taken to the rear of 304-306 Oxford Road in the proximity of the proposed location for the air-conditioning units over a two day period, a weekend (Saturday August 10th) and a week day (Wednesday August 21st). Measurements took place over the proposed opening hours of the new Ladbrokes betting shop, 9am to 9pm and hence the operating hours of the proposed air-conditioning units.
2. The planning department have requested resolution to three points in relation to noise; *the noise output from the units, including cumulative impact of all the units operating simultaneously; any acoustic measures proposed to limit noise breakout from the units; details of the ambient noise levels during the daytime, night and weekends and how noise from the units will impact on ambient noise levels.*
3. Noise measurement parameters are detailed in the report and are based on 1-hour time intervals. The L_{Aeq}, L_{A90}, L_{Amax}, L_{Amin} and L_{A10} are detailed in the report with full 1/3 octave band data to the rear of the report in Appendix A.
4. Six 1-hour measurements were conducted on Saturday August 10th and eight measurements were conducted on Wednesday August 21st. The results obtained for both measurement days were not dissimilar. The average background noise level (L_{A90}) at the rear of 304-306 Oxford Road was 51.5dB.
5. The proposed Ladbrokes air conditioning units, either the Daikin RZQG-L7V1 or RZQ-D7V1B are available in four different models. The RZQG71L7V1 and the RZQ71D7V1B are the quietest of the four models and are recommended here. The three larger models produce higher sound pressure levels and therefore are not recommended. If the three larger models are needed due to their larger motor output, piping length etc., then they should not be operated in *Nominal* mode but in *Night Quiet* mode. The sound pressure levels were confirmed from the manufacturer's data sheets. An enclosure is also recommended to provide some noise attenuation.
6. The location for the external plant will be on the ground floor roof extension up to the first floor façade and mid-way between two first floor rooms.
7. The determining factor in the air-conditioning unit specification is based upon the relatively low levels of background noise at the rear of 304-306 Oxford Road and the proposed location of the units which would be in close proximity to the first floor rooms and their windows.

1. INTRODUCTION

Sanctuary Acoustics was asked by Ladbrokes Plc to assess the noise levels at the rear of their new betting shop located at 304-306 Oxford Road, Manchester. Planning approval was previously granted to Ladbrokes Plc thereby allowing the refit and renovation of the existing ground floor premises to proceed, but that initial approval did not extend to the installation of an air-conditioning system on the premises. This noise assessment which included two days of on-site noise measurements aims to assess the existing background noise levels to the rear of 304-306 Oxford Road where the proposed air-conditioning units would be installed and, if any what affect the proposed air-conditioning units would have on the existing background and ambient noise levels. The optimum sound pressure level produced by the air-conditioning units should also be compared with the measured background noise levels (L_{A90}) with further reference made to criteria in *BS 4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas*. Dwellings, (flats) are located on the first and second floors of the building hence the need for an accurate noise assessment.

The noise assessment has been conducted in order to satisfy a planning condition relating to noise due to concerns raised by the local authority regarding the potential impingement of noise from external units, e.g. air-conditioning units onto nearby residential dwellings.

The request from the planners was thus;

1) *the noise output from the units, including cumulative impact of all the units operating simultaneously;*
2) *any acoustic measures proposed to limit noise breakout from the units,*
3) *details of the ambient noise levels during the daytime, night and weekends and how noise from the units will impact on ambient noise levels.*

In order to assess the existing noise environment, the following were investigated on both a weekday and a weekend, although it must be stated that the operational hours of the shop will be within daytime hours (9am to 9pm):

The noise survey was conducted on Saturday 10th August and Wednesday 21st August 2013.

The proposed location for the air-conditioning units is at the rear of the building, located on the roof of the ground floor extension near to the first floor façade and positioned midway between the two first floor rear windows.

The noise criteria used to assess the ambient noise levels within habitable rooms, e.g. Living Rooms and Bedrooms can be found in *BS 8233 Sound insulation and noise reduction for buildings – Code of practice*, *Table 5 – Indoor ambient noise levels in spaces when they are unoccupied* gives both a Good and a Reasonable Design Range to provide for reasonable resting/sleeping conditions. The Good Design Range states 30dB $L_{Aeq,T}$ for both Bedrooms and Living Rooms while the Reasonable Design Range states 35dB $L_{Aeq,T}$ for Bedrooms and 40dB $L_{Aeq,T}$ for Living Rooms.

The noise survey commenced with a 1-hour measurement at 11:00 on Saturday August 10th. This was followed by further 1-hour measurements at 12:00 to 13:00, 13:00 to 14:00, 17:00 to 18:00, 18:00 to 19:00 and 19:00 to 20:00. A second day of

measurements took place on a week day, Wednesday August 21st with the commencement of 1-hour measurements beginning at 09:00 to 10:00, 10:00 to 11:00, 11:00 to 12:00, 12:00 to 13:00, 13:00 to 14:00, 17:00 to 18:00, 18:00 to 19:00 and 19:00 to 20:00.

Noise measurements are typically taken at a minimum distance of 3.5m from facades to avoid specular reflections. *BS 4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas,* states in section 5.3 Measurement positions; *"To minimise the influence of reflections, make the measurements at least 3.5m from any reflecting surface other than the ground".*

However, Note 2 from this section does state; *where it is necessary to make measurements above ground floor level, choose a position which is 1 metre from the façade on the relevant floor of the building.*

The sound level meter was subsequently positioned on a tri-pod 1.5m above floor/roof level and 1m from the first floor facade.

Figure 1 depicts the measurement location on the ground floor extension roof 1m from the first floor facade.



Figure 1: Measurement location on the extension roof were the proposed air-conditioning units would be located.

Figure 2 depicts the view from the rear car park for where the proposed air-conditioning units would be located, midway between the two barred windows



Figure 2: The external proposed location for the air-conditioning units is between the two barred windows.

The noise measurements were undertaken using a Norsonics 132 Sound Level Meter (Serial Number 1322854) which was calibrated before and after the noise measurements were taken using a Cirrus CR:514 Acoustic Calibrator (Serial Number 59124). Both items of equipment have traceable calibration certificates and are designated as Type 2 instruments which are inline with IEC 60651 & 60804 and IEC respectively. The Sound Level Meter was mounted on a tri-pod 1.5m above ground level. The results of the noise measurements and their acoustic parameters are detailed in section 2, Measurements and Observations. The full 1/1 octave band data for the measurements are detailed at the end of this report in Annex A.

2. MEASUREMENTS AND OBSERVATIONS

The fourteen external noise measurements at the rear façade of 304-306 Oxford Road took place during Saturday August 10th 2013 and Wednesday August 21st 2013 with six external measurements taking place on the Saturday and eight external measurements on the Wednesday. Three 1-hour measurements were conducted between 11.00am to 2.00pm and again between the hours of 5.00pm to 8.00pm on the Saturday. Five 1-hour measurements were conducted between 9.00am to 2.00pm with a further three 1-hour measurements between the hours of 5.00pm to 8.00pm on the Wednesday.

At the rear of the site it was noted that road traffic noise from Oxford Road, particularly large vehicles such as buses were audible. Noise from extraction units at the Big Hands bar and deliveries to the Gemini Food Takeaway were also noted. With the exception of vehicles using the rear car park, people going about their daily business in the area also contributed to the ambient noise levels.

Noise derived from persons resulted from patrons using the Big Hands Roof Terrace and Beer Garden, as depicted in figure 3, Oxfam employees talking at the rear of the shop on mobile phones, pedestrians walking up Dilworth Street and students coming and going from residences on the opposite side of Dilworth Street.



Figure 3: Big Hands ground floor beer garden and first floor roof terrace.

For each of the fourteen measurements the observations and results are detailed in tabular form including descriptions of the weather conditions and pictorial location.

A glossary of the acoustic parameters/terms used can be found in Annex A.

The noise results obtained for measurement 1 at the location 1 depicted in figure 1, are detailed in table 1 for the first day of noise measurements on Saturday August 10th 2013.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	11.00 – 12.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	No perceivable winds, grey overcast sky, 16^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Airplane over the site during the 12th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	54.6dB(A)
L_{A10}	55.3dB(A)
L_{Amin}	47.6dB(A)
L_{Amax}	76.4dB(A)
L_{A90}	50.4dB(A)

Table 1: The results taken at Measurement Location 1 for 11am to 12pm August 10th

The observations noted during the measurement between 11am to 12pm are detailed in table 2.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	11.00 – 12.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	No perceivable winds, grey overcast sky, 16^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Airplane over the site during the 12th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
2	Bang from Big Hands Bar. L_{Amax} 73.7dB(A)
12	Airplane overhead
30 – 34	Oxfam employee next door talking at the rear of their shop on a mobile phone
43	Ambulance siren. L_{Amax} 76.4dB(A)

Table 2: The observations taken at the measurement location 1 between 11am to 12pm

The noise results obtained for the second measurement at location 1 are detailed in table 3.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	12.00 – 13.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes, grey overcast sky, 17^{0}C. Some breaks in cloud develop with some sunny intervals mid-way through measurement. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Neighbour noise during the 29th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	55.1dB(A)
L_{A10}	56.0dB(A)
L_{Amin}	48.9dB(A)
L_{Amax}	80.9dB(A)
L_{A90}	51.1dB(A)

Table 3: The results taken at the measurement location 1 between 12pm to 1pm

The observations noted during the measurement between 12pm to 1pm are detailed in table 4.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	12.00 – 13.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes, grey overcast sky, 17^{0}C. Some breaks in cloud develop with some sunny intervals mid-way through measurement. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Neighbour noise during the 29th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
5	Clatter from rear car park
21	Ambulance siren. L_{Amax} 72.8dB(A)
29	Neighbouring employee. L_{Amax} 80.9dB(A)
33	Background music comes on in bar

Table 4: The observations taken at the measurement location 1 between 12pm to 1pm

The noise results obtained for the third measurement at location 1 are detailed in table 5.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	13.00 – 14.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes, 18^{0}C. Cloud breaking with some sunny intervals. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Helicopter overhead during the 5th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	56.2dB(A)
L_{A10}	56.5dB(A)
L_{Amin}	50.5dB(A)
L_{Amax}	76.2dB(A)
L_{A90}	52.9dB(A)

Table 5: The results taken at the measurement location 1 during 1pm to 2pm

The observations noted during the measurement between 1pm to 2pm are detailed in table 6.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	13.00 – 14.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes, 18^{0}C. Cloud breaking with some sunny intervals. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Helicopter overhead during the 5th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
9	Helicopter overhead. L_{Amax} 76.2dB(A)
6 – 13	Delivery to Gemini fast food takeaway next door. Rear shutter raised and closed. Reversing siren from delivery van when it leaves.
20	Papa Johns delivery scooter arrives on Dilworth Street to make delivery to student accommodation opposite.

Table 6: The observations taken at the measurement location 1 between 1pm to 2pm

The noise results obtained for measurement 4 at measurement location 1 (5pm – 6pm) are detailed in table 7.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	17.00 – 18.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes with gusts up to 3.6km/h, 19^{0}C. Cloud breaking with some sunny intervals. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar which now has customers on its roof terrace. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Taxi driver laughing during the 58th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	54.7dB(A)
L_{A10}	55.8dB(A)
L_{Amin}	50.2dB(A)
L_{Amax}	81.3dB(A)
L_{A90}	52.2dB(A)

Table 7: The results taken at the above Location 1 between 5pm to 6pm.

The observations noted during the measurement between 5pm to 6pm are detailed in table 8.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	17.00 – 18.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes with gusts up to 3.6km/h, 19^{0}C. Cloud breaking with some sunny intervals. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar which now has customers on its roof terrace. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Taxi driver laughing during the 58th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
30	Distant reggae music audible, source unknown
40	Oxfam employee at rear of shop backdoor on mobile phone.
45	Second employee at rear of the shop for 30 seconds then back inside
53	Airplane overhead
56	Car door slam on Dilworth Street. L_{Amax} 69.8dB(A)
57	Musician and taxi driver walk passed measurement location to rear of Big Hands Bar. L_{Amax} 71.6dB(A)
58	Taxi driver laughing. L_{Amax} 81.3dB(A)

Table 8: The observations taken at the measurement location 1 between 5pm to 6pm

The noise results obtained for measurement 5, 6pm to 7pm at location 1 are detailed in table 9.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	18.00 – 19.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes with gusts up to 3.6km/h, 17^{0}C. Cloud breaking with some sunny intervals. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar which now has customers on its roof terrace. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Pedestrian footfall on Dilworth Street during the 1st minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	54.3dB(A)
L_{A10}	55.8dB(A)
L_{Amin}	50.6dB(A)
L_{Amax}	64.9dB(A)
L_{A90}	52.3dB(A)

Table 9: The results taken at Measurement Location 1 for 6pm to 7pm

The observations noted during the measurement between 6pm to 7pm are detailed in table 10.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	18.00 – 19.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes with gusts up to 3.6km/h, 17^{0}C. Cloud breaking with some sunny intervals. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar which now has customers on its roof terrace. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Pedestrian footfall on Dilworth Street during the 1st minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
1	Pedestrian footfall on Dilworth Street. L_{Amax} 64.9dB(A)
5	Distant music from unknown source

Table 10: The observations taken at the measurement location 1 between 6pm to 7pm

The noise results obtained for measurement 6 at measurement location 1 (7pm – 8pm) are detailed in table 11.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	19.00 – 20.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes with gusts up to 3.6km/h, 16^{0}C. Cloud breaking with some sunny intervals. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar which now has customers on its roof terrace. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Sound check at Big Hands Bar during the 9th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	59.2dB(A)
L_{A10}	63.1dB(A)
L_{Amin}	50.9dB(A)
L_{Amax}	74.3dB(A)
L_{A90}	52.8dB(A)

Table 11: The results taken at the above Location 1 between 7pm to 8pm.

The observations noted during the measurement between 7pm to 8pm are detailed in table 12.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	19.00 – 20.00 1 Hour Measurement August 10th
Weather & Site Conditions/Observations	Occasional light breezes with gusts up to 3.6km/h, 16^{0}C. Cloud breaking with some sunny intervals. Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar which now has customers on its roof terrace. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Sound check at Big Hands Bar during the 9th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
1	Live music from Big Hands. L_{Amax} 64.4dB(A)
2	Live music from Big Hands. L_{Amax} 71.9dB(A)
6	Live music from Big Hands. L_{Amax} 72.0dB(A)
9	Live music from Big Hands. L_{Amax} 74.3dB(A)
10	Customer from Big Hands Bar beer garden talking on mobile phone

Table 12: The observations taken at the measurement location 1 between 7pm to 8pm.

The results and observations for the second day of noise monitoring with the measurements taken are as follows;

The noise results obtained for measurement 1 at the location 1 are detailed in table 13.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	09.00 – 10.00 1 Hour Measurement August 21sth
Weather & Site Conditions/Observations	Light occasional gusts, cloudy overcast sky, 18^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Rotary saw used inside the shop by a shop fitter during the 1st minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	53.4dB(A)
L_{A10}	54.6dB(A)
L_{Amin}	49.4dB(A)
L_{Amax}	69.0dB(A)
L_{A90}	50.5dB(A)

Table 13: The results taken at Measurement Location 1 on August 21st at 9am to 10am

The observations noted during the measurement between 6am to 7am are detailed in table 14.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	09.00 – 10.00 1 Hour Measurement August 21st[h]
Weather & Site Conditions/Observations	Light occasional gusts, cloudy overcast sky, 18^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Rotary saw used inside the shop by a shop fitter during the 1st minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
0 – 60	Noise from extract at Big Hands Bar
0 – 60	Rustling of trees
1	Rotary saw use in shop. L_{Amax} 69.0dB(A)

Table 14: The observations taken at the measurement location 1 between 9am to 10am on August 21st.

The noise results obtained for the second measurement at location 1 on August 21st are detailed in table 15.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	10.00 – 11.00 1 Hour Measurement August 21st[h]
Weather & Site Conditions/Observations	Light occasional gusts to 8.4km/h, cloudy overcast sky with sunny intervals, 19^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Rear gate slam of Oxfam shop next door on during the 4th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	54.1dB(A)
L_{A10}	54.6dB(A)
L_{Amin}	48.8dB(A)
L_{Amax}	71.8dB(A)
L_{A90}	50.1dB(A)

Table 15: The results taken at the measurement location 1 between 10am to 11am on August 21st.

The observations noted during the measurement between 10am to 11am are detailed in table 16.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	10.00 – 11.00 1 Hour Measurement August 21st^{h}
Weather & Site Conditions/Observations	Light occasional gusts to 8.4km/h, cloudy overcast sky with sunny intervals, 19^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Rear gate slam of Oxfam shop next door on during the 4th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
0 – 60	Noise from extract at Big Hands Bar
0 – 1	Worker singing. L_{Amax} 70.1dB(A)
4	Neighbouring unit (Oxfam) rear gate slam. L_{Amax} 71.8dB(A)

Table 16: The observations taken at the measurement location 1 between 10am to 11am on the second day of measurement, August 21st.

The noise results obtained for the third measurement at location 1 on August 21st are detailed in table 17.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	11.00 – 12.00 1 Hour Measurement August 21st^{h}
Weather & Site Conditions/Observations	Light occasional gusts to 8.4km/h, cloudy overcast sky with sunny intervals, 20^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Rear gate slam of Oxfam shop next door on during the 4th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	56.1dB(A)
L_{A10}	55.8dB(A)
L_{Amin}	48.8dB(A)
L_{Amax}	83.9dB(A)
L_{A90}	50.2dB(A)

Table 17: The results taken at the measurement location 1 during 11am to 12pm

The observations noted during the measurement between 11am to 12pm are detailed in table 18.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	11.00 – 12.00 1 Hour Measurement August 21st^{h}
Weather & Site Conditions/Observations	Light occasional gusts to 8.4km/h, cloudy overcast sky with sunny intervals, 20^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Rear gate slam of Oxfam shop next door on during the 4th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
0 – 60	Noise from extract at Big Hands Bar
0 – 1	Work activity in ground floor shop refit. L_{Amax} 71.0dB(A)
2	Reversing siren in distance
4	Rear Oxfam gate slam. L_{Amax} 83.9dB(A)

Table 18: The observations taken at the measurement location 1 between 11am to 12pm on Wednesday August 21st.

The results obtained for measurement 4 taken at measurement location 1 between 12pm to 1pm on the second day of noise monitoring on August 21st are detailed in table 19.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	12.00 – 13.00 1 Hour Measurement August 21st^{h}
Weather & Site Conditions/Observations	Light occasional gusts to 8.4km/h, cloudy overcast sky with sunny intervals, 20^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Child shouting during the 32nd minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	53.4dB(A)
L_{A10}	53.4dB(A)
L_{Amin}	48.7dB(A)
L_{Amax}	86.1dB(A)
L_{A90}	50.2dB(A)

Table 19: The results taken at the above Location 1 between 12pm to 1pm on August 21st, day 2.

The observations noted during the measurement between 12pm to 1pm on day 2 are detailed in table 20.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	12.00 – 13.00 1 Hour Measurement August 21st^{h}
Weather & Site Conditions/Observations	Light occasional gusts to 8.4km/h, cloudy overcast sky with sunny intervals, 20^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling along Oxford Road and Dilworth Street. Child shouting during the 32nd minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
0 – 60	Noise from extract at Big Hands Bar
1	Work activity in shop. L_{Amax} 66.2dB(A)
2 – 3	Car horns and shouts from Oxford Road.
14	Neighbour from Gemini hot food takeaway walked passed measurement location. L_{Amax} 68.1dB(A)
14	Neighbour from Gemini hot food takeaway dropped what he was carrying. L_{Amax} 72.9dB(A)
23	Distant emergency vehicle siren
29	Gemini hot food takeaway rear shutters raised. L_{Amax} 72.9dB(A)
32	Child shouting. L_{Amax} 86.1dB(A)
38 – 48	Church bells

Table 20: The observations taken at the measurement location 1 between 12pm to 1pm on day 2, August 21st.

The noise results obtained for measurement 5, 1pm to 2pm at location 1 on August 21st are detailed in table 21.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	13.00 – 14.00 1 Hour Measurement August 21st^{h}
Weather & Site Conditions/Observations	Light occasional gusts to 6.3km/h, cloudy overcast sky with sunny intervals, 20^{0}C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling in area. Van being loaded during the 8th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	57.6dB(A)
L_{A10}	57.5dB(A)
L_{Amin}	49.0dB(A)
L_{Amax}	78.9dB(A)
L_{A90}	50.9dB(A)

Table 21: The results taken at Measurement Location 1 from 1pm to 2pm, day 2, August 21st.

The observations noted during this measurement period between 1pm to 2pm on day 2, August 21st, are detailed in table 22.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	13.00 – 14.00 1 Hour Measurement August 21st[h]
Weather & Site Conditions/Observations	Light occasional gusts to 6.3km/h, cloudy overcast sky with sunny intervals, 20^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction from the Big Hands Bar. Pedestrians frequently walking and cycling in area. Van being loaded during the 8th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
0 – 60	Noise from extract at Big Hands Bar
0 – 1	Van being loaded nearby. L_{Amax} 75.0dB(A)
5	Van being loaded nearby. L_{Amax} 75.5dB(A)
6	Van being loaded nearby. L_{Amax} 76.8dB(A)
8	Van being loaded nearby. L_{Amax} 78.9dB(A)
48	Shop fitter singing
54	Airplane overhead

Table 22: The observations taken at the measurement location 1 between 1pm to 2pm on August 21st.

The noise results obtained for measurement 6 at measurement location 1 (5pm – 6pm) from day 2, August 21st, are detailed in table 23.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	17.00 – 18.00 1 Hour Measurement August 21st[h]
Weather & Site Conditions/Observations	Light occasional gusts to 2.3km/h, cloudy overcast sky with sunny intervals, 20^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar. Pedestrians frequently walking and cycling in area. Oxfam employee talking on mobile phone during the 9th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	55.9dB(A)
L_{A10}	56.7dB(A)
L_{Amin}	50.6dB(A)
L_{Amax}	75.3dB(A)
L_{A90}	52.7dB(A)

Table 23: The results taken at the above Location 1 from 5pm to 6pm on day 2, August 21st.

The observations noted during the measurement between 5pm to 6pm on day 2 are detailed in table 24.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	17.00 – 18.00 1 Hour Measurement August 21st
Weather & Site Conditions/Observations	Light occasional gusts to 2.3km/h, cloudy overcast sky with sunny intervals, 20^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar. Pedestrians frequently walking and cycling in area. Oxfam employee talking on mobile phone during the 9th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
0 – 60	Noise from extract at Big Hands Bar
3	Oxfam employee talking on mobile phone. L_{Amax} 67.8dB(A)
4	Activity on Dilworth Street, students, L_{Amax} 68.6dB(A)
7	Oxfam employee talking on mobile phone now in rear alley. L_{Amax} 74.6dB(A)
9	Oxfam employee talking on mobile phone now in rear alley. L_{Amax} 75.3dB(A)

Table 24: The observations taken at the measurement location 1 between 5pm to 6pm on day 2, August 21st 2013.

The noise results obtained for measurement 7, 6pm to 7pm at location 1 are detailed in table 25.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	18.00 – 19.00 1 Hour Measurement August 21st
Weather & Site Conditions/Observations	Light occasional gusts to 2.3km/h, cloudy overcast sky with sunny intervals, 20^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar. Pedestrians frequently walking and cycling in area. Emergency vehicle sire during the 13th minute provides L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	57.1dB(A)
L_{A10}	57.2dB(A)
L_{Amin}	51.0dB(A)
L_{Amax}	78.1dB(A)
L_{A90}	52.7dB(A)

Table 25: The results taken at Measurement Location 1 for 6pm to 7pm on day 2, August 21st.

The observations noted during the measurement between 6pm to 7pm are detailed in table 26.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	18.00 – 19.00 1 Hour Measurement August 21st
Weather & Site Conditions/Observations	Light occasional gusts to 2.3km/h, cloudy overcast sky with sunny intervals, 20^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar. Pedestrians frequently walking and cycling in area. Emergency vehicle sire during the 13th minute provides L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
0 – 60	Noise from extract at Big Hands Bar
0 - 5	People talking outside rear of Big Hands Bar.
13	Emergency vehicle sirens. L_{Amax} 78.1dB(A)
14	Emergency vehicle sirens

Table 26: The observations taken at the measurement location 1 between 6pm to 7pm

The noise results obtained for measurement 8 at measurement location 1 (7pm – 8pm) are detailed in table 27.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	19.00 – 20.00 1 Hour Measurement August 21st
Weather & Site Conditions/Observations	Light occasional gusts to 2.3km/h, cloudy overcast sky, 19^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar. Pedestrians frequently walking and cycling in area. People laughing nearby during the 4th minute provide L_{Amax}.
Measurement Parameter	**Measurement Reading**
L_{Aeq}	54.3dB(A)
L_{A10}	55.7dB(A)
L_{Amin}	50.3dB(A)
L_{Amax}	72.0dB(A)
L_{A90}	51.9dB(A)

Table 27: The results taken at the above Location 1 between 7pm to 8pm.

The observations noted during the measurement between 7pm to 8pm are detailed in table 28.

Location	1. Rear of 304-306 Oxford Road
Time & Duration	19.00 – 20.00 1 Hour Measurement August 21st
Weather & Site Conditions/Observations	Light occasional gusts to 2.3km/h, cloudy overcast sky, 19^0C Site Conditions – Primary noise source road traffic vehicles on Oxford Road with large vehicles, particularly buses audible although the building does provide barrier attenuation for other smaller road vehicles. Some birdsong noted during lulls in traffic flow. Noise derived at the rear is from air extraction and music from the Big Hands Bar. Pedestrians frequently walking and cycling in area. People laughing nearby during the 4th minute provide L_{Amax}.
Minutes Passed	**Observations**
0 – 60	Regular flow of traffic on Oxford Road
0 – 60	Noise from extract at Big Hands Bar
3	Oxfam employee talking nearby. L_{Amax} 66.3dB(A)
4	People laughing nearby. L_{Amax} 72.0dB(A)

Table 28: The observations taken at the measurement location 1 between 7pm to 8pm.

3. CONCLUSIONS

On comparing the results obtained for the two days of measurements, the background noise level (L_{A90}) ranges from 50dB(A) to 53dB(A) which shows that over the proposed operational period of the air-conditioning units which will be based upon the Ladbrokes betting shop opening hours, the background noise levels remain fairly constant. This is due to the consistent noise sources currently evident within the vicinity.

The proposed external unit will either be the Daikin RZQG-L7V1 or RZQ-D7V1 which are both available as four different models. The manufacturer's specification sheets detail the sound pressure level of the units during various functions. It is assumed that the sound pressure level readings are at 1 metre inline with other Daikin products data sheets.

Tables 29 and 30 detail the sound pressure levels from the manufacturer's data sheets.

Operation Mode		**RZQG71L7V1**	**RZQG100L7V1**	**RZQG125L7V1**	**RZQG140L7V1**
Cooling	Nom.	48dB(A)	50dB(A)	51dB(A)	52dB(A)
Heating	Nom.	50dB(A)	52dB(A)	53dB(A)	53dB(A)
Night quiet mode	Level 1	43dB(A)	45dB(A)	45dB(A)	45dB(A)

Table 29: External unit sound pressure level data for the RZQG-L7V1

Operation Mode		RZQ71D7V1B	RZQ100D7V1B	RZQ125D7V1B	RZQ140D7V1B
Cooling	Nom.	48dB(A)	50dB(A)	51dB(A)	51dB(A)
Heating	Nom.	50dB(A)	52dB(A)	53dB(A)	53dB(A)
Night quiet mode	Level 1	43dB(A)	45dB(A)	45dB(A)	46dB(A)

Table 30: External unit sound pressure level data for the RZQ-D7V1B

The impact of the Ladbrokes air conditioning units on the noise climate in the immediate vicinity will depend upon which model will be installed. The product data sheets show the sound pressure levels for the heating function for both units with the models 125 and 140 at 53dB. The lowest on-site noise level measured, L_{Aeq} 53.4dB would equate to the maximum sound pressure level for the top two models. It must also be noted that the highest level measured was 59.2dB L_{Aeq} so it can be assumed as the other results show, that the typical continuous equivalent noise level, L_{Aeq} or ambient noise level is typically in the mid-fifties.

Using the results obtained from the noise survey the following conclusions have been drawn;

The difference in noise levels with and without the Ladbrokes air conditioning unit in operation will be negligible.

With either the 125 or 140 models for the D7V1B or the L7V1 units installed, in the heating mode this would produce an assumed increase in the ambient noise level by 3dB at 1 metre.

However, with the air-conditioning unit operating as a point source, there will be a 6dB reduction in sound pressure level per doubling of distance. For example, if both the RZQ100D7V1B and the RZQG100L7V1 in cooling mode produce a sound pressure level of 50dB, assuming this is at 1 metre, at 2 metres the measured sound pressure level would be 44dB.

Applicable guidance when considering the impact of industrial noise on a nearby residential development can be taken from *BS 4142: 1997 – Method for Rating industrial noise affecting mixed residential and industrial areas.*

In BS 4142, Section 8 refers to a rating level and discusses the comparison between the specific noise levels i.e. when the site is in operation or a particular piece of machinery is in use, in this case if an air conditioning unit is in operation and the background noise level, i.e. when the air conditioning unit is quiet or in-operable. Sub-section 8.1 states that; *certain acoustic features can increase the likelihood of complaint over that expected from a simple comparison between the specific noise level and the background noise level. Where present at the assessment location, such features are taken into account by adding 5 dB to the specific noise level to obtain the rating level.* Sub-section 8.2 states to the adding of 5 dB to the specific noise level if one or more features are contained in the noise which includes distinguishable, discrete continuous notes or distinct impulses or the noise is irregular enough to attract attention.

Furthermore, Section 9 *Assessment method* states *a difference of around +10dB or more indicates that complaints are likely. A difference of around +5dB is of marginal significance but if the rating level is more than 10dB below the measured level then this is a positive indication that complaints are unlikely.*

On considering BS 4142 and its assessment criteria with reference to the measured background noise levels (L_{A90}) and the sound pressure level criteria for the proposed air-conditioning units, the air-conditioning model type can be determined and recommended.

4. RECOMMENDATIONS AND FINAL CONCLUSION

The proposed location for the air-conditioning units is on the ground floor extension roof, close to the first floor façade between the windows of the first floor flat. The windows are openable but as figure 1 confirms the top window is limited to how much distance it can open due to the security bars.

As the opening hours for the Ladbrokes betting shop are to be 9am to 9pm, therefore within the acknowledged daytime period 07:00 to 23:00, their will be no night-time operation of the air-conditioning units.

Additional reference is made to *BS 8233:1999 Sound insulation and noise reduction for buildings - Code of practice*. This British Standard makes reference in its table 5 which is on page 19 of the standard for the attainment of either one of two design levels. The Good design range for Living Rooms and Bedrooms is set at 30dB with the lesser but still amenable Reasonable design range of 40dB for Living Rooms and 35dB for Bedrooms. This is recommended as suitable indoor ambient noise levels when unoccupied.

An arithmetic average for all 14 background noise measurements would produce an L_{A90} 51.5dB(A).

5dB below the average of the 14 measured background noise levels is 46.5dB.

It is therefore recommended that to achieve at least 5dB below the average background noise level and on considering the close proximity to the rooms in the first floor flat, the recommended air-conditioning models for installation would be the lower powered models, the RZQG71L7V1 or the RZQ71D7V1B.

It should also be noted that if two units, operating in the same mode were running simultaneously, the cumulative noise level would be +3dB, for example, two RZQ71D7V1B units running simultaneously in night-time mode would produce a cumulative noise level of 46dB.

If it is the opinion of the appointed M&E or Air Conditioning Engineers that the RZQG71L7V1 or the RZQ71D7V1B models would not provide the required power for the retail space, the three higher specification models, the 100, 125 and 140 models could be considered but only if they are operated in the quieter *Night Quiet* mode and not the noisier *Nominal* mode.

However, some noise attenuation could be achieved by enclosing the air-conditioning units. Although a complete enclosure is not practical, such an enclosure that would shield some or all of the line of sight between the air-conditioning units and the glazed units would reduce direct noise. The amount of attenuation achieved would depend upon the amount of the units shielded and the material used to construct the enclosure.

5. SUMMARY.

Sanctuary Acoustics was asked by Ladbrokes Plc to assess the noise levels at the rear of their new betting shop located at 304-306 Oxford Road, Manchester. Planning approval was previously granted to Ladbrokes Plc thereby allowing the refit and renovation of the existing ground floor premises to proceed, but that initial approval did not extend to the installation of an air-conditioning system on the premises. This noise assessment which included two days of on-site noise measurements aims to assess the existing background noise levels to the rear of 304-306 Oxford Road where the proposed air-conditioning units would be installed and, if any what affect the proposed air-conditioning units would have on the existing background and ambient noise levels. The optimum sound pressure level produced by the air-conditioning units should also be compared with the measured background noise levels (L_{A90}) with further reference made to criteria in *BS 4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas*. Dwellings, (flats) are located on the first and second floors of the building hence the need for an accurate noise assessment.

To summarise:

1. The noise measurements were taken to the rear of 304-306 Oxford Road in the proximity of the proposed location for the air-conditioning units over a two day period, a weekend (Saturday August 10th) and a week day (Wednesday August 21st). Measurements took place over the proposed opening hours of the new Ladbrokes betting shop, 9am to 9pm and hence the operating hours of the proposed air-conditioning units.
2. The planning department have requested resolution to three points in relation to noise; *the noise output from the units, including cumulative impact of all the units operating simultaneously; any acoustic measures proposed to limit noise breakout from the units; details of the ambient noise levels during the daytime, night and weekends and how noise from the units will impact on ambient noise levels.*
3. Noise measurement parameters are detailed in the report and are based on 1-hour time intervals. The L_{Aeq}, L_{A90}, L_{Amax}, L_{Amin} and L_{A10} are detailed in the report with full 1/3 octave band data to the rear of the report in Appendix A.
4. Six 1-hour measurements were conducted on Saturday August 10th and eight measurements were conducted on Wednesday August 21st. The results obtained for both measurement days were not dissimilar. The average background noise level (L_{A90}) at the rear of 304-306 Oxford Road was 51.5dB.
5. The proposed Ladbrokes air conditioning units, either the Daikin RZQG-L7V1 or RZQ-D7V1B are available in four different models. The RZQG71L7V1 and the RZQ71D7V1B are the quietest of the four models and are recommended here. The three larger models produce higher sound pressure levels and therefore are not recommended. If the three larger models are needed due to their larger motor output, piping length etc., then they should not be operated in *Nominal* mode but in *Night Quiet* mode. The sound pressure levels were confirmed from the manufacturer's data sheets. An enclosure is also recommended to provide some noise attenuation.
6. The location for the external plant will be on the ground floor roof extension up to the first floor façade and mid-way between two first floor rooms.
7. The determining factor in the air-conditioning unit specification is based upon the relatively low levels of background noise at the rear of 304-306 Oxford Road and the proposed location of the units which would be in close proximity to the first floor rooms and their windows.

6. ANNEX A

Location 1 - Measurement 1 – August 10th

Spectrum Time Slot:	10/08/2013 11:01:46 - 12:01:45	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	64.1	50.3
16	66.9	57.2
31.50	65.3	60.0
63	64.6	59.0
125	57.5	52.7
250	54.5	49.7
500	50.2	47.0
1000	49.4	44.8
2000	47.5	41.0
4000	42.8	35.8
8000	37.6	27.8
16000	26.2	21.3
A	54.6	50.4

Location 1 - Measurement 2 – August 10th

Spectrum Time Slot:	10/08/2013 12:01:58 - 13:01:57	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	67.3	50.4
16	65.6	55.5
31.50	64.3	60.0
63	68.2	62.8
125	60.4	56.0
250	54.7	50.0
500	51.0	47.5
1000	50.0	45.6
2000	47.5	41.2
4000	42.7	36.1
8000	35.5	28.1
16000	26.8	20.6
A	55.1	51.1

Location 1 - Measurement 3 – August 10th

Spectrum Time Slot:	10/08/2013 13:02:16 - 14:02:15	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	68.4	50.0
16	65.4	54.7
31.50	66.4	61.4
63	69.4	66.1
125	63.5	59.2
250	56.6	51.7
500	52.2	49.3
1000	50.2	46.8
2000	48.4	44.5
4000	42.7	39.1
8000	35.9	29.1
16000	25.1	19.9
A	56.2	52.9

Location 1 - Measurement 4 – August 10th

Spectrum Time Slot:	10/08/2013 17:00:34 - 18:00:33	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	63.5	50.1
16	65.8	55.6
31.50	65.5	60.5
63	65.7	61.2
125	58.0	54.5
250	56.6	51.2
500	52.0	49.4
1000	49.3	46.7
2000	45.4	42.7
4000	41.4	38.0
8000	34.6	29.5
16000	25.1	20.4
A	54.7	52.2

Location 1 - Measurement 5 – August 10th

Spectrum Time Slot:	10/08/2013 18:00:57 - 19:00:56	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	62.1	49.1
16	64.8	55.2
31.50	64.6	60.0
63	65.6	60.9
125	57.1	53.8
250	55.9	51.0
500	52.0	49.7
1000	49.1	47.0
2000	44.7	42.6
4000	40.4	37.7
8000	33.3	29.3
16000	23.5	20.1
A	54.3	52.3

Location 1 - Measurement 6 – August 10th

Spectrum Time Slot:	10/08/2013 19:01:26 - 20:01:25	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	59.6	47.8
16	64.0	54.8
31.50	65.0	60.7
63	67.7	62.1
125	59.9	53.8
250	57.9	53.3
500	54.5	50.1
1000	55.3	47.2
2000	52.1	43.3
4000	43.9	38.3
8000	35.4	29.5
16000	23.4	20.6
A	59.2	52.8

Location 1 - Measurement 1 – August 21st

Spectrum Time Slot:	21/08/2013 09:05:06 - 10:05:05	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	65.6	51.5
16	67.9	59.1
31.50	69.4	65.0
63	64.1	60.7
125	55.7	53.7
250	52.6	50.3
500	50.0	47.3
1000	47.4	44.8
2000	46.5	40.9
4000	41.6	36.3
8000	34.5	28.0
16000	24.4	20.4
A	53.4	50.5

Location 1 - Measurement 2 – August 21st

Spectrum Time Slot:	21/08/2013 10:05:47 - 11:05:46	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	62.6	50.8
16	64.7	58.7
31.50	66.1	62.7
63	63.0	59.2
125	55.1	53.2
250	53.8	50.0
500	53.5	47.2
1000	47.6	44.3
2000	44.3	40.4
4000	41.3	35.7
8000	34.3	27.5
16000	24.4	20.0
A	54.1	50.1

Location 1 - Measurement 3 – August 21st

Spectrum Time Slot:	21/08/2013 11:06:09 - 12:06:08	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	67.5	51.2
16	64.8	57.8
31.50	68.0	64.2
63	63.5	60.2
125	55.5	53.5
250	51.7	49.7
500	49.2	46.8
1000	50.2	44.6
2000	51.1	40.9
4000	45.3	36.8
8000	37.5	28.6
16000	26.9	21.0
A	56.1	50.2

Location 1 - Measurement 4 – August 21st

Spectrum Time Slot:	21/08/2013 12:06:44 - 13:06:43	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	69.7	52.6
16	68.4	59.4
31.50	69.1	64.5
63	64.7	60.6
125	55.2	53.2
250	52.3	50.0
500	49.1	47.1
1000	49.0	44.8
2000	45.0	40.6
4000	41.4	36.1
8000	35.7	27.8
16000	26.4	20.1
A	53.4	50.2

Location 1 - Measurement 5 – August 21st

Spectrum Time Slot:	21/08/2013 13:07:02 - 14:07:01	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	66.1	51.8
16	67.7	59.2
31.50	70.4	65.1
63	65.1	61.0
125	56.1	53.7
250	53.1	50.3
500	50.7	47.5
1000	49.4	45.5
2000	51.9	41.5
4000	50.6	36.9
8000	45.5	28.2
16000	34.0	20.2
A	57.6	50.9

Location 1 - Measurement 6 – August 21st

Spectrum Time Slot:	21/08/2013 17:00:10 - 18:00:09	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	63.5	51.0
16	65.4	57.4
31.50	67.1	62.9
63	66.1	61.8
125	56.5	54.0
250	55.3	51.6
500	54.8	50.0
1000	50.4	47.3
2000	46.4	43.5
4000	42.7	38.9
8000	34.9	30.8
16000	25.5	21.3
A	55.9	52.7

Location 1 - Measurement 7 – August 21st

Spectrum Time Slot:	21/08/2013 18:00:50 - 19:00:49	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	64.1	51.8
16	66.5	58.2
31.50	67.7	64.0
63	66.5	61.3
125	57.7	54.1
250	55.3	51.5
500	52.8	49.4
1000	51.9	47.2
2000	50.5	43.6
4000	45.8	38.9
8000	36.6	30.8
16000	24.9	21.1
A	57.1	52.7

Location 1 - Measurement 8 – August 21st

Spectrum Time Slot:	21/08/2013 19:01:23 - 20:01:22	
Frequency [Hz]	L_{eq} [dB]	L_{90} [dB]
8	61.9	50.6
16	65.9	58.0
31.50	67.8	63.8
63	66.4	61.0
125	56.4	53.4
250	54.3	50.8
500	52.3	48.9
1000	49.2	46.5
2000	45.1	42.9
4000	40.9	38.3
8000	32.9	30.2
16000	22.8	20.8
A	54.3	51.9

7. ANNEX B

Acoustics Glossary of Terms

$L_{Aeq,T}$ – Equivalent continuous sound pressure level. This is the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that within a specified time interval, T, has the same mean squared sound pressure as a sound that varies with time.

L_{A10} – The A-weighted mean square sound pressure level that is exceeded for 10% of the time.

L_{A90} – The A-weighted mean square sound pressure level that is exceeded for 90% of the time. Referred to as the background noise level.

L_{Amin} – The lowest A-weighted noise level recorded during a noise event.

L_{Amax} – The highest A-weighted noise level recorded during a noise event.