Origin Housing Group

Loudoun Road, Camden

Noise and Vibration Assessment

Project Ref: 22711/001

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June 2009

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1 Introduction

1.1. Peter Brett Associates LLP (PBA) has been commissioned by Origin Housing Group to assess the suitability of the development site for residential use, with respect to the existing noise and vibration climate. The site is located on Loudoun Road with London overground railway lines running to the north of the site.

1.2. A day-time and night-time noise assessment has been carried out to establish whether planning guidelines detailed in Planning Policy Guidance Note 24, '*Planning and Noise*', would be met and to discuss any mitigation measures that may be necessary.

1.3. This report sets out the relevant policy guidance, a description of the noise survey undertaken together with the measurement results. An analysis of the survey measurements has been undertaken to classify the site and its suitability for a residential development.

1.4. A vibration assessment has also been carried out to ascertain the extent of groundborne vibration levels experienced on site from nearby railway movements.

2 Guidance and References

2.1 Planning Policy Guidance Note 24: '*Planning and Noise*'

2.1.1. Planning Policy Guidance 24: '*Planning and Noise*' (PPG24), Department of Environment, September 1994 is used to assess the noise levels at development sites and to determine whether a site has a suitable noise climate so as not to preclude the granting of planning permission. For new dwellings, the guidance sets four Noise Exposure Categories (NECs) which differ according to the noise sources affecting the site. In the case of this development, the noise sources are rail and road traffic. The NEC categories for road traffic sources are given in Table 1 and in Table 2 are the NEC categories for rail traffic.

Time Period	Noise Exposure Category			
	A	B	C	D
07:00-23:00 hrs	<55	55-63	63-72	>72
23:00-07:00 hrs[1]	<45	45-57	57-66	>66

Table 1: PPG24 Noise Exposure Categories from Road Traffic (dB $L_{Aeq,T}$)

Time Period	Noise Exposure Category			
	A	B	C	D
07:00-23:00 hrs	<55	55-66	63-74	>74
23:00-07:00 hrs[1]	<45	45-59	59-66	>66

Table 2: PPG24 Noise Exposure Categories from Rail Traffic (dB $L_{Aeq,T}$)

[1]**Night-time Noise Levels (23:00–07:00 hrs)**: Sites where individual noise events regularly exceed 82 dB L_{Amax} (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq, 8hr}$ (except where the $L_{Aeq,8hr}$ already puts the site in NEC D).

2.1.2. Local planning authorities should have regard to the advice in the appropriate NECs as below:

- **NEC A**: Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.

- **NEC B**: Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.
- **NEC C**: Planning permission should not normally be granted. Where it is considered that permission should be given, for example because here are no alternative sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
- **NEC D**: Planning permission should normally be refused.

2.2 BS 8233: 'Sound Insulation and Noise Reduction for Buildings – Code of Practice'

2.2.1. PPG24 refers to British Standard 8233:1987 '*Sound Insulation and Noise Reduction for Buildings – Code of Practice*'. This standard has been superseded by BS8233: 1999 which sets out, in Section 7.0, recommended indoor noise levels for residential habitable rooms, such as living rooms and bedrooms.

2.2.2. Table 3 below sets out the design criteria for indoor ambient noise levels for unoccupied habitable rooms, as given in Table 5 of BS 8233:1999:

Criterion	Typical Situations	Design Range $L_{Aeq,T}$ dB	
		Good	Reasonable
Reasonable Resting/ Sleeping Conditions	Living rooms	30	40
	Bedrooms[a]	30	35
[a] For a reasonable standard in bedrooms at night, individual noise events (measured with F time-weighting) should not normally exceed 45 dB L_{Amax}			

Table 3: BS 8233 Recommended Internal Ambient Noise Levels

2.2.3. BS 8233 also makes reference to noise levels in gardens, advising that a noise level of 55 dB $L_{Aeq,T}$ should be regarded as an upper limit.

2.3 Calculation of Road Traffic Noise (CRTN):1988

2.3.1. CRTN, Department of Transport (DoT), Welsh Office: 1988, is a memorandum that describes the procedure for calculating noise from road traffic. The methodology is used to determine noise levels from roads due to factors such as the volume and speed of traffic. In Section III it also provides guidance on measuring the day-time noise level ($L_{A10,\ 18hr}$), using two methods.

2.3.2. The first measurement method calculates the arithmetic mean of 18 consecutive 1 hour measurements taken between 07:00 - 23:00 hrs. The second method, called the shortened measurement procedure, recognises the trends in traffic profiles and corrects the arithmetic mean of three readings taken in consecutive hours between 10:00-17:00 hrs to provide a reliable estimate of the 18-hour noise level.

2.3.3. The $L_{A10,18Hr}$ parameter calculated within CRTN can be converted to the noise indicators $L_{Aeq,12Hr}$ (07:00-19:00), $L_{Aeq,16Hr}$ (07:00-23:00), $L_{Aeq,4Hr}$ (19:00-23:00) and $L_{Aeq,8Hr}$ (23:00-07:00) using the procedures contained within the TRL report prepared for DEFRA called 'Method for converting the UK road traffic noise index LA10,18h to the EU noise indices for road noise mapping', dated January 2006.

2.4 BS 6472:2008: Evaluation of Human Exposure to Vibration in Buildings

2.4.1. British Standard 6472-1: 2008 "*Guide to Evaluation of Human Exposure to Vibration in Building. Vibration sources other than blasting*" is used to assess vibration levels experienced by people in buildings with respect to human comfort.

2.4.2. Human exposure to vibration in buildings can be assessed in terms of Vibration Dose Value (VDV), velocity or weighted RMS acceleration.

2.4.3. BS 6472-1 states that VDVs can be used to assess the human exposure to vibration when the vibrations are of impulsive or intermittent type. As the train induced vibration is of intermittent type on this site, a VDV calculation approach has been used.

2.4.4. BS 6472-1 provides recommended Vibration Dose Values (VDVs) criteria for day-time (07:00-23:00hrs) and night-time (23:00 - 07:00 hrs) for residential properties. These criteria are presented in Table 4 below:

Time Period	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Day-time VDV ($m/s^{1.75}$) (07:00 - 23:00 hrs)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Night-time VDV ($m/s^{1.75}$) (23:00 - 07:00 hrs)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Table 4: Day-time and Night-time VDV Criteria for Residential Properties

2.4.5. The vibration dose summation methodology outlined in Section 3.5 of BS 6472-1 has been used to calculate the overall day-time and night-time VDVs. The calculation considers a typical single event VDV along with the number of events occurring within the chosen period to then output an overall VDV.

2.5 Local Planning Guidance

2.5.1. The London Borough of Camden "*Replacement Unitary Development Plan"* (UDP), June 2006 provides guidance on noise and vibration thresholds which will normally be applied in preference to those in PPG24. These are detailed in Tables A, B and C from the 2006 UDP provided in Appendix B.

2.5.2. It should be noted that the criteria separates the day into a 12 hour day and 4 hour evening periods whereas PPG24, as presented in Tables 1 and 2, has these as one 16 hour period. Both these time periods have been assessed in this report. The criteria also describes the measurement location as being '1m external to a sensitive façade'. As the noise survey would be undertaken prior to any proposed development being built there would not usually be any façade on the site and therefore this description has been taken to mean any proposed façade. Furthermore, the measurements in the Tables are assumed to be free-field measurements as is the case in PPG24 in the absence of any proposed buildings without any façade corrections. A further comment on the tables is the reference to the vibration levels which refer to BS6472:1992. It should be noted that this standard was updated in 2008 as presented in Section 2.4 and this report uses this standard to assess the vibration levels as well as those documented in the UDP tables. A final comment on the tables is that Table A covers the night-time as between 23:00 – 07:00 and provides an $L_{Aeq,8hr}$ value to be assessed against. However, in Table B the night-time covers the same 8-hour period but provides an $L_{Aeq,1hr}$ value to be assessed. In this report the full 8 hour night-time noise level has been assessed as it is consistent with the other parameters given in the table.

2.5.3. Policy SD7 B – Noise/Vibration Pollution states that “Unless appropriate attenuation measures are available and are included, the Council will not grant planning permission for:

a) development likely to generate noise/vibration pollution; or

b) development sensitive to noise/vibration in locations with noise/vibration pollution.”

3 Baseline Conditions - Noise

3.1 Noise Climate

3.1.1. The dominant source of noise experienced across the development site was noted to be from road traffic using Loudoun Road and Alexander Road that border the south and west of the site.

3.1.2. The other source of noise affecting the development is from the railway movements associated with the London overground lines that operate to the north of the site. The station South Hampstead is situated directly adjacent the northern boundary of the site. However, the railways are in a cutting of approximately 15m, which serves to attenuate the noise source.

3.2 Survey Details

3.2.1. A noise survey was undertaken at the site on 20 and 21 May 2009. Measurements were taken at three free-field locations. The first location was to the north of the site, approximately 5-10m from the boundary that faces the overground railway lines. The second location was at the south of the site directly facing Alexander Road. The third location was at the western boundary of the site directly facing Loudoun Road. As there is an existing building on the western part of the site this measurement location was closer to the road than any proposed dwelling would be and therefore this location will need to be corrected back for distance to determine the relevant noise level experienced from Loudoun Road. The noise survey locations are shown in Appendix A, Figure 1.

3.2.2. At Location 1 (N1, Figure 1) an unattended long term measurement was undertaken continuously over a period of 24-hours. At Locations 2 & 3 (N2 and N3, Figure 1) road traffic noise was measured using the CRTN shortened measurement procedure over a period of three consecutive hours at each location during the daytime.

3.2.3. The following equipment was used for the survey:

- Brüel and Kjær Type 2250 integrating sound level meter (S/N 2626230)
- Prepolarized Free-field 1/2" Microphone Type 4189 (S/N 2621208)
- Sound level calibrator type Brüel and Kjær Type 4231 (S/N 2619373)
- Brüel and Kjær Type 2250 integrating sound level meter (S/N 2626231)
- Prepolarized Free-field 1/2" Microphone Type 4189 (S/N 2621209)

3.2.4. On-site calibration checks were performed before and after all measurements with no significant drift being observed. The meter and calibrator also have valid laboratory calibration certificates.

3.2.5. Weather conditions remained dry during the survey with wind speeds of less than 1 m/s. Temperatures remained above 10℃ during the daytime . Night-time conditions remained stable so as not to affect the noise measurements.

3.2.6. The sound level meter was mounted on a tripod with the microphone 1.3m above the immediate ground level.

3.2.7. A windshield was fitted over the microphone at all times during the survey period to reduce the effects of any wind-induced noise.

4 Noise Measurements Results

4.1 Presentation of Results

4.1.1. Table 5 presents the measurement results for Location 1. At this location a long-term measurement was undertaken and the PPG24 day and night parameters, $L_{Aeq,16\ hr}$ and $L_{Aeq,8hr}$, are presented along with the highest measured L_{Amax} noise level during the night-time period. Also included are the day and evening noise levels as specified in the LBC replacement UDP criteria.

Measurement Location	Day-time dB $L_{Aeq,16\ hr}$	Day-time dB $L_{Aeq,12\ hr}$	Evening dB $L_{Aeq,4\ hr}$	Night-time dB $L_{Aeq,8\ hr}$	Night-time dB $L_{Amax,S}$
1	57.7	57.7	57.6	54.5	77.3

Table 5: Noise Measurement Results for Location 1

4.1.2. For Locations 2 & 3 at which road traffic noise was measured for three consecutive hours during the daytime, the $L_{Aeq,T}$ and $L_{A10,T}$ parameters are presented in Table 6. Adjustment of these levels into the day, evening and night parameters is detailed in Section 5 of this report.

Measurement Location	Day-time dB $L_{Aeq,3\ hr}$	Day-time dB $L_{A10,3\ hr}$
2	61.5	63.1
3	63.5	67.3

Table 6: Noise Measurement Results for Location 2 and 3

5 Planning and Noise Analysis

5.1 Location 1

5.1.1. At Location 1 measurements were undertaken at the position where the facades of proposed dwellings facing the railway would be situated. Therefore no corrections have been applied to the measurements. The long term measurement provided an $L_{Aeq,16hr}$ noise level of 57.7 dB and a night-time $L_{Aeq,8hr}$ level of 54.5dB. It is noted that the worst-case night time $L_{Amax,S}$ event noise level is below the 82dB value stated in PPG24.

5.1.2. Analysing these results against Table 2 taken from PPG24, it can be seen that Location 1 falls within NEC B during the daytime and night-time periods. For dwellings falling within NEC B limited mitigation measures would need to be applied to ensure noise levels fall within the internal noise criterion of BS 8233.

5.1.3. Analysing these results against the LBC replacement UDP criteria, it can be seen that Location 1, at 54.5dB $L_{Aeq, 8h}$ at night time may require attenuation measures.

5.2 Locations 2 & 3

5.2.1. For Locations 2 and 3 the shortened CRTN measurement procedure was followed to provide the $L_{A10,3hr}$ value. This level was then converted to the $L_{A10,18hr}$ value by subtracting 1dB as stated in CRTN.

5.2.2. The predicted $L_{A10,18h}$ traffic noise levels determined by CRTN was then converted to the standard PPG24 day (07:00 – 23:00 hrs) and night (23:00 – 07:00 hrs) L_{Aeq} levels using the conversion factors provided by the Transport Research Laboratory (TRL). The results are presented in Table 7. The TRL conversion factors have also been used to provide the day and evening measurements as specified in the LBC replacement UDP criteria. For Location 3 a distance correction has been applied. This was because the measurement was undertaken close to Loudoun Road due to the presence of an existing building, which did not allow for a free-field measurement to be undertaken at the location of the proposed dwelling façade.

Measurement Location	Day-time dB $L_{Aeq,16hr}$	Day-time dB $L_{Aeq,12\ hr}$	Evening dB $L_{Aeq,4\ hr}$	Night-time dB $L_{Aeq,8hr}$
2	59.8	60.4	57.4	52.1
3	60.8	61.4	58.4	52.9

Table 7: Calculated Noise Levels

5.2.3. The above table demonstrates that in relation to PPG24's guidance for new dwellings both locations would fall within NEC B during the daytime and night-time periods.

5.2.4. In relation to LBC's criteria the levels are shown to be within the range that would require attenuation measures during the evening and night. Mitigation is discussed in Section 7 of this report.

6 Vibration Measurement & Analysis

6.1 Introduction

6.1.1. A vibration survey was undertaken during the day-time period on 20th May 2009 to assess the groundborne vibration for the railway. The assessment was undertaken in line with BS6472-1:2008. This document advises on the degree of adverse comment that may be expected in residential buildings based on the vibration dose values (VDV, $m/s^{1.75}$).

6.1.2. It should be noted that the railway is situated in a cutting of approximately 15m below the site level.

6.2 Vibration Survey

6.2.1. Vibration measurements were carried out at Location V1 to the north of the site (refer to Appendix A, Figure 1). The location was chosen as it experiences a typical level of railway vibration close to the site boundary.

6.2.2. The following instrumentation was used for the vibration measurements:

- Rion VM 54 Tri-axial Vibration Meter
- Rion VX-54WB1 Whole Body Vibration Program Card

- Rion PV-83CW Tri-axial Accelerometer

6.2.3. BS 6472-1 states that: "*Measurements of vibration should normally be taken on a building structural surface supporting a human body*". However, as the buildings do not yet exist, the transducer was mounted onto an inertia block with three spikes directly in contact with the surface of the ground.

6.2.4. A Rion VM-54 Tri-Axial Vibration Meter was used as this gives the VDV value direct from the measurements. VDVs were measured for a number of passenger and freights trains. The meter was left to continually log the VDV value over the following time period:-

- 13:45 –15:00 hrs (20/05/09)

6.3 Presentation of Vibration Results

6.3.1. Table 8 shows the typical VDVs for single passenger and freight train events, at Location V1. It considers train events from both directions (north and southbound).

Typical Passenger Single Train Event VDV ($m/s^{1.75}$)	Typical Freight Single Train Event VDV ($m/s^{1.75}$)
0.01	0.02

Table 8: Single Train Events VDVs – Location V1

6.3.2. Both typical single train event VDVs and train flows were used to calculate the overall day-time (16 hours) and night-time (8 hours) VDVs from the train data supplied by PBA Transportation following the methodology outlined in Section 3.5 of BS 6472-1. Table 9 shows the overall results.

Overall VDV ($m/s^{1.75}$)	
Day-time (16 hours)	Night-time (8 hours)
0.06	0.05

Table 9: Overall Day-time and Night-time VDVs – Location V1

6.4 Analysis of Vibration Results

6.4.1. The overall day-time and night-time VDVs have been assessed against the BS 6472-1 criteria and are presented in Table 10 below.

Measurement Location	Time Period	Overall VDV ($m/s^{1.75}$)	Lowest BS 6472 Criteria	BS6472 Assessment
V1	Day-time (07:00–23:00 hrs)	0.06	0.2	Below "*low probability of adverse comment*"
	Night-time (23:00–07:00 hrs)	0.05	0.1	Below "*low probability of adverse comment*"

Table 10: Day-time and Night-time VDVs

6.4.2. As can be seen in Table 10 above, that the day-time and night-time VDVs for both locations fall significantly below the relevant standard's "*low probability of adverse comment*" criteria with respect to human comfort in residential buildings, and meet the LBC criteria for vibration in dwellings.

6.4.3. In view of the above findings it is concluded that groundborne vibration is not a significant issue with respect of residential development at this site.

7 Mitigation - Noise

7.1 Introduction

7.1.1. The following mitigation measures have been outlined based on the noise survey results and corresponds to the areas of the site close to the site boundaries to the north, west and south.

7.2 Indoor Ambient Noise Levels

7.2.1. In Section 7.0 of BS 8233:1999 reference is made to suitable indoor ambient noise levels in living rooms and bedrooms in dwellings.

7.2.2. Calculations have been undertaken to estimate the required standard of glazing to obtain the recommended internal noise levels given in BS 8233.

7.2.3. For the proposed residential apartments facing the railway to the north of the site (ie Location 1), these dwellings would fall within NEC B. For facades containing habitable rooms that are exposed to such noise levels, it is recommended that glazing with a Weighted Sound Reduction Index of at least R_w = 30 dB should be specified in order to achieve the '*good*' design standard as advised in BS 8233.

7.2.4. For proposed residential properties to be located in the vicinity of survey Locations 2&3, directly facing Loudon Road and Alexander Road, the noise levels experienced would be higher than at Location 1 due to unshielded road traffic noise exposure. For habitable rooms directly facing the southern and western site boundaries measurements undertaken at Locations 2&3 indicate that installation of double glazing offering minimum Weighted Sound Reduction Index of R_w = 32 dB should be sufficient to ensure internal noise levels are below 30dB.

7.3 Garden Areas

7.3.1. A proposed private garden area is shown on the northern boundary directly facing the railway. Measurements undertaken at Location 1 are representative of the noise levels likely to be experienced in these garden areas.

7.3.2. The measurement results show that the noise levels at this location would be 57dB, which would exceed the BS 8233 day time outdoor upper limit criterion of 55dB $L_{Aeq,T}$. If considered appropriate, this moderate excess in noise level could be dealt with by mitigation to this noise-sensitive space by incorporating an acoustic fence to protect any private garden areas exposed to railway noise.

8 Conclusion

8.1. An assessment of the noise levels affecting the proposed residential development site at Loudoun Road, Camden has been carried out. The main noise sources affecting this site are road traffic and railway movements associated with the London overground. The noise sources affecting the development site have been assessed using the PPG24 Noise Exposure Categories (NECs) and the London Borough of Camden Noise and Vibration thresholds.

8.2. It has been found that the site falls into NEC B or within the LBC threshold for the requirement of attenuation measures for the evening and night-time periods at the southern and western boundaries and during the night-time at the northern boundary. Any dwellings proposed on land lying within NEC B would require a limited degree of noise mitigation to ensure acceptable internal noise levels are achieved. Measures have been outlined to achieve '*good*' conditions for residential internal noise levels as advised in BS 8233.

8.3. Noise levels for garden areas have also been assessed. It has been concluded that the noise levels in garden areas would exceed the outdoor criteria by a small degree and appropriate mitigation measures could be incorporated to ensure the levels do not exceed the appropriate criteria.

8.4. The Vibration Dose Value resulting from the operation of the nearby railway is well below the threshold criteria that would indicate a '*low probability of adverse comment*' with respect to the relevant human comfort standard for residential buildings. It is concluded that groundborne railway vibration would not be a significant issue with respect to residential development at this site.

8.5. Against this background, it is considered that development proposals would not be constrained by noise levels, subject to the implementation of appropriate mitigation measures.

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Appendix A: Figures

Figure 1 – Noise Measurement Locations

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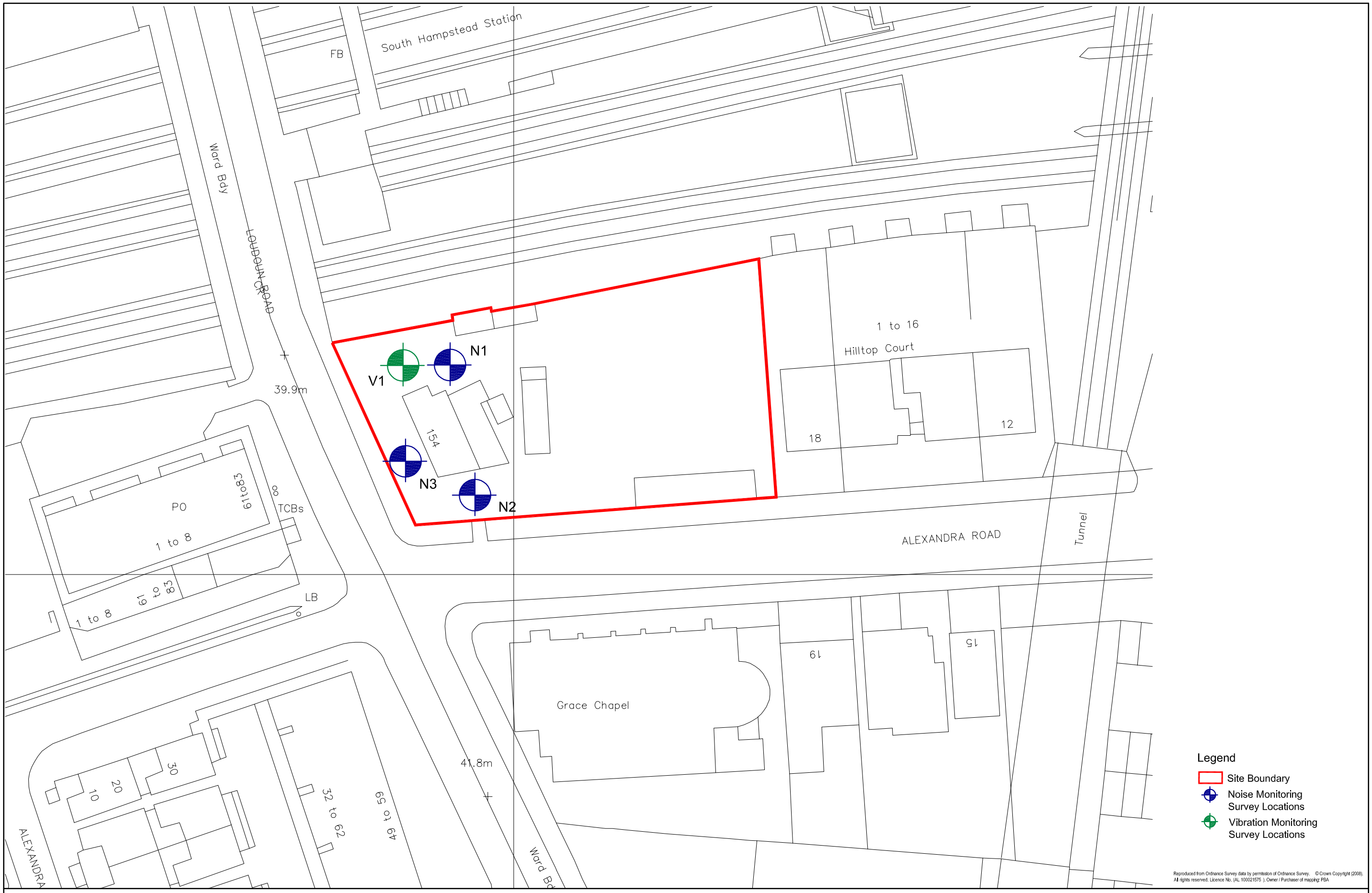

Origin Housing Group	pba peterbrett	**Loudoun Road - Camden** Noise and Vibration Survey Locations	**Figure 1** Date: June 2009 Drawn By: CF Checked By: SP Scale: 1.:500

Appendix B: LBC Local Policy (2006 UDP) – Extract N&V Tables

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Table A: Noise levels on residential sites adjoining railways and roads at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1 metre external to a sensitive façade	Day	0700-1900	74 dB L_{Aeq},12h	72 dB L_{Aeq},12h
Noise at 1 metre external to a sensitive façade	Evening	1900-2300	74 dB L_{Aeq},4h	72 dB L_{Aeq},4h
Noise at 1 metre external to a sensitive façade	Night	2300-0700	66 dB L_{Aeq},8h	66 dB L_{Aeq},8h

Table B: Noise levels on residential sites adjoining railways and roads at and above which attenuation measures will be required

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1 metre external to a sensitive façade	Day	0700-1900	65 dB L_{Aeq},12h	62 dB L_{Aeq},12h
Noise at 1 metre external to a sensitive façade	Evening	1900-2300	60 dB L_{Aeq},4h	57 dB L_{Aeq},4h
Noise at 1 metre external to a sensitive façade	Night	2300-0700	55 dB L_{Aeq},1h	52 dB L_{Aeq},1h
Individual noise events several times an hour	Night	2300-0700	>82dB L_{Amax} (S time weighting)	>82dB L_{Amax} (S time weighting)

Table C: Vibration levels on residential sites adjoining railways and roads at which planning permission will not be granted (BS 6472:1992)

Vibration description and location of measurement	Period	Time	Vibration levels
Vibration inside critical areas such as a hospital operating theatre	Day, evening and night	0000-2400	0.1 VDV ms-1.75
Vibration inside dwellings	Day and evening	0700-2300	0.2 to 0.4 VDV ms-1.75
Vibration inside dwellings	Night	2300-0700	0.13 VDV ms-1.75
Vibration inside offices	Day, evening and night	0000-2400	0.4 VDV ms-1.75
Vibration inside workshops	Day, evening and night	0000-2400	0.8 VDV ms-1.75
Where dwellings may be affected by ground-borne regenerated noise internally from, for example, railways or underground trains within tunnels, noise levels within the rooms should not be greater than 35dB(A)max			