aulos ACOUSTICS

163 Iverson Road, West Hampstead

Environmental Noise & Vibration Report

Thursday, 15 December 2011

James Tomalin

163 Iverson Road, West Hampstead

Environmental Noise & Vibration Report

contents

163 Iverson Road, West Hampstead

Environmental Noise & Vibration Report

contents

document control

Document Reference	Revision	Title & Revision Comment	Checked	Approved	Date
1160 JT R556-52		Environmental Noise & Vibration Report	JT	JT	15.12.11

163 Iverson Road, West Hampstead

Environmental Noise & Vibration Report

Introduction

Aulos Acoustics has been appointed by Winbush Properties Ltd to undertake an investigation of environmental noise impact affecting 163 Iverson Road, West Hampstead.

The project is a proposed residential development comprising a new-build scheme. The application site is, potentially, noise-sensitive requiring an investigation of the effect of noise exposure on the proposed residential property. The principal noise sources of concern are:

- Railway traffic
- Operations and Vehicle Movements

The proposed scheme is a residential development consisting of 33 units of one, two and three bedroom apartments and three two bedroom houses. The application site is developed land adjoining a principal railway, a small commercial unit and the West Hampstead Thameslink and Midland Mainline Station.

Consequently, the future occupants may be exposed to existing noise sources. An investigation is required to determine the risk of material effects on future residential amenity.

The following reports the results and conclusions of the investigation made in accordance with local, regional, national requirements.

Information Used

The full dexter moren associates drawing package has been used in completing the investigation.

Further guidelines and standards are referenced in the report and detailed in the attached Appendix B.

No prior noise or vibration investigations have been made at the application site to the best knowledge of the author.

Planning Framework

The policy framework under which the application site needs to be assessed is defined in the following documents:

- PPG24 Planning & Noise (1)
- Camden Local Development Framework. Development Policies 2010-2025 (2)
- The London Plan (3)

Further guidance on the approach to noise across London is provided in the Sounder City The Mayor's Ambient Noise Strategy (4).

Planning Policy Guidance PPG24

Where new residential property is proposed and it may be affected by existing noise sources, an assessment in accordance with the requirements of PPG24 shall be completed normally.

The assessment process includes the categorization of the application or areas of the application site to determine which Noise Exposure Category (NEC) these fall into. NEC bands are referred to as NEC A to NEC D and are set in terms of $L_{Aeq,16hour}$ daytime, and $L_{Aeq,8hour}$ night-time noise levels free-field, 1.2 - 1.5m above ground level.

The Noise Exposure Categories for the principal transportation noise sources are as follows:

NEC		A	B	C	D	
Road						
Day	07:00-23:00h	<55	55-63	63-72	>72	$L_{Aeq,16h}$ dB
Night	23:00-07:00h	<45	45-57	57-66	>66	$L_{Aeq,8h}$ dB
Rail						
Day	07:00-23:00h	<55	55-66	66-74	>74	$L_{Aeq,16h}$ dB
Night	23:00-07:00h	<45	45-59	59-66	>66	$L_{Aeq,8h}$ dB
Air						
Day	07:00-23:00h	<57	57-66	66-72	>72	$L_{Aeq,16h}$ dB
Night	23:00-07:00h	<48	48-57	57-66	>66	$L_{Aeq,8h}$ dB

Table 1a – Recommended Noise Exposure Categories for New Dwellings

Note: In addition, sites where individual noise events regularly exceed 82dB(A) L_{max}(slow), several times in any night time hour should be treated as being in NEC C, unless the L_{eq}(8 hour) already puts the site in NEC D.

The measured and analysed noise levels are compared to the above ranges to determine which category the application site falls into. Planning policy guidance is provided in PPG24 to Local Planning Authorities for each Noise Exposure Category. These provide an objective means for investigating the potential adverse effects of noise on future residents. Minor variations in the above category boundaries are permitted.

The planning guidance for each NEC is as follows:

NEC	PPPG24 Guidance
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.
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.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

Table 1b – Noise Exposure Category Planning Advice

PPG24 recommends the further reading and guidance is available in various documents and standards. Key among these are:

- BS8233:1999 *Sound insulation and noise reduction for buildings-Code of practice* (3)
- BS 4142:1997 *Method for rating industrial noise affecting mixed residential and industrial areas* (4)

The planning guidance, whilst ostensibly objective, does not provide a significant degree of detailed direction. Further information in the PPG24 provides only general guidance. Consequently, the application of the Noise Exposure Categories guidance has developed over time.

Aulos applies a varied approach to each NEC and within those categories due to the wide range of noise levels they address. A general guide to the approach and some of the implications in planning can be found in Appendix E.

Local Planning Policy

The current planning policies of London Borough of Camden ["LBC"] are defined in the Local Development Framework 2010-2025 (2)["LDF"]. The relevant specific policies are understood to be:

- DP28. Noise and vibration

The relevant core strategic policies are understood to be:

- CS14. Promoting high quality places and conserving our heritage
- CS16 – Improving Camden's health and well-being.

DP28 states the following:

Policy	Statement
DP28. Noise and vibration	The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for: a) development likely to generate noise pollution; or b) development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided. Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted. The Council will only grant permission for plant or machinery if it can be operated without cause harm to amenity and does not exceed our noise thresholds. The Council will seek to minimise the impact on local amenity from the demolition and construction phases of development. Where these phases are likely to cause harm, conditions and planning obligations may be used to minimise the impact.

Table 2 – LB Camden Planning Policy

The reasoned justification and detail of the policy section then defines a series of Noise & Vibration Thresholds on which planning decisions shall be based. These are reproduced in Appendix E.2.

Table A defines the thresholds above which noise will be refused.

Table B defines the thresholds above which noise attenuation measures are required.

At this time, the threshold values do not accord with national planning policy, as set out in PPG24, in the following manner:

a) Separate evening and daytime periods are used to divide the 16 hour day of PPG24

b) Evening values are more stringent as such large fall in evening noise may not occur for the prevailing road or rail noise source

c) All values are more stringent by virtue of a 3dB façade reflection where none applies in PPG24

In effect, LB Camden defines a refusal position where noise levels are at or below the NEC D boundary.

The criteria are those defined in the previous Local Plan and SPG relating to noise. The Camden Noise Strategy 2002 stated:

> **16.26 There are three time periods in the standard, rather than the two time periods in PPG24, because of the considerable density of the rail and road network and the wide range of tourism and entertainment facilities in the Borough. These factors combine to make the area particularly susceptible to road and rail noise during the evening period, when local residents are entitled to expect reasonable peace and quiet in their own homes.**

No time period variations are permitted under PPG24, which states in Annex 1:

> **7.** Traditionally, different indices have been used to describe noise from different sources, and limits have been set over different time periods. This has caused confusion, and this PPG follows the move towards consistency advocated in BS 7445: 1991 by expressing all noise in terms of $L_{Aeq,T}$. The recommended time periods are 07.00-23.00 and 23.00-07.00.

By contrast, the Table B values adopt an approach which at least clarifies the point where attenuation is expected, without defining a basis for the approach. These place the threshold values in NEC B, although again the different time periods skew comparison with PPG24.

Without the benefit of the national consultation process applied in developing Planning Policy Guidance / Statements, the local planning policy remains contrary to current guidance. The benefits of a consistent and comparable approach will not accrue. In comparison, few if any other London Boroughs adopt a day, evening and night approach, and the London Ambient Noise Strategy does not require or encourage such an approach at this time. Critically, neighbouring City of Westminster has a similar or greater density of transport infrastructure and "tourism and entertainment facilities" and a developed approach to noise historically. Westminster retains the PPG24 approach.

Most urban environments experience extended periods of road and railway noise. The benefits to residents of highly-developed transport infrastructure generally outweigh the potential adverse effects. Benefits include greater employment flexibility and choice, as well as wider options for leisure, entertainment and training/education.

The investigation will consider both approaches and identify the implications of the evening approach, if any.

The application site required investigation for noise and vibration exposure. The recommended method of determining the prevailing noise climate is by direct survey over an extended period.

Arrangements were made to install meters on the site to measure noise and vibration from 29 September to 6 October 2011.

Limitations

Critical to the outcome of any survey are the conditions of the main sources being considered. At the time of the survey particular restrictions apply to both the noise and vibration exposure:

- Thameslink Programme is incomplete till 2015-2018
- Restrictions apply on Thameslink operations outside peak hours till May 2012
- Nearest long siding and relief tracks of the railway have been unused for three years
- Nearest relief track will not become operationally active till Late Winter / Spring 2012
- Full, current operation of relief track and mainline not expected till well into 2012

In general, noise exposure is unlikely to be as greatly affected as vibration. The relief track is at a similar distance to the nearest mainline tracks and will experience many fewer train movements. The combination of fast trains and stopping trains on the operational lines should remain the main component of the noise climate even when Thameslink becomes fully active and the relief track is operational.

The noise survey was completed and is discussed further below.

Vibration is more likely to be determined by nearest track due to proximity, but also to the types of trains, which will be disproportionately heavy, such as some freight traffic and peak hour passenger movements.

The vibration survey was deferred and is discussed further below.

Construction works on the nearest tracks and support for the West Hampstead Thameslink station refurbishment mean that the results of the survey were affected at times by a number of extraneous noise sources including:

- Site machinery & vehicles on tracks and on Iverson Road
- Manual working and impacts on the reconditioned railway
- Mechanical and powered equipment used in and around the station

Where feasible, the effect of the works will be determined, but the following general framework applies:

- Works on permanent way are limited to 07:00-16:00 (generally) during Monday to Friday with additional Saturday morning period
- Works on station generally use same or similar hours but during the survey period were permitted to use a 24-hour weekday approach for the period of the survey

Noise Survey

An environmental noise survey was undertaken in accordance with the measurement requirements of PPG24 (1) and BS7445:2 (7).

The measurement parameters and settings used were as follows:

Symbol	Name	General Description
LAeq,T	Continuous equivalent sound pressure level	Single figure value averaging varying sound signal over period T
LpA	Sound Pressure Level	Average over each high resolution period t of sample period T
LAFmax	Maximum sound pressure level FAST	Highest 125ms sound pressure level over T
LASmax	Maximum sound pressure level SLOW	Highest 1s sound pressure level over T
LA10	Statistical Lp – level exceeded 10% of time	Typical highest noise level
LA50	Statistical Lp – level exceeded 50% of time	Median noise level
LA90	Statistical Lp – level exceeded 90% of time	Typical minimum Background noise level
A	A frequency weighting	"Equal loudness" weighting for moderate noise levels
F	FAST time weighting	A quick reaction time for measurement
S	SLOW time weighting	A slower reaction time for measurement
T	Sample time period	Five minute (5min)
t	Recording Resolution	One second (1s)

Table 3 – Survey Measurement Parameters

Intermittent audio recordings were also made using the following settings:

24 bit	30 second period	Trigger by level
48kHz	10 second delay	57dB(A) trigger level

The survey measurements began 14:00 hours on 29 September 2011 and ended at 16:00 hours on 6 October 2011.

Weather conditions were changeable over the period with high winds initially falling to within measurement parameters on 30 September except for brief periods over the following week. Rainfall was intermittent but light.

The equipment used was a Norsonic 140 with GRAS all-weather microphone. The microphone was located on the rear (north) boundary with the railway at 3m above ground level: Measurement Position M1. The Measurement Location Plan and more detailed equipment information are provided in Appendix C.

The position was selected at the point of maximum subjective noise exposure to the trains in an area of the proposed building more open to propagation.

Measurement data was downloaded and post-analysed using Norsonic Nor-Review software.

Vibration

Vibration measurements may be dominated by heavy sources close to the building foundations. The full use of the five operational tracks will not resume till May 2012 at the earliest. Bringing the relief track into full operation may take longer, based on discussions with NetworkRail (rail infrastructure) and First Capita Connect (train operating company).

For this reason, the survey was deferred following consultation with Camden Environmental Health Officers Anita Kidby and Hardesh Bhatti. The confirmatory email sent on 21 October 2011 is attached in Appendix C.3.

The clear understanding is that a deferred approach by condition is acceptable and this would include the following elements, as stated in the email:

"We would submit a "prior to construction" planning condition providing Camden Council with the ability to approve or disapprove any proposals. This would consist of the following requirements:

1. A vibration survey shall be undertaken to determine magnitude of railway vibration in accordance with LPA requirements prior to commencement of construction on site and a technical report submitted as a record
2. An assessment of vibration propagation and amplification within the proposed property shall be undertaken in accordance with LPA requirements prior to commencement of construction on site
3. Vibration mitigation and control measures shall be determined to achieve the LPA requirements of policy DP28 prior to commencement of construction on site
4. A technical report of the mitigation and control design shall be submitted to the LPA with supporting drawings to demonstrate compliance with the criteria of policy DP28 and shall be subject to examination and approval prior to commencement of construction on site beyond enabling stage [to be defined but prior to sub-structural works, piling, etc.]"

No comments, objections or amendments have been issued to in response to the email at this time.

In the interim, other sources of vibration data in the area have been sought. At present, no documents have been found which confirm clear vibration measurements. Further information is being sought from engineers on sites and development areas to the south of the application site, but no data has yet been forthcoming.

Whilst estimates of vibration from trains are to be treated with caution, initial calculations indicate a risk that minor to moderate vibration magnitudes could arise on the upper floors, particularly towards the north-west corner of the application site. At this point, the ground surface is nearest to track level and the structure of the building will be most complex.

Provision will need to be made for vibration isolation of the structure across the site with potential pile cap isolation and isolation of building fabric and services from the ground. Separate advice will be provided to the design team.

Computer Modelling

Modelling of environmental noise is being undertaken to determine the effect of full operation of the railway. Incorporation of the Thameslink, relief and future freight use will be estimated, as even the Thameslink Programme operational targets remain vague (i.e. 12 train movements per hour of eight to ten carriages on this line as a target).

Freight train use of the Midland Mainline and relief track is stated to be approximately 12 per day peak. The freight demand on the line is not significant, in comparison to many London mainline routes.

Modelling of groundborne vibration is possible, but may lack accuracy due to significant variations in track and ground conditions. Reliance is to be placed on measured data at the building position to ensure a reliable and accurate design. This in turn is reliant on full and accurate exposure to railway vibration, which will not be apparent till well into 2012.

Both environmental noise and vibration modelling will be reported separately.

Survey Results

The results of the environmental noise survey have been determined for the different periods and for the overall averages:

- Appendix D.1 Daytime periods 07:00-23:00, 07:00-19:00 and 19:00-23:00 hours
- Appendix D.2 Night-time period 23:00-07:00 hours

- Appendix D.3 Average Noise Exposure Day, Evening and Night

These detailed results are post-analysed using proprietary software. The process enables the elimination of spurious or extraneous noise sources, where these can be identified. Only a small number of such events have been removed. Equally, technical faults with source data, such as time period inconsistency, have been removed. The effect of such changes when compared against direct measurement results is ±0.5dB approximately.

Weather effects have not been omitted, meaning the 29 and 30 September include wind-affected results, where the underlying ambient noise level is likely to be higher than under optimum conditions.

Measurement results are at 2.5m high. This varies from PPG24 height requirements, but is not inconsistent with the LB Camden approach. Results are free-field unless specifically stated otherwise in the summary results.

Road Traffic Noise

The application site is largely open which leads to a significant level of railway noise on Iverson Road. The flow of vehicles there was sporadic and light on both site visits, with long periods where no or few cars passed.

Coupled with the ongoing construction noise, significant difficulty was presented for measurement.

Measurement was attempted, but was not deemed to be statistically accurate or reliable. The sample periods were too short and exclusion of other noise sources was uncertain.

Alternative positions were unavailable due to the steep gradient compared to the rest of Iverson Road.

Measured levels varied widely and erratically between LAeq,T 64dB and 76dB over selected periods, with no opportunity for accurate time-averaging or clear selection of noise sources.

It is presumed, for the basis of the assessment, the road traffic noise may require a minor degree of attenuation, but is not as significant as the railway once away from immediate road edge.

The maximum noise ranged from LAmaxSLOW 71dB to 89dB, including construction site vehicles and all other sporadic sources that could not be excluded. Most maxima on the better samples were below 81dB. These would not require attenuation under LB of Camden criteria.

In general, Iverson Road is considered to be light traffic road with sporadic flows. Individual noise events of vehicle movements or groups of vehicles are expected to determine the requirements. Maximum noise levels are considered to be more important particularly during the evening and night.

Maximum noise levels of LAmax,SLOW 71-81dB at the site boundary are considered to be within expectations for cars and light goods vehicles passing the site.

Commercial Units

There is a tyre and battery service centre to the west of the site. Close observation during both site visits indicated minimal audible activity, although there were workers inside and a large number of cars in the yard.

The one exception was an external telephone bell mounted at high level on the wall. As there were no staff members in the yard outside there seemed to be no purpose and superfluous.

It is recommended that means of removing, relocating or replacing the bell be sought, although it is only moderately loud at around LAFmax 50-55dB(A) at the yard entrance.

Environmental Noise Results

The summary of Noise Exposure Results is as follows:

Position	Day $L_{eq(16\ hour)}$	Day $L_{eq(12\ hour)}$	Evening $L_{eq(4\ hour)}$	Night $L_{eq(8\ hour)}$	
29/09	-	-	63.0	55.0	dB(A)
30/09	65.3	65.6	64.1	53.2	dB(A)
01/10	62.6	62.5	63.0	49.5	dB(A)
02/10	59.6	59.6	59.4	53.5	dB(A)
03/10	64.6	65.2	61.6	53.7	dB(A)
04/10	64.3	64.9	62.2	54.5	dB(A)
05/10	64.0	64.4	62.3	57.2	dB(A)
06/10	-	-	-	-	dB(A)
Mean	63.0	64.0	62.0	54.0	dB(A)
Log Mean	63.7	64.1	62.4	54.3	dB(A)
Façade k	+3	+3	+3	+3	dB(A)
Log Mean+k	66.7	67.1	65.4	57.3	dB(A)

Table 4a – Summary Results – Period Noise Exposure

The summary of the maximum noise level results at night are as follows:

Position	Night $L_{AFmax(8\ hour)}$	Night $L_{AFmax(8\ hour)}$ 5%	Night $L_{AFmax(8\ hour)}$ 10%	Night $L_{ASmax(8\ hour)}$	Night $L_{ASmax(8\ hour)}$ 5%	Night $L_{ASmax(8\ hour)}$ 10%	
29/09	84.5	63.5	59.7	82.2	60.9	56.8	dB(A)
30/09	80.1	61.9	57.6	78.7	59.8	55.6	dB(A)
01/10	78.4	59.3	56.0	74.2	56.3	53.7	dB(A)
02/10	86.2	62.3	58.1	84.4	58.8	55.5	dB(A)
03/10	86.2	60.7	57.1	86.7	59.3	55.5	dB(A)
04/10	95.4	60.6	56.4	89.4	59.0	55.1	dB(A)
05/10	87.5	65.4	62.8	85.2	64.3	61.4	dB(A)
06/10	-	-	-	-	-	-	dB(A)
Mean	85.0	62.0	58.0	83.0	60.0	56.0	dB(A)
Log Mean	88.8	62.4	58.9	85	60.4	57	dB(A)
Façade k	+3	+3	+3	+3	+3	+3	dB(A)
Log Mean+k	91.8	65.4	61.9	88	63.4	60	dB(A)

Table 4b – Summary Results – Noise Events

Noise Exposure Assessment

The noise exposure assessment of the application site has been completed based on both PPG24 and the LB of Camden Threshold Noise Levels.

Appendix D.3 states these assessments at the end of the summary results.

PPG24 Assessment Result

Were the standard defined Noise Exposure Category values of PPG24 to apply the following outcome would be expected:

- Daytime NEC B
- Night-time NEC B
- Maximum noise levels of individual events at night would not elevate to NEC C

Were the maximum decrease in PPG24 Noise Exposure Category boundary values to be applied then the following outcome would be expected:

- Daytime NEC B
- Night-time NEC B/C
- Maximum noise levels of individual events at night would not elevate to NEC C

Either situation would require only moderate deviation from standard acoustic design with, perhaps, some provision for acoustic ventilation of bedrooms and/or living rooms at night. The latter would be precautionary and not a significant measure.

LB of Camden

The Table A threshold value describe the levels above which planning permission would be refused.

On the basis of the survey data, the noise exposure is insufficient to require refusal of the application on noise grounds.

The Table B threshold values describe the levels above which attenuation measures would be expected by the Council.

The survey results indicate some attenuation is required for period noise exposure, but not for individual noise events at night.

Period	LAeq,T Facade	LASmax 5% Facade	Table B	Difference	Outcome
Day	67.1		65	+2	Minor attenuation required
Evening	65.4		60	+5	Moderate attenuation required
Night	57.3		55	+2	Minor attenuation required
		63.4	82	-19	Attenuation not required

Table 5 – Compare Results to LB Camden Criteria

Minor to Moderate attenuation; noise control measures; would be required during day, evening or night-periods.

Variations

Relief Line

The above assessment outcomes are based on measured data in the absence of one active minor line. The impact of the relief line is not considered to be significant as the primary use is to ease peak flow through-train movements and, possibly, train relocation before and during peak times. Confirmed data on use of these lines is unavailable, but indications given by train operators and NetworkRail personnel are that around 5% of peak time fast train movements out of London might use the line.

The effect is expected to be small but will be determined by environmental noise model.

Freight Traffic

NetworkRail has confirmed that expected freight use for all lines through West Hampstead Thameslink is approximately 12 movements per day spread equally over the full period. Freight operations are less at weekends.

The effect is expected to be small, but will be determined by environmental noise model assuming all trains are on the relief line.

Height Above Grade

The relative height of a receiver above grade or track level tends to increase noise exposure to a point. The expectation here is that noise exposure will be relatively consistent from the measurement position upwards as all tracks are visible in whole or in part.

The effect is expected to be small, but will be determined by environmental noise model assuming all trains are on the relief line.

Building view and screening reductions will be more substantial.

Overall Variations

The general level of variations from the above are expected to be minor with greater effects expected due to the orientation, arrangement and design of the building, even on the most exposed elevations.

The effect of railway noise propagation is to be determined by environmental noise model reported separately.

Allowance is to be included within the further assessment for +2dB(A) variation on $L_{Aeq,T}$ results and +4dB(A) variation on L_{ASmax} results to ensure margin exists within the planning submissions for variations.

Implications of Assessment

With allowance for variation the following outcomes are expected:

PPG24 Assessment Result

Were the standard defined Noise Exposure Category values of PPG24 to apply the following outcome would be expected:

- Daytime NEC B
- Night-time NEC B
- Maximum noise levels of individual events at night would not elevate to NEC C

Were the maximum decrease in PPG24 Noise Exposure Category boundary values to be applied then the following outcome would be expected:

- Daytime NEC B
- Night-time NEC B/C
- Maximum noise levels of individual events at night would not elevate to NEC C

LB of Camden

On the basis of the adjusted data, the noise exposure is insufficient to require refusal of the application on noise grounds under the Table A threshold values.

The Table B threshold values describe the levels above which attenuation measures would be expected by the Council.

Period	LAeq,T Facade	LASmax 5% Facade	Table B	Difference	Outcome
Day	69		65	+4	Minor – Moderate attenuation
Evening	67		60	+7	Moderate – Major attenuation
Night	59		55	+4	Minor – Moderate attenuation
		67	82	-17	Attenuation not required

Table 6 – Compare Adjusted Results to LB Camden Criteria

Overall Allowance

The acoustic design of 163 Iverson Road shall allow for attenuation to achieve the "Reasonable" to "Good" standards of BS8233:1999 *Sound insulation and noise reduction for buildings-Code of practice* (5) where feasible to do so. During daytime and evening the Living Room standards shall apply. During night-time the Bedroom standards shall apply.

Acoustic design focus on the elective use of private amenity spaces shall be on optimizing privacy between neighbours whilst minimizing noise exposure from environmental sources. These acoustic design criteria are as follows:

Inside Unoccupied Space	"Good"	"Reasonable"	Actual Design Target	
Bedroom	30	35	32 or less	LAeq,8h
Living Room	30	40	37 or less	LAeq,16h

Table 7 – Reasonable Internal Noise Design Targets

The external communal amenity spaces shall be designed to achieve noise exposure below Serious Community Annoyance levels wherever possible. If less than Moderate Community Annoyance is achievable and practical then necessary design measures shall be included.

Where applicable and feasible, lower evening acoustic design targets shall be achieved, however; the nature of most environmental transportation noise sources does not allow for such stringent targets. The over-arching aim is to protect the most people for the greater part of the day when they are more likely to be using or passing through the communal space.

Community Annoyance Outside Free Field	Moderate	Serious	Actual Design Target	
Communal Amenity Space				
– Day	50	55	55 or less	LAeq,16h
– Evening	45	50	50 or less	LAeq,4h

Table 8 – Reasonable Community Annoyance Targets

Applying the "Good" standards of BS8233 as an upper limit is considered to be precautionary and leads to excessive design allowances and cost. In essence, to ensure 30dB(A) is achieved inside the designer must also allow for a significant margin. Given the costs of construction, highly varied design is not feasible, therefore, the outcome is that a few rooms will have noise levels approaching 30dB(A), but most can experience noise levels far lower. Where internal noise levels approach 20-25dB(A), or lower, the effect on perceived sound insulation from neighbouring flats and isolation from external noise and events can have a real and adverse impact on occupants. These effects can be exacerbated where night-time noise needs to be designed to achieve the maximum noise level target, particularly where conditions insist on achieving this at all times for all events.

The design targets proposed above are those deemed most practical and effective in controlling and balancing the whole acoustic design, including both disturbance, perceived sound insulation and the isolation of people.

Individual Noise Events

The Table B Threshold Values of the LB Camden criteria indicate attenuation is not required in this instance; however, there still needs to be some degree of design to ensure conditions are reasonable and comparable.

The LB Camden criteria do not require attenuation for the low maximum noise levels measured in this case, but indicate a requirement by reference to other internal noise targets discussed elsewhere. The aim shall be to ensure a similar standard is applied to that which the Table B threshold values imply:

Description	Comparison	
LAmax,SLOW façade level outside	82dB(A)	
Attenuation	12 dB(A) open window loss	20-25dB(A) closed window loss
LAmax,SLOW inside	70dB(A)	57-62dB(A)
Equivalent LAmax,FAST	72dB(A)	59-64dB(A)

Table 9 – Implied Internal Noise Levels of LB Camden Criteria

These are the levels which research considers people find acceptable for railway noise and some other similar sources, provided louder individual noise events are relatively few. The indications from several studies described in PPG24 and elsewhere, that "several" events can occur at or above this level before an adverse effect occurs. "Several" may be approximately 6-12 in terms of measurable changes documented.

The design aim shall be to ensure the basic standard above is achieved and that the design shall aim to improve on this towards the sleep disturbance design targets of BS8233:1999. It is noted that LB of Camden do not define these as a requirement, but they remain as indicative of a reasonable internal noise climate, where practical and achievable. The BS8233:1999 target value is $L_{Amax,FAST}$ 45dB inside bedrooms.

The approach shall be to apply the upper 5-10% of individual event noise levels, rather than the 5% of all loudest events. These are typically both loud and more frequent than the loudest 5% of events, which include loud, extraneous events such as car alarms and sirens in this case.

In terms of the results in Appendix D, the night-time LAFmax5% is 62dB(A). For 180 seconds of each hour or 1440 seconds of the entire night (28,800 seconds), the noise events measured exceed this level.

Inspection of the noise levels and audio recordings indicate that night-time maxima are infrequent and brief. Importantly, there are not "several in any one hour" throughout the night.

Outline Noise Control Measures

The purpose of the outline design is not to identify specific measures for noise control, but the general principles of the proposed scheme, including position, appearance, scale and materials. Even so, the scheme includes substantial noise control measures, which accord with the guidance in BS8233:1999 and other guidance.

Current Proposed Noise Mitigation

The design includes for reasonable measures to minimize noise exposure including:

- Application site for development is not immediately adjacent to busiest sections of mainline railway as two low impact tracks provide separation
- Large proportion of rooms on screened elevations or with a restricted view of the railway
- Communal amenity area at low level where the effect of screening and topography are greatest and view of railhead is obscured
- Private amenity spaces are located away from railway or benefit from building screening in most instances
- Bedroom windows oriented away from railway in most instances
- Use of buffer spaces on Blocks 01 and 02 separate bedrooms from facade
- Other habitable rooms oriented away from railway in most instances or major window openings are facing away
- Remaining bedrooms and other habitable rooms are located at high level further from railway
- Use of building and façade features to provide for localized screening and dispersion effect from facades

Further Measures

A general review of further requirements has been undertaken. The degree of noise exposure requires more detailed consideration be given prior to construction. Specific measures recommended for inclusion at this stage are discussed below.

Block 01 Elevated Wing

The following apartments in Block 01 are those most exposed to railway noise, including noise reflected into the amenity space:

- 01.05
- 02.05
- 03.05
- 03.06
- 04.01
- 04.02

A range of attenuation measures are recommended to provide a reasonable internal noise climate, due to expected exposure to railway noise on all elevations, including:

- Provision for maintaining an alternative ventilation system to each habitable room to provide alternative to open windows, if desired by occupants
- Elimination of unattenuated background or trickle ventilation to each habitable room
- Provision for improved, medium performance window sound insulation

- Provision of optimized sound insulation for other elements of building envelope, with particular focus on sound insulation of underside of floor and walls
- Optimise screening of balconies, rooftop amenity space and access by providing solid screen to perimeter 1.2-1.5m high to enable an obscured sound transfer path when seated, where applicable

Other Block 01 Apartments

The following apartments in Block 01 are not as exposed as in the elevated north-west wing to railway noise, including noise reflected into the amenity space:

- G.01-G.04
- 01.01-01.04
- 02.10-02.04
- 03.01-03.04

Ground & Lower Ground Apartments G.01-G.04

A range of attenuation measures are recommended to provide a reasonable internal noise climate, due to expected exposure to railway noise on all elevations, including:

- Provision for improved, medium performance window sound insulation to north
- Provision for improved, medium performance window sound insulation to south along road
- Seal north window of living / kitchens if possible
- Provision for maintaining an alternative ventilation system to each habitable room to provide alternative to open windows, if desired by occupants
- Elimination of unattenuated background or trickle ventilation to each habitable room
- Provision of optimized sound insulation for other elements of building envelope to north
- Optimise screening of balconies, rooftop amenity space and access by providing solid screen to perimeter 1.2-1.5m high to enable an obscured sound transfer path when seated, where applicable

Other Apartments

A range of attenuation measures are recommended to provide a reasonable internal noise climate, due to expected exposure to railway noise on all elevations, including:

- Provision for improved, medium performance window sound insulation to north
- Seal north window of living / kitchens if possible
- Provision for maintaining an alternative ventilation system to each habitable room to provide alternative to open windows, if desired by occupants
- Elimination of unattenuated background or trickle ventilation to each habitable room
- Provision of optimized sound insulation for other elements of building envelope to north
- Optimise screening of balconies, rooftop amenity space and access by providing solid screen to perimeter 1.2-1.5m high to enable an obscured sound transfer path when seated, where applicable

Block 02 and 03

A range of attenuation measures are recommended to provide a reasonable internal noise climate, due to expected exposure to railway noise on all elevations, including:

- Provision for improved, medium performance window sound insulation to north
- Seal north window of living / kitchens if possible
- Provision for improved, medium performance window sound insulation to south along road (first storey only)
- Provision for maintaining an alternative ventilation system to each habitable room to provide alternative to open windows, if desired by occupants
- Elimination of unattenuated background or trickle ventilation to each habitable room
- Provision of optimized sound insulation for other elements of building envelope to north
- Optimise screening of balconies, rooftop amenity space and access by providing solid screen to perimeter 1.2-1.5m high to enable an obscured sound transfer path when seated, where applicable

West Ground Level Amenity

The proposed amenity space is to be landscaped. The boundary to the north and west will require further protection to provide an enhanced level of screening from the railway and buildings to the west.

- Provision for solid screening to north and west boundaries of communal amenity space to optimize attenuation from railway
- Height 1.8-2m
- Mass 15-20kg/m2
- Form: solid board or sheet material or planks jointed and sealed

Roof & Other Non-Vision Areas

Sound insulation will be provided to minimise the window and door sound insulation requirements. In general, standard construction allowances are expected to be sufficient. The exception will be the Block 01 elevated wing, where the full envelope is likely to be exposed to railway noise to a degree.

Enhanced sound insulation will be needed particularly for the walls and underside of floor slabs.

The roof will be assessed for rain impact noise with the aim of ensuring internal noise levels due to rainfall do not exceed 45-50dB(A) except under exceptional conditions.

Ventilation

The provisions of The Building Regulations are understood to encourage the use of combined ventilation systems, although the extent of such systems is debatable. Where they are required for noise control then central, whole flat systems are recommended incorporating mechanical supply and extract air service into one. The presence of trickle vents in any window or door is not recommended for NEC C and the more exposed NEC B areas – this is likely to be the case at Iverson Road in some areas. The provision of fresh air and background ventilation by separate attenuated paths or ventilators is advisable. In using any mechanical system it shall be ensured there is sufficient air leakage to provide for minimum fresh air or there are dedicated intake ducts / openings.

Most central flat systems are suitable to include heat exchangers and particulate filters to improve energy use and air quality, respectively.

Sound Insulation

The target noise level differences from outside to inside are:

Performance	Level Difference, dB(A)
Open Windows	15
Standard Closed	20-25
Medium Closed	25-30
High Closed	30-35

Table 10 – Sound Level Difference Required

The detailed design process will determine the exact laboratory-tested performance required of the different building elements, however; the estimated performance and typical constructions expected are as follows:

External Windows & Doors	Weighted Sound Reduction Index, Rw dB	Glass Unit / Basic Construction	Frames
Standard Window	25-30	4-20-4 Argon filled	Rebated+sealed openable sections. No trickle vents. Not flush in window opening
Medium Window	30-35	10-20-6 Argon filled	As above
High Window	35-40	10-20-6 Ar +100mm cavity+6.4mm laminated secondary pane	As above
Non-vision area / walls / roofs	+7dB above highest window performance on elevation e.g. Rw 47dB where High Closed windows used	Medium density cavity masonry Lined framed and clad wall system	Staggered and sealed linings Mineral wool in primary void
Floor Slab	45	200-250mm concrete	No other finishes included

Table 11a – Typical Lab Performance & Construction – Envelope

Ventilation	Weighted Element Sound Level Difference, Dn,e,w dB	Position Openings	Type of Vent System
Trickle vents & wall vents	20-25	Elevation (where permissible)	Exclude except in NEC A areas where open windows can be used
Medium Performance	35-40 (two openings)	Elevation	Central ducted whole-flat combined extract supply unit with attenuated intake
High Performance	40-45 (two openings)	Elevation Reduce performance needed by moving to screened positions	Central ducted whole-flat combined extract supply unit with attenuated intake Additional duct attenuation
Noise Limit from Supply diffusers	30dB(A) at 1m inside	-	Under all fan speeds except very high / boost ventilation

Table 11b – Typical Lab Performance & Construction – Ventilation

Further development of the design is required and will include determination of:

- Variation of noise across the elevations
- Final building and room layout
- Composite Sound Reduction Performance of all building envelope elements

Much of the above will be informed by the results of the Environmental Noise Model to be reported separately.

Acoustic Benefits

The current site is largely open and does not provide any substantive screening of railway noise.

The proposed development forms a significant and continuous building barrier alongside the railway.

The properties on the opposite (south) side of Iverson Road are expected to benefit from a marked reduction in railway noise exposure. The following factors influence the degree of reduction:

1. Proportion of current view remaining after completion (3dB per doubling)
2. Degree of interruption to line of sight
    - Slight 5dB reduction
    - Moderate 10dB reduction
    - Major 15dB reduction

For a flat or house located opposite the centre of the Block 02 façade, substantial reductions in railway noise are likely to accrue. A 10dB reduction would be the least expected, based on current estimates. In general terms, such a difference equates to a halving of loudness.

Even at the east and west end of the property a moderate reduction of 5-8dB is expected, provided there is line of sight interruption. In general terms, such a difference equates loudness of a quarter less.

The benefits then are expected to be substantial to the occupants of residential property opposite the application site.

Conclusions

Aulos Acoustics has completed an investigation of the environmental noise exposure expected at the application site of 163 Iverson Road, West Hampstead.

A noise survey was completed to determine the noise climate affecting the proposed residential properties. The application site is widely affected by railway noise due to its proximity to the Midland Mainline operating through West Hampstead Thameslink station. Both fast and stopping trains result in frequent railway movements.

Noise exposure has been assessed against both the LB Camden criteria of development policy *DP28. Noise and vibration* and PPG24 and the outcomes are as follows:

The noise exposure is insufficient to require refusal of the application on noise grounds as levels do not exceed the Table A threshold values of DP28.

The Table B threshold values describe the levels above which attenuation measures would be expected by the Council.

The noise exposure results indicate some attenuation is required for period noise exposure, but not for individual noise events at night, as levels slightly exceed the Table A threshold values of DP28.

Period	LAeq,T Facade	LASmax 5% Facade	Table B	Difference	Outcome
Day	67.1		65	+2	Minor attenuation required
Evening	65.4		60	+5	Moderate attenuation required
Night	57.3		55	+2	Minor attenuation required
		63.4	82	-19	Attenuation not required

Table C1 – Compare Results to LB Camden Criteria

Some variation may occur due to freight, height of receivers above grade and use of the relief line (second track north of boundary). These variations are expected to result in a +2dB(A) variation on LAeq,T results and +4dB(A) variation on LASmax results.

Were the maximum decrease in PPG24 Noise Exposure Category boundary values to be applied then the following outcome would be expected:

- Daytime NEC B
- Night-time NEC B/C
- Maximum noise levels of individual events at night would not elevate to NEC C

The moderate attenuation requirement has been designed to achieve the implied reasonable internal noise levels of policy DP28 as follows:

Description	Comparison	
LAmax,SLOW façade level outside	82dB(A)	
Attenuation	12 dB(A) open window loss	20-25dB(A) closed window loss
LAmax,SLOW inside	70dB(A)	57-62dB(A)
Equivalent LAmax,FAST	72dB(A)	59-64dB(A)

Table C2 – Implied Internal Noise Levels of LB Camden Criteria

The design criteria recommended in BS8233:1999 *Sound insulation and noise reduction for buildings-Code of practice* have also been taken into account, applying the reasonable design target range.

Current Proposed Noise Mitigation

The design includes for reasonable measures to minimize noise exposure including:

- Application site for development is not immediately adjacent to busiest sections of mainline railway as two low impact tracks provide separation
- Large proportion of rooms on screened elevations or with a restricted view of the railway
- Communal amenity area at low level where the effect of screening and topography are greatest and view of railhead is obscured
- Private amenity spaces are located away from railway or benefit from building screening in most instances
- Bedroom windows oriented away from railway in most instances
- Use of buffer spaces on Blocks 01 and 02 separate bedrooms from facade
- Other habitable rooms oriented away from railway in most instances or major window openings are facing away
- Remaining bedrooms and other habitable rooms are located at high level further from railway
- Use of building and façade features to provide for localized screening and dispersion effect from facades

Further attenuation measures have been determined and recommended in the report. These include the following on the most exposed elevations:

- Provision for maintaining an alternative ventilation system to each habitable room to provide alternative to open windows, if desired by occupants
- Elimination of unattenuated background or trickle ventilation to each habitable room
- Provision for improved, medium performance window sound insulation
- Provision of optimized sound insulation for other elements of building envelope, with particular focus on sound insulation of underside of floor and walls
- Optimise screening of balconies, rooftop amenity space and access by providing solid screen to perimeter 1.2-1.5m high to enable an obscured sound transfer path when seated, where applicable
- Provision for solid screening to north and west boundaries of ground / lower ground level communal amenity space to optimize attenuation from railway

The most exposed facades containing habitable rooms include:

- Elevated Wing of Block 01
- North elevation of south-west wing of Block 01
- North elevation of Block 02 and 03
- Roadside lowest storey of all blocks on South elevation
- Western amenity space at ground level

In general, medium attenuation performance windows and ventilation system will be required for the most exposed habitable rooms. This equates to thermal double glazing with heavier glass than is standard and a central ventilation system for each flat or house.

Vibration

The railway is not currently operating at full capacity and the nearest lines are not operational at all. The effect on noise exposure is expected to be small, but vibration exposure may be determined by these nearest lines.

Consequently, an alternative approach was discussed and agreed with LB Camden which includes for:

- Full vibration survey once the lines are operating fully
- Assessment of vibration transfer in the proposed building
- Vibration control measures if required based on the DP28 threshold values

The approach would be conditioned and is discussed further in the reported and at Appendix C.3.

Benefits to Neighbours

Exposure to railway noise would be reduced at the houses and flats on the south side of Iverson Road as the building acts as a significant screen. The effect of maximum noise levels of individual train movements would be clearly and noticeably improved.

Such improvements to the noise climate of existing residents are expected to be substantial and noticeable.

The proposed development and design is capable of achieving a reasonable internal and external noise climate for future residents with moderate attenuation provided. There is expected to be material benefit to the existing residents as noise exposure to railway noise is reduced noticeably.

James Tomalin MIOA