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Greggs Bakery / Twickenham

Environmental Viability Assessment

February 2019 | 20190211_4340_ Residential development on site of Greggs Factory_B

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Client:	London Square			
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Contents

1.0 Executive Summary

Proposals have been made to construct a new residential development and a B1 office building on the land formally operated by Greggs Bakery located off the Gould Road, Twickenham, TW2 6RT within the London Borough of Richmond upon Thames.

The site is subject to a number of noise sources, including aircraft overflight associated with arrivals and departures from London Heathrow Airport (LHA), and the railway to the north of the site. Noise needs to be considered when new developments would be sensitive to existing noise conditions.

National Planning Guidance and the Local Planning Authority guidance documents have been considered in the assessment of noise at the proposed site and noise targets have been discussed. Following survey works undertaken over a number of days the results have been used to calibrate a detailed three dimensional computer model of the proposed site using CadnaA acoustic software.

The findings of the acoustic model indicate that building envelope acoustic performances can in principle be maintained by suitably selected building constructions of the walls, roof, ventilation products and glazing systems. Due to the noise climate in the location of the development it is predicted that windows will have to remain closed in order to meet with the target internal noise criteria established.

The external amenity ideal amenity space noise levels will not be maintained at all locations all of the time. However, it is noted that the site lies within an area predominantly comprising existing residential dwellings which typically include external amenity spaces that will be subject to similar noise levels to the amenity spaces of the site under consideration. In addition, BS8233: 2014 states:

However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

2.0 Introduction

It is proposed to construct approximately 116 new residential properties and a B1 office building on a plot of land of approximately 1.1 ha, presently occupied by industrial units operated by Greggs bakery. Paragon Acoustic Consultants Ltd has been commissioned to undertake an environmental noise assessment associated with the development in the context of national and applicable planning policy and guidance and is based on the principles and recommendations contained within the following documents.

- National Policy Statement for England (NPSE) March 2010;
- National Planning Practice Guidance "Noise" August 2013;
- World Health Organisation: 1999: "Guidelines for Community Noise";
- BS 8233:2014 "Guidance on sound insulation and noise reduction for buildings".

This report has been compiled by John Gillott who is a member of the Institute of Acoustics. John has over 30 years of experience in the acoustic industry and has knowledge and experience of large residential schemes

2.1 Site Description

The site is located off Gould Road and Edwin Road, Twickenham, TW2 6RT the London Borough of Richmond upon Thames in South West London, within a predominantly residential area. The site currently stands as a single industrial unit occupied by Greggs bakery. The bakery buildings includes a number of offices, sheds, production buildings and hard standings.

Immediately north of the site is the River Crane and the Waterloo to Reading railway line. Beyond which lies mixed residential, commercial and sports facility areas. To the east of the site are established residential areas and immediately to the west is 'Crane Mews', a collection of commercial studios, most of which have recently been converted into residential units. Edwin Road delineates the south of the site, beyond which are located Turner Automotive vehicle repair workshop and Youngs Welders outlet. To the west of the site lie residential properties on Gould Street and Crane Road.

The site is illustrated by plan below

Figure 1: Site location

3.0 Planning Policy Guidance

3.1 Noise Policy Statement for England (NPSE) March 2010

The Government published the Noise Policy Statement for England (NPSE) in March 2010 with the aim of providing clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level. The aims of the Government's noise policy are:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

1. Avoid significant adverse impacts on health and quality of life;
2. Mitigate and minimise adverse impacts on health and quality of life; and
3. Where possible, contribute to the improvement of health and quality of life.

In its aims the Policy uses the key phrases "Significant adverse" and "adverse". In clarifying what these mean the Policy notes that "….there are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the WHO. They are:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected."

The Policy extends these concepts to include:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur."

It is further noted that NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise.

The Policy notes that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is for a project to identify relevant SOAELs taking account the different sources of exposure and different receptors.

It can be seen that the test of significance in relation to government policy is a question of degree and that a significant noise level will be somewhere above a level where the onset of adverse effect might be expected - i.e. SOAELs will always be greater in magnitude than LOAELs and LOAELs are greater than NOELs. In other words as exposure to a sound source increases there will start to be some level of effect on a receptor, and, as the exposure increases, the severity of the effect or effects increase with further increase in exposure to the level where the effect becomes significant.

It is also worth noting that the second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. The aim is that "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

3.2 National Planning Practice Guidance – Noise (March 2014)

Noise needs to be considered when new developments would be sensitive to the prevailing acoustic environment. When determining impact, Local Authorities' plan making and decision taking should account for the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or is likely to occur;
- Whether or not an adverse effect is occurring or is likely to occur; and
- Whether or not a good standard of amenity can be achieved

The subjective nature of noise means that there is not a simple relationship between noise levels and the impact of those affected. This will depend on how factors combine in any particular situation, including:

- The source and absolute level of the noise together with the time of day it occurs;
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- The spectral content of the noise and its general character (whether the noise contains particular tonal characteristics or other particular features).

More specific factors to consider, when relevant, include:

- Where applicable, the cumulative effect of more than one noise source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;

- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases, a suitable alternative means of ventilation is likely to be necessary.

In respect of mitigating noise, the approach to be adopted will depend on the nature of the development and the character of the location. For noise sensitive developments measures can include designing the development to reduce the impact of the noise from the local environment and optimising the sound insulation provided by the building envelope.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

4.0 London Borough of Richmond upon Thames

The London Borough of Richmond upon Thames (LBRT) Supplementary Planning Document (SPD) titled “Development Control for Noise Generating and Noise Sensitive Development”

provides guidance in order to address noise issues affecting the Borough and assist in providing a consistent approach to development where noise is an issue.

The document includes the statements that:

> *It is important that acoustic design is considered at an early stage of the development control process. This SPD contains guidance intended to help protect occupiers of new or existing noise sensitive buildings from existing or introduced noise sources respectively and to seek to protect and improve the residential amenity of the Borough overall. It is government policy that noise should not be considered in isolation or separately from the economic, social and other environmental dimensions of proposed development. However there may be circumstances where noise considerations could override other planning concerns and advice is provided in this SPD on when this situation is likely to arise.*

The following stages have been considered:

4.1 Stage 1: Initial Site Noise Risk Assessment

The LBRT SPD document advises:

> *Figure 2 summarises the Stage 1 Initial Site Noise Risk Assessment. The indicative noise levels provided in Figure 2 are considered to be appropriate in most circumstances as they should give a broad indication of the extent of the noise challenge at a potential residential development site. It should be noted, however, that these levels could be varied (by local agreement) to suit local and project context without undermining the overall approach. In the final column, the initial noise risk assessment is aligned with pre-planning application guidance that reflects the increasing importance of good acoustic design as the noise risk increases.*

Figure 2: Initial Site Noise Risk Assessment

Noise Significance Risk	Noise Significance (without mitigation)	Indicative Noise Levels	Pre-Planning Application Advice
Negligible	No adverse noise effect	L_{Aeq}, 16hr <50dB L_{Aeq}, 8hr < 40dB	Low noise levels indicate that the development site is likely to be acceptable from a noise perspective.
Low	Increasing risk of adverse effect	L_{Aeq}, 16hr 50-63dB L_{Aeq}, 8hr 40-55dB	Noise levels in this region mean that the development site is likely to be acceptable from a noise perspective, provided that good acoustic design is followed and demonstrated in an Acoustic Design Statement which confirms how the adverse impacts of noise will be mitigated and minimised in the completed development.
Medium		L_{Aeq}, 16hr 63-69dB L_{Aeq}, 8hr 55-60dB	As noise levels increase, the site is less likely to be suitable for development from a noise perspective and planning consent is more likely to be refused unless a good acoustic design process is demonstrated in a detailed Acoustic Design Statement which confirms how adverse noise impacts will be mitigated and minimised, and which clearly demonstrates that any significant adverse noise impacts will be avoided in the completed development.
High		L_{Aeq}, 16hr >69dB L_{Aeq}, 8hr >60dB	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. The risk of refusal may be reduced by following a good acoustic design process. Applicants are strongly advised to seek expert advice and discuss the proposals in advance with the Local Authority.

Assessment of the noise monitoring provides the folowing outcomes:

The Free Field data for the rear of the site (North) is provided as follows:

Period		LAeq	Number of times 80 dB Lamax F exceeded (5 min samples) During the night time period (23:00 - 07:00 hours)
Period 1 Daytime	(07.00- 23.00)	64	N/A
Period 1 Night-time	(23.00-07.00)	58	12
Period 2 Daytime	(07.00- 23.00)	64	N/A
Period 2 Night-time	(23.00-07.00)	58	10
Period 3 Daytime	(07.00- 23.00)	63	N/A
Period 3 Night-time	(23.00-07.00)	54	3
Period 4 Daytime	(07.00- 23.00)	61	N/A
Period 4 Night-time	(23.00-07.00)	57	9
Period 5 Daytime	(07.00- 23.00)	63	N/A

The Free Field data for the front of the site (South) is provided as follows:

Period		LAeq	Number of times 80 dB Lamax F exceeded (5 min samples) During the night time period (23:00 - 07:00 hours)
Period 1 Daytime	(07.00- 23.00)	57	N/A
Period 1 Night-time	(23.00-07.00)	50	1
Period 2 Daytime	(07.00- 23.00)	58	N/A
Period 2 Night-time	(23.00-07.00)	47	1
Period 3 Daytime	(07.00- 23.00)	50	N/A
Period 3 Night-time	(23.00-07.00)	44	0
Period 4 Daytime	(07.00- 23.00)	47	N/A
Period 4 Night-time	(23.00-07.00)	39	0
Period 5 Daytime	(07.00- 23.00)	51	N/A

Analysis of the measurement data shows that the areas to the rear of the site (North) are considered to be of medium risk, whilst the areas to the front of the site (South) are considered to be of low risk.

Based on the 5 minute samples used for measurement it will be seen that the LAmax, F is very unlikely to exceed 80 dB more than 20 times a night. The worst case exceedance of 80 dB at the rear of the site over the measurement duration was 12 times on one night and at the front of the site only once during a night time period.

For low risk areas the Pre-Planning Application Advice provided states:

Noise levels in this region mean that the development site is likely to be acceptable from a noise perspective, provided that good acoustic design is followed and demonstrated in an Acoustic Design Statement which confirms how the adverse impacts of noise will be mitigated and minimised in the completed development.

For medium risk sites the Pre-Planning Application Advice provided states:

As noise levels increase, the site is less likely to be suitable for development from a noise perspective and planning consent is more likely to be refused unless a good acoustic design process is demonstrated in a detailed Acoustic Design Statement which confirms how adverse noise impacts will be mitigated and minimised, and which clearly demonstrates that any significant adverse noise impacts will be avoided in the completed development.

4.2 Stage 2 – Internal Design Noise Levels

Target internal design levels are provided in Section 6.0 of this report. The justification for use of the internal noise criteria is also provided in Section 5.0.

It is noted that the design is based on a situation where windows are closed. When windows are open internal target noise levels will not be achieved. (See also section 4.4.3)

4.3 Stage 3 – Design Noise Levels for External Amenity Spaces

Amenity spaces will not meet with BS8233:2014 or World health guideline values of 50-55dB in all locations on all days. Noise levels at the site generally exceed 50-55dB, primarily due to the aircraft but including train noise towards the north. The Heathrow airport noise contours concur with the predicted noise levels with certain of the contours indicating 60-63 dBA based on 100% E Leq noise contours for 2016 and 2006 average summer day (with 2006 N-S runway usage). However, it will be seen from the daily noise data given in Section 8.1 that the front of the site noise levels do on certain occasions fall within the 50-55dB range. The LBRT document Development Control for Noise Generating and Noise Sensitive Development does accept that "in some circumstances it may be appropriate to vary, or not to apply, these goals in order to meet wider planning objectives". In addition, BS8233 advises:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

4.4 Stage 4 – Assessment of Other Relevant Issues

4.4.1 Magnitude and Extent of Compliance with SPD

The LBRT SPD document advises:

> *It is recognised that it may not always be possible to achieve the recommended internal noise level guidelines in all rooms within noise sensitive developments. Where it is not possible to achieve good acoustic standards in every respect, regard will be had to the number of dwellings and number of habitable rooms in each of the dwellings where the good standard cannot be achieved. Similarly, the external amenity area noise assessment is multi-faceted and, where it cannot be met in its entirety, regard will be had to the extent to which the guidance has been followed.*

With regards to achievement of recommended internal noise level guidelines the assessment indicates that it should be possible to achieve the internal noise level guidelines by good acoustic design of the building envelope. The preliminary building envelope acoustic performances are provided herein. The assessment is based upon windows to the dwellings being closed.

With regards to external amenity spaces this report confirms that ideal amenity space noise levels will not be maintained at all locations all of the time, however, it is noted that the site lies within an area predominantly comprising existing residential dwellings which typically include external amenity spaces that will be subject to similar noise levels to the amenity spaces of the site under consideration.

4.4.2 Likely Occupants of the Development

The likely occupants of the proposed development are not known at this stage, therefore differing acoustic requirements cannot be assessed for future occupants or future changes in the type of occupancy. It is suggested that there will not be any specific groups of people likely to take up residence within the proposed properties, nor will certain groups be excluded.

4.4.3 Acoustic Design v Unintended Adverse Consequences

The proposed development is located within an area where the background levels can be relatively low, but the dB LAeq continuous noise levels are dictated by transient noise sources such as rail, aircraft and vehicle noise. By meeting with the internal target dB LAeq noise criteria typically used and reiterated in the Local Authorities document there is the possibility that the internal noise levels within habitable rooms will be very low during periods between transient noise sources, which could potentially lead to acoustic privacy issues. This occurrence has been encountered in the past by this practice, although, in reality, complaints are not common.

4.4.4 Good Acoustic Design

This practice discussed the scheme design with the Messrs Assael Architecture Ltd (AAL), the project architects. AAL confirmed that they did consider the noise from the surrounding area when considering the site layout, and that the surrounding acoustic environment was taken into account in relation to the internal layout of residential units proposed. Where possible bedrooms were located on quieter facades and there are habitable spaces in units which do not overlook the railway line to the north.

In addition, consideration has been given to the noise insulation requirements of the building envelope in order that reasonable internal noise guideline criteria shall be maintained.

5.0 Guidance on the Assessment of Noise Levels

5.1 World Health Organisation

The World Health Organisation (WHO) document “Guidelines for Community Noise” provided a review of the effects of noise and a description of the principles of health criteria.

Table 1 of the document presents guideline values arranged according to specific environments and critical health effects. Noise indices to be adopted and the accompanying time base to be used for the assessment are also presented.

The guideline values consider all health effects for a specific environment. An adverse health effect refers to any temporary or long-term impairment of physical, psychological or social functioning associated with noise exposure. The specific noise limits were set for each health “using the lowest noise level that produces an adverse health effect”

Table 1: WHO Guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	L_{Aeq} [dB]	Time base [hours]	L_{Amax} fast [dB]
Dwelling, indoors	Speech intelligibility & moderate annoyance daytime & evening	35	16	
	Sleep disturbance, night time	30	8	45

For noise events, the guideline value was set at 45 dB L_{Amax}, with research cited in the text advising that this value should not be exceeded by more than 10 to 15 times per night to ensure "good sleep".

5.2 BS 8233:2014: *"Guidance on sound insulation and noise reduction for buildings"*

This British Standard came into effect on 28 February 2014 and supersedes BS 8233:1999, which is withdrawn.

The standard draws on the results of research and experience to provide information on the design of buildings that have internal acoustic environments appropriate to their functions. It deals with control of noise from outside the building, noise from plant and services within it, and room acoustics for non-critical situations. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

5.2.1 Dwellings

Indoor ambient noise levels for dwellings are set out at BS8233:2014, Section 7.7.2, Table 4, reproduced below.

Table 2: Indoor ambient noise levels for dwellings (from BS 8233:2014, Table 4)

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	—
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	—
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

A series of notes provide context to the guideline values of Table 4. Note 1 advises that the indoor ambient noise levels are *"the sum total of structure-borne and airborne noise sources. Groundborne noise is assessed separately and is not included as part of these targets, as human response to groundborne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity."*

Note 3 states "*These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve."*

Note 4 deals with individual events and advises that "Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or LAmax,F, depending on the character and number of events per night. Sporadic noise events could require separate values".

Note 5 states that if relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation arrangement that does not compromise the façade insulation or the resulting noise level. It is understood that mechanical cooling is proposed.

Note 7 provides a rider to the guideline values of Table 4, "*Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".*

6.0 Design Intent

The following indoor ambient noise levels are proposed for the development:

Table 3: Proposed indoor ambient noise levels for dwellings

Indoor ambient noise level living areas 07:00 to 23:00: 35 dB $L_{pAeq,16h}$
Indoor ambient noise level for bedrooms 23:00 to 07:00: 30 dB $L_{pAeq,8h}$
Indoor ambient noise level for bedrooms 23:00 to 07:00: 45 dB L_{Amax*}

Notes:

A) These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

B) This practice has used the guidance given in the LBRT SPD document "Development Control for Noise Generating and Noise Sensitive Development" Table 1 Note (iii) such that the 45 dB L_{Amax} is the level predicted to be exceeded 10 times per night based on the sample measurements taken during the survey. In respect of 45 dB $L_{Amax,}$ transient noise, it should be noted that it is standard design practice to adopt a typical maximum noise level and not the absolute worst-case.

C) The suggested design targets apply when windows are closed and background ventilation is provided. When windows are opened, an increase in internal noise levels is inevitable and it is not reasonable[1] to expect the target levels above to be achieved. As noted in the previous section, the targets are based on annual average data and do not have to be achieved in all circumstances.

D) Adoption of the above design limits would not provide absolute control of transient noise sources such as police sirens, etc., which may occasionally occur however, the final building design should nevertheless minimise any resultant disturbance due to external noise.

7.0 Environmental Noise Surveys

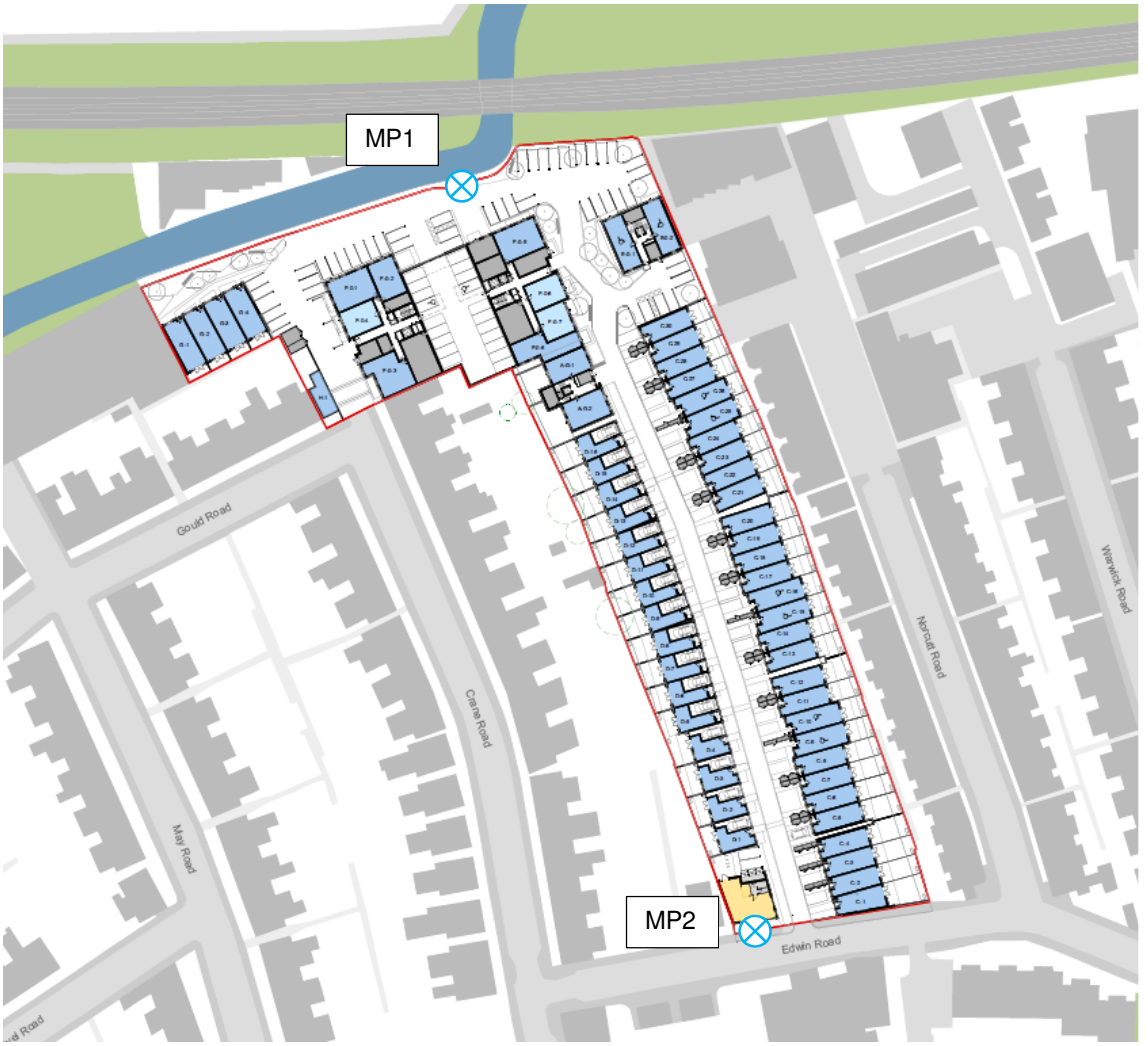
7.1 Environmental Noise

Detailed noise surveys have been carried out at site to determine the extant noise climate in the area. Measurements were made between 8th November 2018 and 12th November 2018, at the locations described below.

- MP1: North of the site at 5m in height adjacent to the River Crane. Measurements considered free field
- MP2: South of the site external to an existing industrial building. Considered to be façade measurements

[1] Proposals for amending Part E (resistance to the passage of sound): consultation, Clause C1.5

Figure 2: Approximate Measurement Positions



Sound pressure level measurements were obtained using the following instrumentation, complying with the Type 1 specification of BS EN 60804, BS EN 60651, BS EN 60942, BS EN 61260, and BS EN 61672-1, as follows:

- **Position MP1:** Norsonic Type 118 Sound level analyser, serial number 31663, Norsonic Type 1225 ½" microphone
- **Position MP2**: SVAN 971 Sound level meter serial number 56214, pre-amplifier type SV18 serial number 57317, and type 7052E ½" microphone serial number 65484.

Calibration checks were made prior to and after completion of measurements using a Norsonic Type 1251 acoustical calibrator complying with Class 1 of BS EN 60942, calibration level 114.0 dB ± 0.3 dB, @ 1.0 kHz. All instrumentation carries a current manufacturer's certificate of conformance a copy of which is available upon request.

Various statistical broad-band and spectral sound pressure level measurements were obtained during the survey, including:

- $L_{Aeq,T}$: the equivalent continuous noise level over a measurement period, T
- L_{AFmax}: the maximum sound pressure level over a measurement period, T
- $L_{AF90\%,T}$: the noise level exceeded for 90% of the measurement period, T

Weather conditions at the start of the survey were mild and dry with a slight breeze. At the end of the survey the weather conditions were similar. Web site data suggests that the survey duration daytime temperatures were in the order 14 degrees at their highest and during the night time the temperature dropped as low as 5 degrees. Web site data suggests wind direction generally south west / south / south east depending on the day. As the survey was generally unmanned, full weather conditions during the survey cannot be reported accurately, however, the survey duration was considered of appropriate time to allow a reasonable representation of the noise climate to be established.

Direct measurement of the noise during daytime and night time was taken.

Runway departure direction was checked on the Heathrow XPlane website to ensure noise levels were taken during both Easterly and Westerly operations. On 8th November 2018, aircraft departed in a westerly direction and on 9th November the aircraft departed in an easterly direction. Inspection of the noise data shows that the noise levels were marginally higher on easterly departures and these have been used in the assessment.

Measurements were chosen at both ends of the proposed site. The railway noise is dominant at the north of the site, as is aircraft noise due to the flight path locations. As such a measurement was undertaken at the north end of the site. The southern elevation of the site is furthest away from railway noise and aircraft, although local traffic is potentially greater than at the north of the site. As such, a measurement position at the south of the site was also considered reasonable.

8.0 Results and Data Analysis

8.1 Environmental Noise Survey Results

Measurement results have been processed to determine day and night L_{Aeq} values, together with the typical night maximum noise levels. The highest daytime and night time period noise levels measured have been used in the assessment, these being confirmed as follows:

Table 4: Summary of Environmental Noise Levels

Measurement Position	Day $L_{Aeq,16h}$ *	Night $L_{Aeq,8h}$	L_{AFmax} 10th Highest
MP1 (North of site)	64 dB	58 dB	80 dB
MP2 (South of site)	61 dB	53 dB	71 dB

The details of each survey day / night time period are confirmed as follows:

Position	Day of survey	Period	Hours	LAeq	10th Highest LAMax	Partial / full period data
Rear of site	Thursday	Period 1 Daytime	(07.00- 23.00)	64		PARTIAL DATA ONLY
Rear of site	Thursday Night	Period 1 Night-time	(23.00-07.00)	58	80	FULL PERIOD DATA
Rear of site	Friday	Period 2 Daytime	(07.00- 23.00)	64		FULL PERIOD DATA
Rear of site	Friday Night	Period 2 Night-time	(23.00-07.00)	58	80	FULL PERIOD DATA
Rear of site	Saturday	Period 3 Daytime	(07.00- 23.00)	63		FULL PERIOD DATA
Rear of site	Saturday Night	Period 3 Night-time	(23.00-07.00)	54	75	FULL PERIOD DATA
Rear of site	Sunday	Period 4 Daytime	(07.00- 23.00)	61		FULL PERIOD DATA
Rear of site	Sunday Night	Period 4 Night-time	(23.00-07.00)	57	80	FULL PERIOD DATA
Rear of site	Monday	Period 5 Daytime	(07.00- 23.00)	63		PARTIAL DATA ONLY

Position	Day of survey	Period	Hours	LAeq	10th Highest LAMax	Partial / full period data
Front of site	Thursday	Period 1 Daytime	(07.00- 23.00)	60		PARTIAL DATA ONLY
Front of site	Thursday Night	Period 1 Night-time	(23.00-07.00)	53	71	FULL PERIOD DATA
Front of site	Friday	Period 2 Daytime	(07.00- 23.00)	61		FULL PERIOD DATA
Front of site	Friday Night	Period 2 Night-time	(23.00-07.00)	50	67	FULL PERIOD DATA
Front of site	Saturday	Period 3 Daytime	(07.00- 23.00)	53		FULL PERIOD DATA
Front of site	Saturday Night	Period 3 Night-time	(23.00-07.00)	47	63	FULL PERIOD DATA
Front of site	Sunday	Period 4 Daytime	(07.00- 23.00)	50		FULL PERIOD DATA
Front of site	Sunday Night	Period 4 Night-time	(23.00-07.00)	42	64	FULL PERIOD DATA
Front of site	Monday	Period 5 Daytime	(07.00- 23.00)	54		PARTIAL DATA ONLY

The results are provided graphically as follows:

Figure 3: MP1 - Environmental Noise Time Series

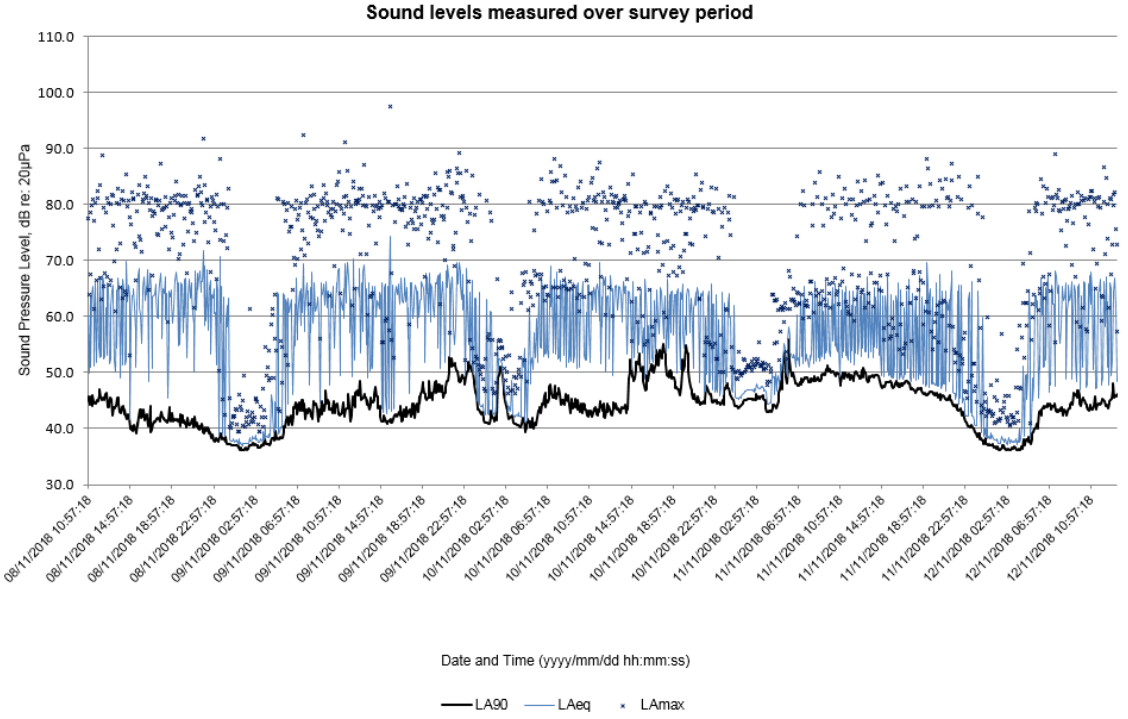
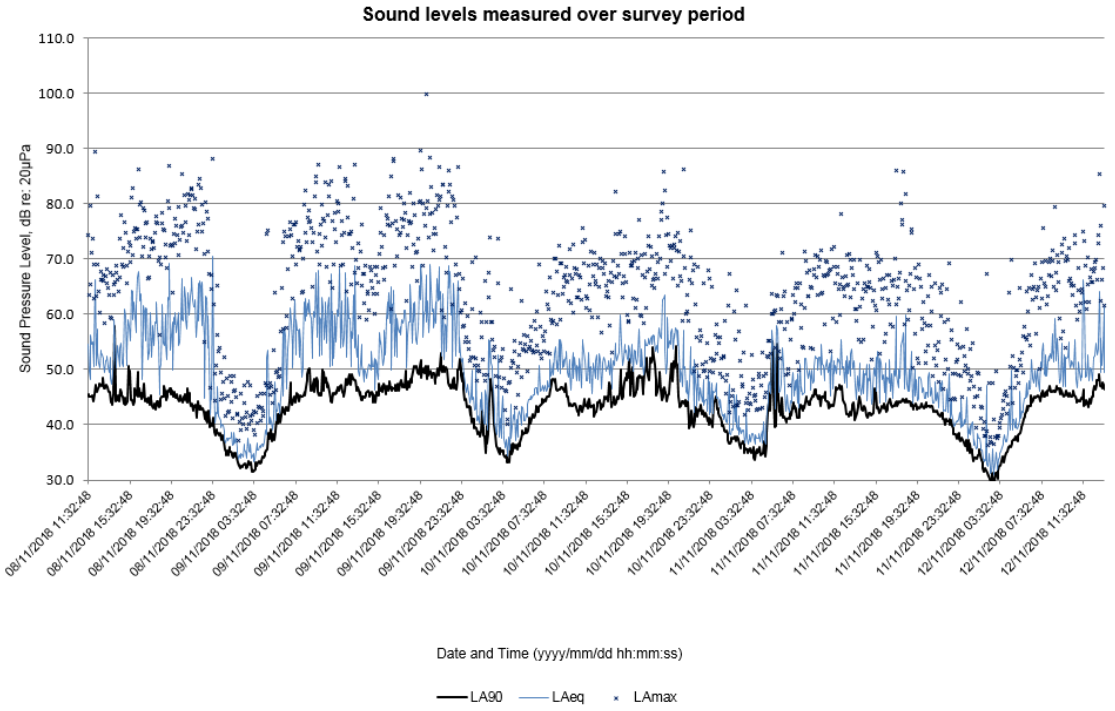


Figure 4: MP2 - Environmental Noise Time Series



8.2 With-scheme Noise Levels

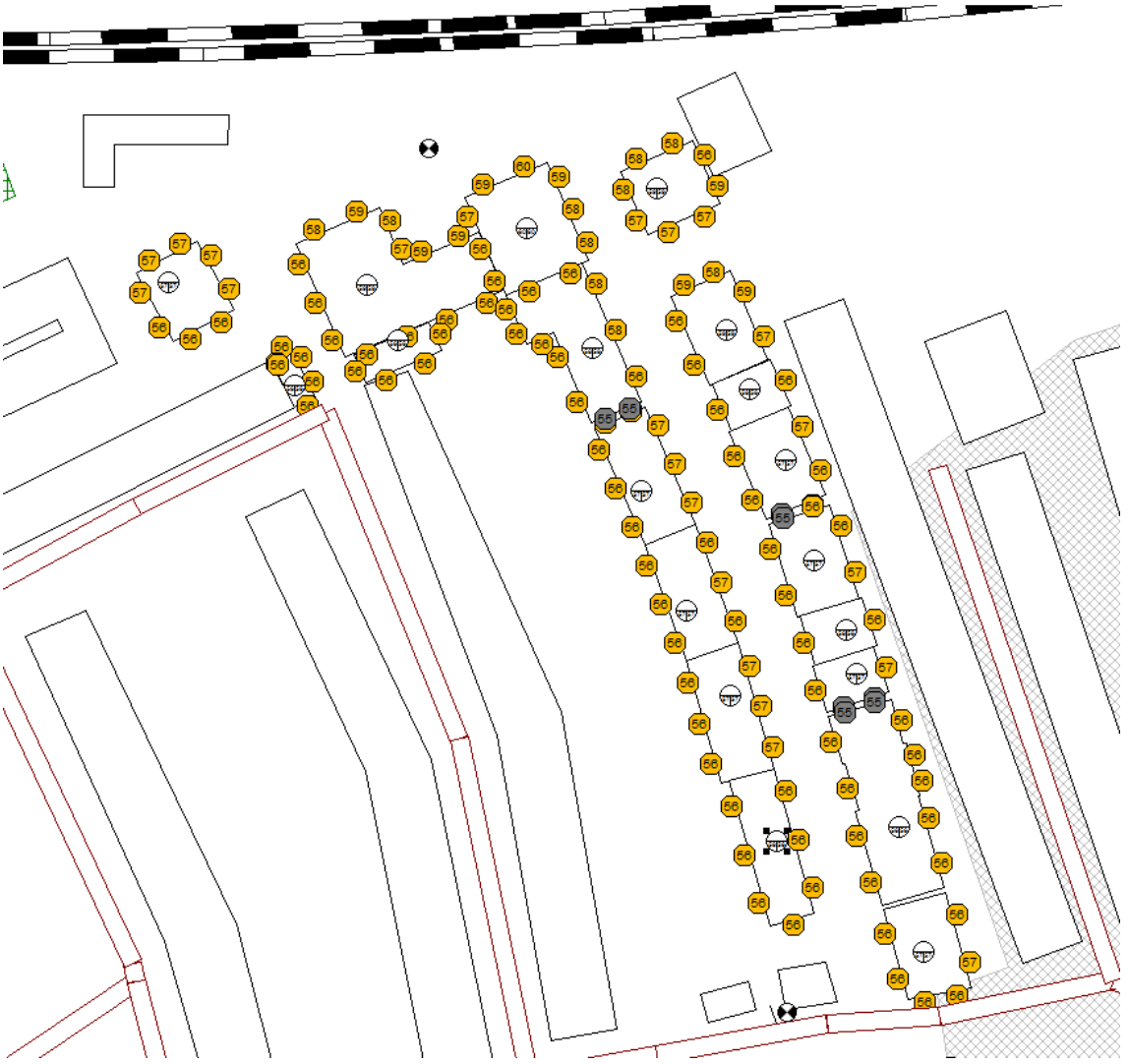
To determine noise levels across the application site attributable to ground based transportation sources (road and rail), a detailed three dimensional computer model of the locality has been constructed using CadnaA software, which implements the procedures contained in a number of pertinent documents including Calculation of Road Traffic Noise (CRTN), Calculation of Railway Noise (CRN) and ISO 9613-2: Acoustics to Abatement of sound propagation outdoors, Part 2: General method of calculation, etc..

The measurement data obtained during the surveys has been input to the model to assess how transportation noise will propagate across the proposed scheme. An enhancement has been applied to areas to the southernmost properties based on a potential acoustic character correction for possible daytime commercial related noise.

Building evaluation has been subsequently been undertaken to determine day and night L_{Aeq} noise levels on a facade-by-facade basis, Figures 5 and 6 below refer accordingly. For brevity, noise levels illustrated are the worst case and thus are independent of storey height.

Figure 5: Predicted with-scheme Façade LAeq,16h Noise Levels day

Figure 6: Predicted With-scheme Façade LAeq,8h Noise Levels night



9.0 Facade Sound Insulation

The overall building envelope sound insulation requirements may be quantified using appropriate single figure quantities such as those described below.

Table 5: Sound Insulation Descriptors

Quantity	Definition	Description
R	Sound reduction index	The sound reduction index R is a property of the building element, independent of its surface area and absorption within the receiving room. R is obtained from the results of Laboratory tests
R_w	Weighted sound reduction index	Single figure sound insulation value derived from the measured sound reduction index R.
C; C_{tr}	Spectrum adaptation terms 1 and 2. Used with single figure ratings as defined by ISO 717-1:1996	C - calculated with spectrum No. 1 (A-weighted pink noise); C_{tr} - calculated with spectrum No. 2 (A-weighted urban traffic noise).

9.1 Outline Building Envelope Sound Insulation Performance

To determine the sound insulation requirements of the constituent facade elements detailed calculations to BS EN 12354-3 (or alternatively as per BS 8233:2014) will be need to be undertaken at an appropriate stage of the project. However, to demonstrate that external noise ingress may be adequately attenuated, the overall facade sound insulation requirement has been determined using single figure quantities, in this case $R_w + C_{tr}$ has been used where R_w is the Weighted Sound Reduction Index and C_{tr} is the spectrum adaptation term.

The proposed properties will be subject to differing levels of noise across the site. For the ease of identification of the different areas the site has been split into three zones as indicated in Figure 7.

Figure 7: Zones used for façade sound insulation Tables

The outline façade performances for properties in each zone are provided as follows:

Based on the total site noise levels illustrated by Figures 5 and 6 above, the outline facade sound insulation performance for the scheme are given in Tables 6, 7 and 8 for the different Zones.

The following façade sound insulation requirements are therefore presented on the basis that living and bedroom spaces may be exposed to noise incident on any of the building facades:

Table 6: Outline Façade Sound Insulation Requirement – Zone A

Building Elevation	Space	Design intent		Predicted Noise exposure (worst case figures on façade used)		Target $R_w + Ctr$
		$L_{Aeq,T}$	L_{AFmax}	$L_{Aeq,T}$	L_{AFmax}	
North	Living room	35	-	65 dB	-	30 dB
	Bedroom	30	45	60 dB	82 dB	37 dB
East	Living room	35	-	64 dB	-	29 dB
	Bedroom	30	45	59 dB	80 dB	35 dB
South	Living room	35	-	63 dB	-	28 dB
	Bedroom	30	45	57 dB	77 dB	32 dB
West	Living room	35	-	64 dB	-	29 dB
	Bedroom	30	45	58 dB	79 dB	34 dB
Roof structures	Living room	35	-	65 dB	-	30 dB
	Bedroom	30	45	60 dB	82 dB	37 dB

Table 7: Outline Façade Sound Insulation Requirement – Zone B

Building Elevation	Space	Design intent		Predicted Noise exposure (worst case figures on façade used)		Target $R_w + Ctr$
		$L_{Aeq,T}$	L_{AFmax}	$L_{Aeq,T}$	L_{AFmax}	
North	Living room	35	-	64 dB	-	29 dB
	Bedroom	30	45	58 dB	73 dB	28 dB
East	Living room	35	-	65 dB	-	30 dB
	Bedroom	30	45	59 dB	77 dB	32 dB
South	Living room	35	-	66 dB	-	31 dB
	Bedroom	30	45	56 dB	74 dB	29 dB
West	Living room	35	-	68 dB	-	33 dB
	Bedroom	30	45	56 dB	75 dB	30 dB
Roof structures	Living room	35	-	68 dB	-	33 dB
	Bedroom	30	45	58 dB	77 dB	32 dB

Table 8: Outline Façade Sound Insulation Requirement – Zone C

Building Elevation	Space	Design intent		Predicted Noise exposure (worst case figures on façade used)		Target $R_w + Ctr$
		$L_{Aeq,T}$	L_{AFmax}	$L_{Aeq,T}$	L_{AFmax}	
North	Living room	35	-	64 dB	-	29 dB
	Bedroom	30	45	56 dB	73 dB	28 dB
East	Living room	35	-	71 dB	-	36 dB
	Bedroom	30	45	57 dB	74 dB	29 dB
South	Living room	35	-	77 dB	-	42 dB
	Bedroom	30	45	56 dB	73 dB	28 dB
West	Living room	35	-	71 dB	-	36 dB
	Bedroom	30	45	56 dB	73 dB	28 dB
Roof structures	Living room	35	-	77 dB	-	42 dB
	Bedroom	30	45	57 dB	74 dB	29 dB

Notes:

Day time reference time interval T = 16 hours (07:00 to 23:00)

Night time reference time interval T = 8 hours (23:00 to 07:00)

Examination of Tables 6, 7 and 8 shows a worst case facade sound insulation requirement of R_w + Ctr = 42 dB. Acoustic performances can in theory be maintained by suitably selected building constructions of the walls, roof, ventilation products and glazing systems. Experience of comparable projects has shown that the required R_w + Ctr values identified in Table 6, 7 and 8 are achievable for glazed elements.

The Building elevation description (North, East, South , West) apply to all individual dwellings, for example, properties on the east side of the road within the development shall be considered for their respective façade acoustic treatment on their north, east, south and west facades.

9.2 Ventilation and Cooling

The LBRT SPD titled "Development Control for Noise Generating and Noise Sensitive Development" advises the following:

> *Ideally, the above internal design noise levels could be met with windows open. However on some of the potentially noisy sites in the Borough, high specification acoustic glazing may be necessary to achieve the above internal design noise levels. In such circumstances alternative means of ventilation and cooling will be required.*

Based on the measurement of noise levels in the area that are impacted by various noise sources including aircraft overflights and rail noise it is evident that the target internal noise levels will be exceeded with the windows open. In order to meet with the target internal noise levels it is expected that double glazed windows shall remain closed. Under the circumstances, the LBRT document advises that alternative means of ventilation and cooling will be required.

Following discussion with the design team it is considered likely that mechanical cooling will be used in order to meet with the overheating requirements. The future proposed cooling scheme shall be required to reduce external noise sources to appropriate internal levels when also considering all other noise paths and shall be required to ensure that the noise levels of the ventilation cooling system itself does not exceed the target internal noise criteria given in Section 6 when considering the cumulative noise levels of all noise paths to the room.

10.0 Uncertainty

Acoustic surveys are subject to a relatively small degree of uncertainty, as there is always the potential for vehicular movements to vary slightly, together with the other noise sources that contribute to the noise levels obtained. There are also numerous tolerance associated with the sound data used, such as sound reduction performances for structures that can be influenced by not only the build quality but also the uncertainty associated with acoustic testing of the product. Whilst this practice will follow due process and use the noise data at face value, it is advised that in practice the prediction of noise levels may be subject to a tolerance of +/- 3dB, and possibly greater under certain circumstances.

11.0 Conclusions

The results of environmental noise surveys have been used as the basis of assessment of noise impinging on the facades of the proposed residential development of the former Greggs Bakery site, located off the Gould Road, Twickenham, TW2 6RT the London Borough of Richmond upon Thames in South West London.

Appropriate internal noise limits have been discussed based on various sources of guidance and target internal noise criteria have been proposed.

Based on the results of 3D modelling, the single figure facade sound insulation requirements have been provided and indicate that when fully assessed the building envelope elements such as the acoustically rated glazing, cladding, masonry, roof structure and ventilation products will in theory be able to reduce external noise levels to target internal design criteria. It is predicted that on achievement of the outline building envelope sound insulation requirements given in Tables 6, 7 and 8, reasonable indoor ambient noise levels can be achieved.