SHARPS REDMORE

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Report

Persephone Gardens, London
Acoustic Planning Report (Extended Version)

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1.0 Introduction

1.1 Sharps Redmore (SR) are instructed to advise on acoustics-related matters associated with a proposed development known as Persephone Gardens in Camden, London.

1.2 The proposals comprise the partial demolition of the existing subterranean reservoir which currently occupies the site and the erection of six 4-6 storey buildings and four 2-3 storey link buildings with common basement, to provide 82 self-contained extra care apartments and a 15-bed nursing home (both Class C2), together with associated communal facilities including restaurant, café, bar, library, exercise pool, gym, therapy rooms and cinema. Ancillary facilities include laundry, kitchen, cycle storage, car parking and plant areas.

1.3 Land usage around the proposed development is predominantly residential with existing housing surrounding the site (Gondar Gardens and Hillfield and Agamemnon Roads). Hampstead Cemetery lies to the north and West Hampstead police station to the east.

1.4 The nearest railway line (serving Cricklewood station to the West of the site) is at least 175m from the nearest site boundary. Ground-borne vibration from the railway is thus not considered to be a concern in this case and is not addressed herein.

1.5 This report documents an assessment of the existing noise climate on and around the site to determine whether the proposed development can both ensure the amenity of future residents and preserve the amenity of existing, neighbouring residents.

1.6 A planning application for the development (reference 2017/6045/P) was submitted in November 2017 and included a previous iteration of this report. Planning permission was refused by London Borough of Camden (LBC) on 30th January 2018 citing a number of reasons. Reason 11 relates directly to noise generated by the development:

"11. In the absence of a sufficiently comprehensive Noise and Vibration Impact Report outlining the proposed mitigation for the mechanical ventilation and for the car lift, the applicant has failed to demonstrate that the development would provide a suitable standard of development which would not cause harm to the amenity of future occupiers nor neighbouring properties in respect of noise and vibration levels, contrary to policies A1 (Managing the impact of development), A4 (Noise and Vibration) and CC1 (Climate change mitigation) of the London Borough of Camden Local Plan 2017."

1.7 Further clarification was provided by John Diver (Senior Planner) of LBC in October 2018 confirming that "*their primary concern related to the lack of information regarding the noise levels from the proposed car lift and the resulting effect to cumulative levels"*.

1.8 It is consequently the intention of this expanded report to address the specific matters raised in reason for refusal 11 alongside those matters already addressed in the previous iteration. This takes the form of an updated assessment of cumulative noise emissions likely to be generated by the development affecting existing residents (Section 5.0). While environmental noise emissions generated by the vehicle lift is evidently LBC's *"primary concern*" the noise impact of proposed mechanical ventilation plant on existing residents has also been revisited to ensure reason for refusal 11 has been adequately addressed.

1.9 As such this report is necessarily technical. A guide to common acoustic terminology is included in Appendix A.

2.0 Policy Context

2.1 National Planning Policy

2.1.1 The National Planning Policy Framework (NPPF), July 2018, sets out the Government's planning policies for England and *"these policies articulate the Government's vision of sustainable development."* In respect of noise, Paragraph 180 of the NPPF states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation". The National Planning Policy Framework (NPPF), July 2018, sets out the Government's planning policies for England. In respect of noise, Paragraph 170 states the following:

2.1.2 Guidance on the interpretation of the policy aims within the NPPF is provided in the online resource National Planning Practice Guidance (NPPG). The NPPG introduces the concept of a noise exposure hierarchy based on likely average response. The guidance contained in the NPPG is summarised in the table below:

Table 2.1: NPPG Noise Exposure Hierarchy

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 Lowest Observed Adverse Effect Level	No specific measures required
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 Significant Observed Adverse Effect Level	Mitigate and reduce to a minimum
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

2.1.3 The NPPF and NPPG reinforce the March 2010 DEFRA publication, *'Noise Policy Statement for England'* (NPSE) (Appendix F), which states three policy aims, as follows:

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

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

2.1.4 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"… all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

2.1.5 The NPSE does not define the SOAEL numerically, stating 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 acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."

2.2 Local Planning Policy

2.2.1 LBC's planning policies are set out in their Local Plan (2017).

2.2.2 Policy A1 describes how LBC will manage the impact of new development:

"The Council will seek to protect the quality of life of occupiers and neighbours. We will grant permission for development unless this causes unacceptable harm to amenity.

We will:

a. seek to ensure that the amenity of communities, occupiers and neighbours is protected;

b. seek to ensure development contributes towards strong and successful communities by balancing the needs of development with the needs and characteristics of local areas and communities;

c. resist development that fails to adequately assess and address transport impacts affecting communities, occupiers, neighbours and the existing transport network; and

d. require mitigation measures where necessary."

2.2.3 The factors which LBC will consider in respect of managing the impact of new development under Policy A1 include *"j. noise and vibration levels".*

2.2.4 LBC Policy A4 refers to *'Noise and Vibration' specifically, stating that:*

"The Council will seek to ensure that noise and vibration is controlled and managed.

Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:

a. development likely to generate unacceptable noise and vibration impacts; or

b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.

We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development."

2.2.5 Appendix 3 of LBC's Local Plan presents specific guidance on the way in which they will evaluate the significance of noise and vibration impacts:

"The significance of noise impact varies dependent on the different noise sources, receptors and times of operation presented for consideration within a planning application. Therefore, Camden's thresholds for noise and vibration evaluate noise impact in terms of various 'effect levels' described in the National Planning Policy Framework and Planning Practice Guidance:

- *NOEL – No Observed Effect Level*
- *LOAEL – Lowest Observed Adverse Effect Level*
- *SOAEL – Significant Observed Adverse Effect Level*

Three basic design criteria have been set for proposed developments, these being aimed at guiding applicants as to the degree of detailed consideration needed to be given to noise in any planning application. The design criteria outlined below are defined in the corresponding noise tables. The values will vary depending on the context, type of noise and sensitivity of the receptor:

- *Green – where noise is considered to be at an acceptable level.*
- *Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.*
- *Red – where noise is observed to have a significant adverse effect."*

2.2.6 With regard to developments likely to be sensitive to noise, Appendix 3 states that:

"The threshold of acceptability of the noise will primarily depend on two factors: the intended use of the noise sensitive development and the source of the noise experienced, or likely to be experienced."

2.2.7 Table B of Appendix 3 presents specific quantitative criteria for *"noise levels applicable to noise sensitive residential development proposed in areas of existing noise"*. The criteria are reproduced below:

Table 2.2 – Reproduction of Table B from Appendix 3 of the LBC Local Plan

Dominant Noise Source	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Anonymous noise such as general environmental noise, road traffic and rail traffic	Noise at 1m from noise-sensitive façade/free-field	Day	< 50 dB $L_{Aeq,16hr*}$	50 dB to 72 dB $L_{Aeq,16hr*}$	> 72 dB $L_{Aeq,16hr*}$
		Night	< 45 dB $L_{Aeq,8hr*}$ < 40 dB $L_{night**}$	45 dB to 62 dB $L_{Aeq,8hr*}$ > 40 dB $L_{night**}$	> 62 dB $L_{Aeq,8hr*}$
	Inside a bedroom	Day	< 35 dB $L_{Aeq,16hr*}$	35 dB to 45 dB $L_{Aeq,16hr*}$	> 45 dB $L_{Aeq,16hr*}$
		Night	< 30 dB $L_{Aeq,8hr*}$ 42 dB $L_{Amax,fast}$	30 dB to 40 dB $L_{Aeq,8hr*}$ 40 dB to 73 dB $L_{Amax,fast}$	< 40 dB $L_{Aeq,8hr*}$ > 73 dB $L_{Amax,fast}$
	Outdoor living space (free-field)	Day	< 50 dB $L_{Aeq,16hr*}$	50 dB to 55 dB $L_{Aeq,16hr*}$	> 55 dB $L_{Aeq,16hr*}$
Non-anonymous noise					
*$L_{Aeq,T}$ values specified for outside a bedroom window are façade levels **L_{night} values specified for outside a bedroom window are free-field levels					

2.2.8 With regard to industrial and commercial noise sources, Appendix 3 also states that:

"A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15 dB if tonal components are present) should be considered as the design criterion)."

2.2.9 Table C of Appendix 3 presents specific quantitative criteria for *"noise levels applicable to proposed industrial and commercial developments (including plant and machinery)*". The criteria are reproduced below:

Table 2.3 – Reproduction of Table C from Appendix 3 of the LBC Local Plan

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57 dB L_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88 dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 57dB L_{Amax}

*10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

**levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises. The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration. There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room (based upon measured or predicted Leq,5mins noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area.

2.2.10 Paragraph 6.99 of LBC's Local Plan provides further guidance on the way in which they will consider the impact of noise from new *"plant and other noise generating equipment"*:

"Planning conditions will be imposed to require that plant and equipment which may be a source of noise is kept working efficiently and within the required noise limits and time restrictions. Air conditioning will only be permitted where it is demonstrated that there is a clear need for it after other measures have been considered (Policy CC2 Adapting to climate change). Conditions may also be imposed to ensure that attenuation measures are kept in place and are effective throughout the life of the development."

2.2.11 Policy CC2 of LBC's Local Plan sets out the way in which they will *"ensure that buildings and people can adapt to changes already evident within the climatic system"*.

2.3 **BS 8233:2014**

2.3.1 The LBC criteria for assessing anonymous noise inside bedrooms and in outdoor living spaces as set out in Table B, Appendix 3 of LBC's Local Plan appear to be at least partly in line with the guidance in British Standard 8233:2014 *'Guidance on Sound Insulation and Noise Reduction for Buildings'*. BS 8233 provides guideline internal design criteria for new residential developments. These are reproduced below.

Table 2.4: BS 8233:2014 indoor ambient noise levels for dwellings

Activity	Location	0700 to 2300	2300 to 0700
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 $L_{Aeq,8hour}$

2.3.2 Achievement of the acoustic design criteria in Table 2.1 inside the finished development would fall within the LOAEL (Green) category according to LBC's guidance, and these criteria have therefore been adopted for the assessment of typical (dB L_{Aeq}) noise levels within the habitable rooms of the proposed development.

2.3.3 BS 8233:2014 does not contain specific guidance for assessing maximum noise levels affecting new residential development although it acknowledges that regular individual noise events can cause sleep disturbance. The LBC LOAEL (Green) category requires typical maximum noise levels not normally exceeding 42 dB L_{Amax} in bedrooms at night. Appropriate guidance is also given in the 1999 World Health Organisation (WHO) guidance document '*Guidelines for Community Noise'*, which recommends that *"noise exceeding 45 dB L_{AFMax} should be limited, if possible"*.

2.3.4 BS 8233:2014 states that for external amenity areas *"it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments".* This design range falls within the LOAEL to SOAEL (Amber) category according to LBC's guidance. Noise levels below 50 dB $L_{Aeq,T}$ would be required to be within the LOAEL (Green) category.

2.4 **BS 4142:2014**

2.4.1 Appendix 3 of LBC's Local Plan states that where appropriate British Standard 4142:2014 *'Methods for rating and assessing industrial and commercial sound'* (BS 4142) will be used to assess noise from proposed plant and machinery.

2.4.2 BS 4142:2014 describes a method for rating and assessment sound or noise of an industrial and/or commercial nature (including plant) according to the following summary process:

i) Determine the background sound level, in terms of L_{A90}, at the nearest noise sensitive receptors of interest.

ii) Determine the specific sound level of the source being assessed, in terms of L_{AeqT} level (T = 1 hour for day or 15 minutes at night) at the receptor locations.

iii) Apply acoustic feature corrections if the sound source has tonal, impulsive, intermittent or other characteristics which attract attention. The specific sound + the acoustic feature correction(s) = the *'rating level'*.

iv) Compare the rating level against the background sound level; the greater the difference between the two, the higher the likelihood of noise complaints arising.

v) Differences (rating – background) of around +10dB is likely to be an indication of significant adverse impact depending upon the context; a difference of +5dB is likely to be an indication of adverse impact, depending upon the context. Where the rating level does not exceed the background sound level (L_{A90}) at the nearest receptor of interest, the indication is that the sound source will have a low impact, depending upon the context.

2.4.3 The significance of sound of an industrial and/or commercial nature (including mechanical services noise) depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which it is placed. This is reflected in the criteria presented in Table C of Appendix 3 of LBC's Local Plan.

3.0 Survey details

3.1 A survey of prevailing environmental noise levels affecting the site was carried out between Wednesday 8th and Thursday 9th February 2017.

3.2 Survey data was used to establish typical day and night-time average (L_{Aeq}) and night-time maximum (L_{AFMax}) noise levels, as well as the typical background sound level (L_{A90}) representative of the nearest noise-sensitive properties.

3.3 The survey comprised unattended monitoring at one location over a 24 hour period, supplemented by additional attended measurements at five locations on Thursday 9th February. The measurement positions are indicated clearly in Figure 3.1

Figure 3.1: Monitoring Locations

The microphone installation at the unattended monitoring position was approximately 2.5 metres above street level and 4.5 metres from the centre of Gondar Gardens.

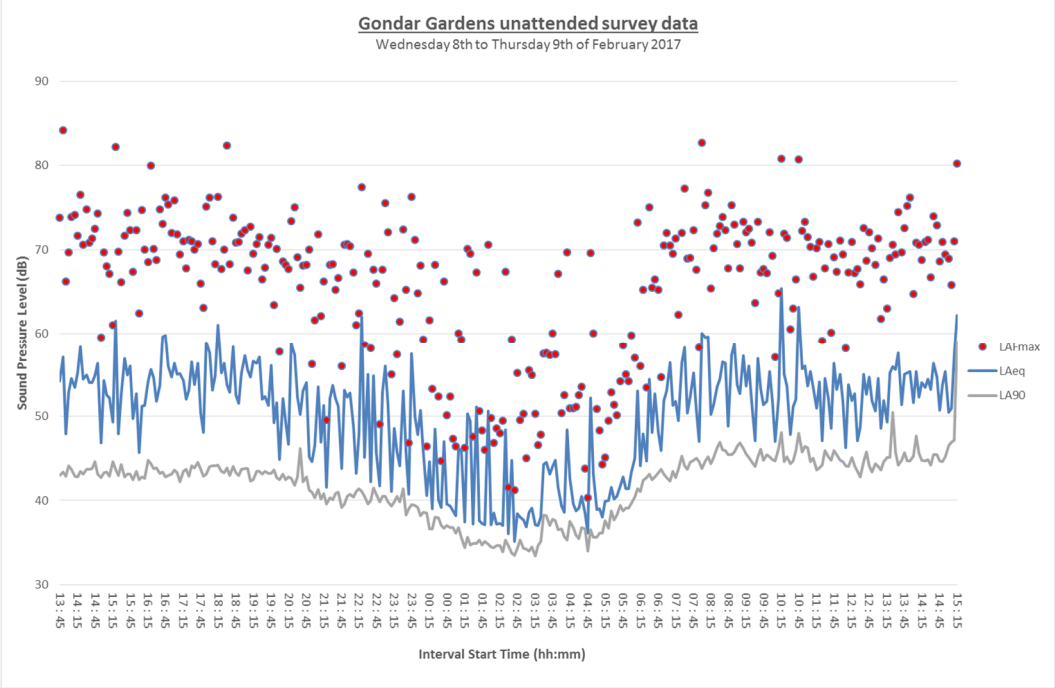
3.4 Weather conditions were considered suitable for carrying out environmental sound level measurements; being dry and with wind speeds under 5 m/s.

3.5 Measurements were taken using a Norsonic 140 Class 1 precision sound level meter. The sound level meter was calibrated before and after use with no significant drift noted. The meter has a fully traceable calibration history.

3.6 Sound level measurements were taken at 5 minute intervals during the unattended and attended survey. In both cases measurements were taken in free-field conditions.

3.7 The average dB $L_{Aeq,5\ mins}$, background dB $L_{A90,5\ mins}$ and maximum dB $L_{AFMax,\ 5\ min}$ noise levels were recorded during the survey. The results of the survey are presented in Figure 3.2.

Figure 3.2: Noise Survey Results



3.8 Table 3.1 summarises the survey results for day and night-time average dB $L_{Aeq,\ 16\ hrs}$ and $L_{Aeq,\ 8\ hrs}$, typical background dB $L_{A90,\ 5\ min}$ and typical maximum $L_{AFMax,\ 5\ min}$ noise levels recorded at the (free-field) unattended measurement position.

Table 3.1: Survey Measurement Summary

Typical Ambient		Lowest Typical Background		Typical Max (Night) dB $L_{AFmax,15min}$
Daytime 0700-2300hrs dB $L_{Aeq,16hrs}$	Night-time 2300-0700hrs dB $L_{Aeq,16hrs}$	Daytime 0700-2300hrs dB $L_{A90,15mins}$	Night-time 2300-0700hrs dB $L_{A90,15mins}$	
55	47	44	37	51

3.9 Average and maximum noise levels were dictated by a combination of distant road traffic and natural noise sources on Gondar Gardens, typical of a relatively quiet urban site. Sources included distant (and to a much lesser extent local) road traffic and aircraft noise, bird song, and wind rustling vegetation.

3.10 Table 3.2 presents the octave-band levels for the proposed development, which have been used as part of the sound insulation assessment for the residential units.

Table 3.2: Octave-band linear frequency spectra

Parameter	Octave-Band Centre Frequency, Hz								dBA
	63	125	250	500	1k	2k	4k	8k	
Day dB L_{eq}	60	54	52	51	51	46	38	32	55
Night dB L_{eq}	54	49	45	44	43	38	33	30	47
Night typical dB L_{Fmax}	66	62	55	41	41	36	37	35	51

4.0 Existing noise sources affecting future residents of the development

Building envelope sound insulation

4.1 The survey results indicate that the façades of the development will be exposed to day and night-time average noise levels up to 55 dB $L_{Aeq,16hour}$ and 47 dB $L_{Aeq,8hour}$ respectively (equivalent to approximately 58 dB $L_{Aeq,16hour}$ / 50 dB $L_{Aeq,8hour}$ as reflected 'façade' levels) which will fall within LBC's LOAEL to SOAEL (Amber) category, the guidance for which suggests that the noise is observed to have an adverse effect level, but may be considered acceptable when assessed in the context of other merits of the development.

4.2 Ultimately if noise levels in the habitable rooms of the development do not exceed the BS 8233:2014 criteria summarised in Table 2.1 (equivalent to LBC's LOAEL (Green) category) then residents will be provided with an acceptable standard of internal acoustic amenity. Night-time maximum noise levels in bedrooms should also not exceed 42 dB L_{AFmax} to fall within LBC's LOAEL (Green) category (rather than 45 dB L_{AFmax} per the WHO guidance).

4.3 The external building envelope will therefore require a sufficient level of sound insulation against external incident environmental noise. The calculated minimum airborne sound reduction of building envelope elements to achieve the required LBC LOAEL criteria are presented ahead in terms of 1/1 octave band R values for specification purposes.

4.4 Suitable products shall provide evidence of compliance in accordance with BS EN ISO 101040/2:2010 and rated in accordance with BS EN ISO 717/1:1998, or equivalent.

Façade

4.5 It is not confirmed if the external walls of the development are to be a lightweight framed system or a brick and/or block construction. Regardless of the system used, façades must meet the minimum sound insulation performance requirements detailed in Table 4.1. These performance requirements are the calculated sound reduction index (SRI) at each 1/1 octave band that would achieve the BS 8233:2014 and LOAEL internal noise limits.

Table 4.1: Minimum external wall specification

1/1 Octave-Band Centre Frequency, Hz							
63	125	250	500	1k	2k	4k	8k
17	19	14	22	38	41	33	34

4.6 The minimum performance requirements presented above are below even the most lightweight Metsec/steel frame-based systems and therefore it is the view of SR that the external walls of the development will meet the performance criteria needed to ensure acceptable internal ambient noise levels under BS 8233:2014; provided standard

Roof

4.7 To control noise ingress to the top floor of the development (primarily from rain noise), the roof combined with the ceilings to the top floor bedrooms would need to provide a sound reduction of at least 45 dB R_w. However if a composite lightweight build up is used, the minimum roof performance would need to rise to 50 dB R_w.

Window Systems

4.8 The window systems must be considered as the glazing, seals and frames combined.

4.9 The window systems should achieve the minimum sound reduction values in Table 4.2. These performance requirements are the calculated sound reduction index (SRI) at each 1/1 octave band that would achieve the BS 8233:2014 and LOAEL internal noise limits.

Table 4.2: Window system specification

1/1 Octave-Band Centre Frequency, Hz					
125	250	500	1k	2k	4k
17	23	21	31	31	27

4.10 The above indicative sound insulation requirements are the overall performances for the window systems (including frame, seal and glass). Once the requirements are confirmed it will be necessary to ensure that laboratory test data is provided to demonstrate that the window system as a whole achieves the acoustic performance standards. However, the above sound reduction performances would be achieved by the lowest specified thermal double glazing commonly in use and therefore it is the view of SR that window systems used in the development will meet the performance criteria needed to ensure acceptable internal ambient noise levels under BS 8233:2014; provided standard construction methods and materials are used.

Ventilation

4.11 Natural ventilation via open windows (which typically provide 10-15 dB attenuation) would result in the BS 8233 guideline limits being exceeded in parts of the development. However, if open windows are to be used for background ventilation, internal noise levels are still predicted to be within *"reasonable"* limits in accordance with BS 8233:2014.

4.12 If passive vents are to be utilised for background ventilation, these would need to provide the following minimum octave-band sound reduction specification (D_{ne}) when open:

Table 4.3: Ventilator system specification

1/1 Octave-Band Centre Frequency, Hz					
125	**250**	**500**	**1k**	**2k**	**4k**
31	34	36	33	34	33

4.13 The above specification could typically be met using ventilators with an overall weighted performance of 32 dB $D_{ne'w}$ (e.g. hit and miss trickle ventilator) and therefore it is the view of SR that any ventilators used in the development will meet the performance criteria needed to ensure acceptable internal ambient noise levels under BS 8233:2014; provided standard construction methods and materials are used.

External amenity areas

4.14 At this stage we understand that the development will provide external amenity space in the form of communal landscaped gardens at the rear of the site and private balconies and/or terraces to many individual dwellings.

4.15 Based on the noise survey data, typical daytime average noise levels in the front part of the site closest to Gondar Gardens do not exceed 55 dB $L_{Aeq,\ 16\ hrs}$. Average noise levels at the rear of the site and further from Gondar Gardens are typically 10 dB or more lower. Therefore the private residential balconies and/or terraces will be exposed to noise levels which fall within LBC's LOAEL to SOAEL (Amber) category on the worst-case elevation and the LOAEL (Green) category in most other areas.

4.16 Daytime average noise levels in the landscaped communal gardens at the rear of the site are expected to be no higher than 45 dB $L_{Aeq,16hour}$, based upon the noise survey results. This would fall within the LOAEL (Green) category.

4.17 Furthermore, typical daytime average noise levels anywhere on the site are not expected to exceed the BS 8233:2014 upper guideline limit of 55 dB $L_{Aeq,16hour}$. This provides further assurance that future occupants of this scheme could readily be provided with acoustically appropriate external amenity space, with no additional mitigation required.

5.0 Noise sources associated with the development affecting existing residents

Building Services Noise Emissions

5.1 External noise emissions generated by building services and/or mechanical plant associated with the proposed development should be controlled to preserve the amenity of existing residential noise-sensitive premises in the vicinity of the site.

5.2 The cumulative 'Rating Level' from all building services should not exceed the following day and night-time noise limits 1 metre from the nearest existing noise-sensitive façade (existing residences on Godar Gardens). These correspond to a 'Rating Level' 10 dB below background, which would fall within LBC's LOAEL (Green) category.

Table 5.1: Proposed building services plant noise limits

Location	Period	Plant Noise Limit
1 metre from nearest noise-sensitive façade to development	Day-time (0700-2300hrs)	34 dB $L_{Aeq,1hr}$
	Night-time (2300-0700hrs)	27 dB $L_{Aeq,15min}$

5.3 Plant noise emissions exceeding these levels should be avoided where this is achievable. However, plant noise emissions between 10 dB below and +5 dB above background should fall within the LOAEL to SOAEL (Amber) category, the upper threshold of which is the point at which BS 4142 suggests is *"an indication of an adverse impact, depending on the context".* Plant noise emissions exceeding the LOAEL threshold would therefore not necessarily result in adverse noise impact on existing noise-sensitive receivers.

5.4 The design, layout and specifications for building services plant are still being developed. Current proposals indicate that the building services strategy will require the provision of dry air coolers in a dedicated plant zone on the roof. The proposed location for the dedicated rooftop plant zone is shown on the marked up roof plan in Appendix B.

5.5 Current specifications indicate that a single bank of dry air coolers (DACs) will be installed which according to the manufacturer (Guntner) produce a sound power level of 85 dB L_{wA}. The resultant sound pressure level at the worst-case (nearest) existing residential receptors (Chase Mansions on Gondar Gardens) have been calculated based on a minimum distance of 20m to the nearest façade and taking into account the acoustic screening provided by the intervening structure of the proposed building. The calculations are summarised below.

Table 5.2: Summary of DAC Noise Propagation Calculations

	1/1 Octave-Band Sound Pressure Level (dBA)							dB(A)
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
SWL	67	72	77	80	79	74	72	85
Distance	-37	-37	-37	-37	-37	-37	-37	
Screening	-7	-8	-10	-12	-15	-18	-21	
Resultant	22	25	28	28	24	17	12	35

5.6 It can be seen from Table 5.2 that the calculated noise level from the DACs at the nearest existing receptor (taking into account distance and screening) is 35 dB(A) with the plant operating at typical maximum duty. Based on our experience noise from this type of plant is not impulsive or tonal in character at the receptor. The plant may run intermittently but with the LBC target criterion (LOAEL) of 10 dB below background, any intermittency would not be sufficiently distinctive to attract a 3 dB penalty. Therefore the predicted noise levels are considered the rating noise levels, in accordance with BS 4142:2014.

5.7 The predicted rating noise level of 35 dB (A) is 9 dB and 2 dB respectively below the lowest typical day- and night background sound levels. According to BS 4142:2014 a rating noise level below the background sound level is an indication of a low impact. However, the LBC LOAEL criterion of 10 dB below background would be exceeded by 1 dB during the day and 8 dB during the night based on the above worst-case assessment.

5.8 A reduction in cooling plant noise of 8 dB is normally achievable with acoustic screening. For example, the installation of a 1.8m solid acoustic barrier or parapet wall along the perimeter of the roof nearest Chase Mansions is capable of reducing overall rating noise levels at the nearest receptor to 27 dB (A) which would meet the LBC (LOAEL) criterion.

Table 5.3: Summary of DAC Noise Propagation Calculations (Additional Screening)

	1/1 Octave-Band Sound Pressure Level (dBA)							dB(A)
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
SWL	67	72	77	80	79	74	72	85
Distance	-37	-37	-37	-37	-37	-37	-37	
Screening	-7	-8	-10	-12	-15	-18	-21	
Parapet	-6	-8	-9	-9	-9	-9	-9	
Resultant	17	19	21	22	18	10	5	27

5.9 This is only one possible solution and a number of technical solutions would be possible, including alternative screening heights/locations or an acoustic enclosure. An acoustic enclosure would need to be designed to achieve the following minimum insertion loss performance to achieve the LBC (LOAEL) criterion based on the current specifications:

Table 5.4: Minimum Insertion Loss of DAC Acoustic Enclosure (No Additional Screening)

1/1 Octave-Band Centre Frequency						
125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
3 dB	5 dB	7 dB	8 dB	6 dB	5 dB	2 dB

5.10 This insertion loss specification would be achievable with an acoustic enclosure. This would need to be bespoke and the detailed design of such a solution would not normally be completed until the specification of applicable equipment has been finalised. However, it is likely that any such enclosure would include overhead baffling and low-level acoustic louvres to facilitate (and acoustically attenuate) airflow. Shown below are indicative external/internal photographs of a comparable acoustic enclosure:

Figure 5.1: Photographs of Previous DAC Acoustic Enclosure

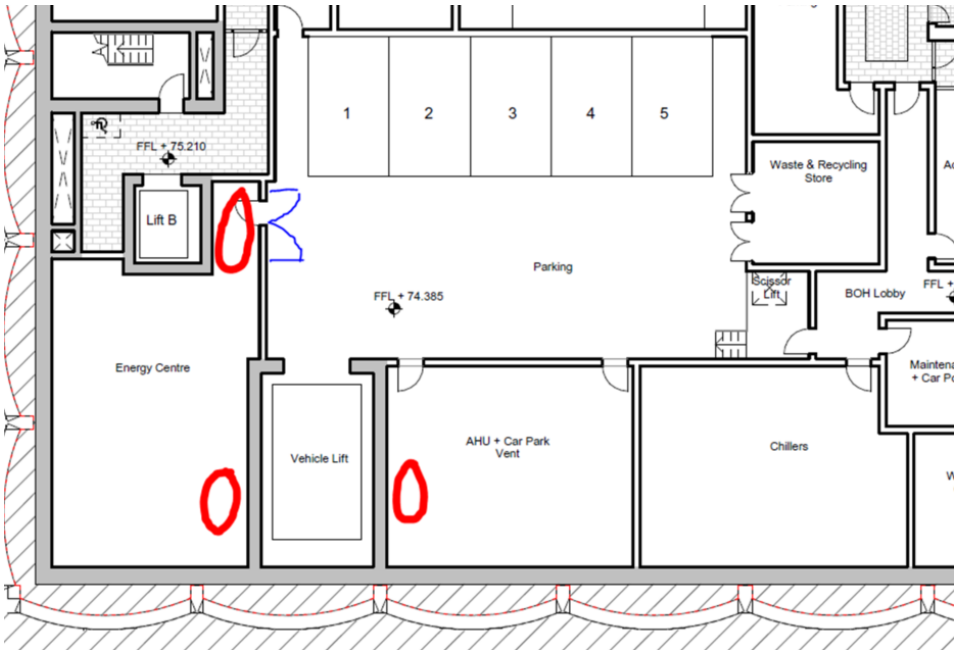
5.11 Regardless of the exact nature of mitigation, it is clearly evident that LBC's LOAEL criterion is achievable through design and specification. This is a technical matter which can be ensured through the imposition of an appropriate planning condition. Indeed, this is reinforced by Paragraph 6.99 of LBC's Local Plan which advises that "*Planning conditions will be imposed to require that plant and equipment which may be a source of noise is kept working efficiently and within the required noise limits and time restrictions".*

Vehicle Lift Noise Emissions

5.12 Proposals also include the provision of a vehicle lift serving the basement car park. This will require supporting equipment which can generate relatively high levels of noise, with the lift motor typically the most significant source. Current proposals indicate that worst-case noise levels of up to 65 dB (A) might occur within the lift motor room, which will be accommodated within one of the basement plant spaces adjacent to the vehicle lift.

5.13 The exact location for the motor room would be finalised during the detailed design of the development in consideration of other building services and architectural requirements. However, both spaces are fully enclosed in the basement of the building and noise breakout to the external environment is therefore very unlikely to be an issue.

Figure 5.1: Possible Vehicle Lift Motor Room Locations



5.14 The possible locations for the vehicle lift motor room are fully enclosed in the basement and noise breakout to the external environment would therefore be naturally constrained by the surrounding structure. Noise would need to travel through the ground floor slab and out through the external façade(s) which is a relatively torturous transmission path.

5.15 The design and specification of the internal structure and external building envelope will be finalised during the detailed design but even conservative estimates of 45 dB reduction through a 150mm concrete floor slab (minimum density 2340 kg/m_3) and 10 dB reduction through a partially-open window in the external façade would reduce the motor room noise to insignificant levels (~10 dB (A)) by the time it reaches the external environment. This level would be further reduced by 5-10 dB due to the attenuation provided by distance to the nearest existing dwelling (at least 10m away).

5.16 These are conservative estimates and in reality the building structure is likely to reduce noise breakout from the lift motor room to a much greater extent. Regardless, based on the proposals it is evident that lift motor room noise is extremely unlikely to have any significant impact regardless of the exact construction types used.

5.17 Use of the vehicle lift is likely to generate some operational noise at ground floor level, although published technical data for this is rare because most noise generated by a vehicle lift emanates directly from the lift motor. In any case, the proposed development provides only 5no parking spaces which will limit the number of daily lift actions required. The project lift consultant has indicated a conservative estimate of 4no actions per car per day equating to a maximum 20 vehicle lift actions over a typical 24-hour period (very few of which would be expected to occur during the night-time period 2300-0700hrs). Furthermore, the pump does not run on downwards journeys (only upwards) which limits motor/pump starts to 10 per day. 10 motor/pump starts per day is extremely unlikely to have any significant impact or effect on cumulative building services noise levels.

5.18 In our experience of similar vehicle lift installations, noise emissions are typically only an issue where the lift motor is located externally and/or where noise from within the lift motor room is able to easily escape to the atmosphere. This will not be the case for this development, which in combination with the relatively low number of lift actions projected to occur on a typical day make any significant adverse impact unlikely.

5.19 Regardless, noise generated by the proposed vehicle lift is a technical matter which is typically straightforward to address through appropriate design and can therefore be ensured through the imposition of an appropriately worded planning condition. Indeed, this is reinforced by Paragraph 6.99 of LBC's Local Plan which advises that "*Planning conditions will be imposed to require that plant and equipment which may be a source of noise is kept working efficiently and within the required noise limits and time restrictions".*

Vehicular Noise Impact

5.20 The potential impact on existing residents of additional vehicle movements associated with the development has also been considered.

5.21 Transportation survey data provided by Cannon Consulting Engineers indicate that the current Average Annual Daily Traffic (AADT) is around 422 vehicles, while the projected (future) AADT is 462. This means that the AADT will increase by 40 vehicles (around 9%). This equates to 40 two-way trips, i.e. 20 arrivals at the development and 20 departures.

5.22 The additional trips are not expected to increase the typical maximum noise level existing residents are exposed to during the night-time as a result of vehicles on Gondar Gardens, particularly as 90% of these are predicted to occur between 0600-0000hrs and therefore only 10% (four two-way trips) during the most sensitive night-time period 0000-0600hrs.

5.23 An increase in overall vehicle numbers of 9% is also unlikely to result in any significant increase in longer-term day and night-time average noise levels, given that an effective doubling of road traffic typically equates to an increase of around 3 dB, which in turn is typically the minimum perceptible change in noise levels under normal conditions.

5.24 Additional vehicle traffic associated with the development is therefore not expected to result in any significant increase in prevailing road traffic noise levels, and subsequently no significant impact on existing residents of Gondar Gardens.

6.0 Conclusion

6.1 An environmental noise survey has been conducted and the prevailing noise climate at the site has been established.

6.2 Based on the results of the survey, environmental noise levels incident on the external façades of the development will fall within either the LOAEL to SOAEL (Amber) category for the Gondar Gardens elevation or the LOAEL (Green) category for most other areas.

6.3 Acoustic design specifications have been proposed for the external building envelope to ensure that internal noise levels in habitable rooms meet LBC' criteria for LOAEL (Amber) categorisation and the BS 8233:2014 guideline criteria. The required internal conditions can be readily achieved using minimum/standard construction methods and materials (e.g. using lightweight façade, standard thermal double glazing and trickle ventilators).

6.4 Noise limits for building services plant at the nearest noise-sensitive receptors have been proposed in accordance BS 4142:2014 and the criteria set out in the LBC Local Plan. Indicative calculations have been completed to assess preliminary details of external plant equipment, and no adverse impact on existing residents is expected provided appropriate care is taken in the design, specification and selection of building services equipment. Rooftop plant may require some form of acoustic mitigation and specifications for two possible options have been provided based on the current plant equipment selections. In any case, ensuring an acceptable noise impact from building services plant is a technical matter which can be secured with a planning condition, in line with LBC's Local Plan.

6.5 Proposals for the vehicle lift have been assessed and are considered acoustically robust. The lift motor room (the most significant source of noise) will be located within one of the basement plant rooms which will naturally contain the noise and restrict noise breakout to insignificant levels. Furthermore, the vehicle lift is projected to be used no more than 20 times over a typical 24 hour period which will negate the impact of any other operational noise. In any case, ensuring an acceptable noise impact from the vehicle lift is a technical matter which can be secured with a planning condition, in line with LBC's Local Plan.

6.6 An assessment of vehicle traffic associated with the development indicates that the additional trips will not result in any significant impact on existing residents.

6.7 In summary, the noise impact both on and of the proposed development is expected to be acceptable provided standard building methods and materials are used and appropriate care is taken in the specification and selection of mechanical plant.

APPENDIX A

ACOUSTIC TERMINOLOGY

Acoustic Terminology

A1 Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sounds is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase in level of 3 dB, i.e. 50 dB + 50 dB = 53 dB. Increases in continuous sound are perceived in the following manner:

1 dB increase - barely perceptible
3 dB increase - just noticeable
10 dB increase - perceived as twice as loud

A2 Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz (Hz) = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 18000Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium than high or low frequencies.

A3 To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability automatically to weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).

A4 The second important characteristic of sound is amplitude or level. Two units are used to express level, a) sound power level - L_w and b) sound pressure level - L_p. Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity, etc. The sound level that is measured on a meter is the sound pressure level, L_p.

A5 External sound levels are rarely steady but rise or fall in response to the activity in the area - cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on the type and temporal distribution of a particular type of noise. A set of statistical indices have been developed for the subjective response to these different noise sources.

A6 The main noise indices in use in the UK are:

L_{A90}: The sound level (in dBA) exceeded for 90% of the time. This level gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background sound level" of an area.

L_{Aeq}: The equivalent continuous sound level in dBA. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the intermittent noise". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as aircraft and trains.

L_{A10}: The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given sample. It has been used to measure and assess road traffic noise.

$L_{AMAX:}$ The maximum level of sound measured in any given period. This unit is used

APPENDIX B

Marked Up Roof Plan (Cooling Plant)

PV Panels & IRS Aerial Systems mounted on This Roof Access Required & Safe Maintenance Facilities

11m x11m x 1m(H)
Dry Air Coolers linked to basement chillers.

1.2m x 0.65m Mechanical Riser For CHP Flue and Boiler Flue Terminates 3 meters above heights accessible point.

1m (H)

11.00 m

Key

PV ARRAY

GAS FLUE

DAC COMPOUND FOR BASEMENT CHILLERS

Key

1Bed
2 bed (Pent)
2Bed
BoH
CareBed
Communal
Corridor
WG-2BP
WG-2B

ROOF LEVEL (INDICATIVE)

1 : 500

Designed with reference to the surveys, information and reports listed: Xxxxxxxxxxxxxx Xxxxxxxxxxxxxx, Xxxxxxxxxxxx Xxxxxxxxxxx, Xxxxxxxxxxxx Xxxxxxxxxxx, Xxxxxxxxxxxx Xxxxxxxxxxx, Xxxxxxxxxxxx Xxxxxxxxxxx.

Rev	Date	Description
-	02-06-16	First Issue
A	24-06-16	General Revision
B	28-06-16	Winter Gardens and Service Link added

Dwn	Ckd		
		Drawn	CJP
		Checked	SH
		Date	06/01/16
		Scale @ A3	1 : 500

Gondar Gardens **OPTION C**

Level +3

AA6253-1005
REV B

CBC- MARKUP
07/07/16