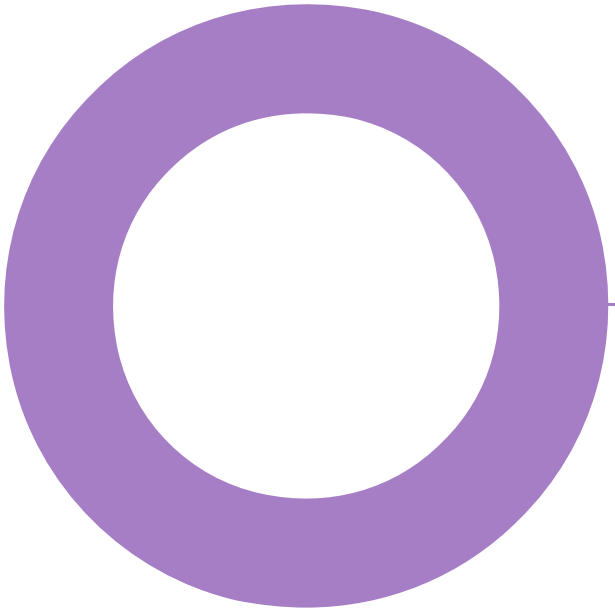
HOARE LEA

Oxford Institute of Digital Health. Oxford. University of Oxford.

ACOUSTICS
NOISE IMPACT ASSESSMENT FOR PLANNING

REVISION 00 – 08 FEBRUARY 2024



Audit sheet.

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Contents.

Executive summary

This report comprises a noise impact assessment of the Oxford Institute of Digital Health, proposed within the Radcliffe Observatory Quarter (ROQ) in the Jericho area of Oxford. The development is a refurbishment of the existing Gibson and Harkness Buildings within the ROQ. This will require the installation of new fixed plant items for ventilation, heating and cooling, and electrical power. New fixed plant items are the only new sources of noise associated with the development.

The noise assessment strategy is in accordance with the Local Authority guidance, which requires noise from new fixed plant sources to be less than the existing background sound level at the nearest noise sensitive receptors, rated in accordance with BS 4142.

The existing sound climate was quantified via an acoustic survey undertaken by Hoare Lea in June 2023. The survey allowed for the measurement of ambient and background sound levels over a 7-day period at a location deemed representative of the nearest noise sensitive receptors.

Noise limits have been set based on the results of the acoustic survey.

The MEP design has been assessed to predict noise levels at the nearby noise sensitive receptors. Sound power level limits have been applied to each noise source to ensure resultant noise levels are suitable. Outline mitigation is provided based on the current MEP design / selections to reduce noise level suitably.

Mitigation advice has been provided through strategies – operational, mechanical, and architectural:

Operational mitigation advice includes:

- Night-time setbacks on air handling units and air source heat pumps.

Mechanical mitigation advice includes:

- Installation of 1200 mm attenuators on all AHU atmospheric terminations.
- Installation of acoustic packaging on top and sides of ASHPs.

Architectural mitigation advice includes:

- Construction of an enclosure around both transformers each with a minimum performance of 39 dB R_w.
- If ventilation louvres are required in the enclosure construction, these should be on the eastern side (facing away from the receptors) and have a minimum performance of 22 dB R_w.

With the mitigation advice followed, noise levels at receivers are predicted to have less than a low impact when assessed in accordance with BS 4142.

This report is suitable for submission to the Local Authority as part of the planning application.

1. Introduction.

This report comprises the noise impact assessment of the Oxford Institute of Digital Health (OIDH) development proposed for the Radcliffe Observatory Quarter (ROQ) in Jericho, Oxford. Proposals include new plant equipment that will serve the development building. The new plant equipment is a potential new source of noise. Given the proposed use of OIDH, this is considered the only source of noise for assessment.

This report provides an acoustic assessment of the proposed plant equipment. External plant noise emission limits are proposed based on the Oxford City Council requirements, based on the results of an environmental noise survey of the prevailing acoustic climate at the site. Mitigation advice is provided to ensure that the plant noise emission limits are not exceeded at the nearest noise sensitive receptors.

This report is suitable for submission alongside the planning application for the development.

2. Site context.

The OIDH development proposal involves the refurbishment and integration of the existing Harkness Building and Gibson Building, situated within the Radcliffe Observatory Quarter (ROQ). The development site is on the west side of the ROQ and is directly surrounded by other University properties including the Radcliffe Observatory and New Radcliffe House. The Stephen A Schwarzman Centre for the Humanities is currently under construction directly adjacent to the east of the OIDH site.

The Doll Building, directly adjacent to the development site, is a student accommodation building within the grounds of Green Templeton College. This has been identified as the nearest noise sensitive receptor to the development site. Other nearby noise sensitive receptors include residential dwellings on Observatory Street, to the north and west of the site.

Whilst on site, it was noted that the noise from the nearby construction site was most dominant. Aside from construction noise, the acoustic climate was subjectively quiet, with some light road traffic and quiet mechanical ventilation noise (extract fans) noted to be audible. The development site is situated adjacent to an existing substation, but this was not creating audible noise at the time of the acoustic survey.

The site context is shown below in Figure 1.

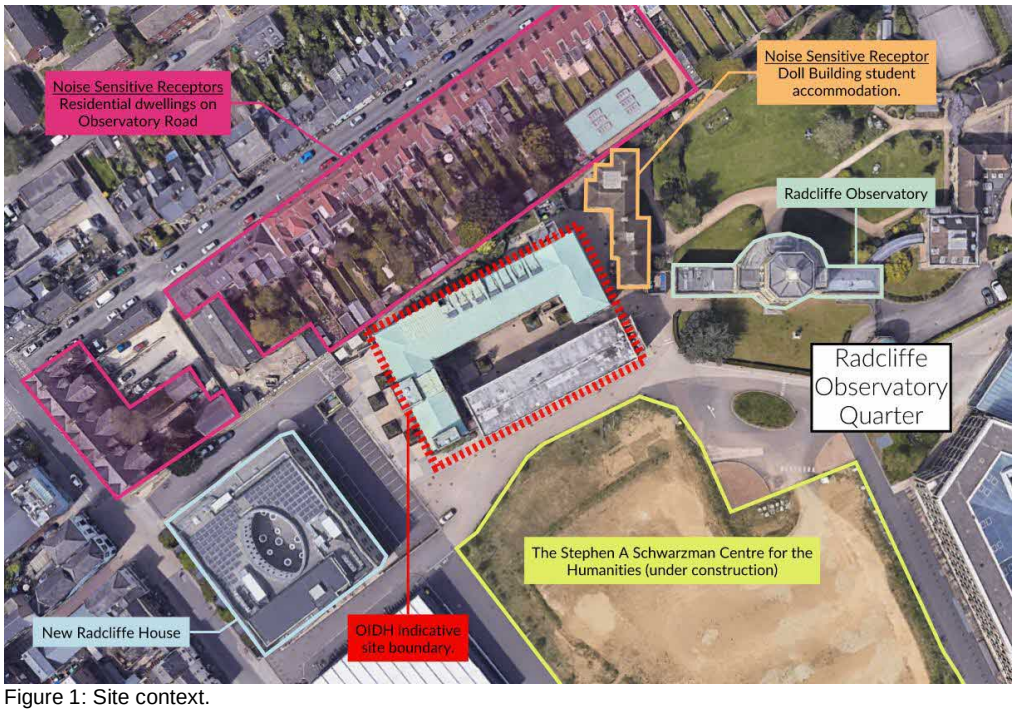

Figure 1: Site context.

3. National and local planning policy.

3.1 National policy.

3.1.1 Noise Policy Statement for England.

Noise Policy Statement for England (NPSE) (Department for Environment, Food & Rural Affairs, 2010) advises that noise impacts should be assessed on the basis of adverse and significant adverse effect but does not provide any specific guidance on assessment methods or noise limits.

NPSE introduces the concepts summarised in Table 1 that can be applied when considering the significance of noise impacts, which are applied by the World Health Organization.

The document advises that it is not possible to have *'a single objective noise based measure…that is applicable to all sources of noise in all situations*'. NPSE further advises that the sound level at which an adverse effect occurs is likely to be different for different noise sources, for different receptors at different times.

Effect Level	Description
No Observed Effect Level (NOEL)	This is the noise level below which no effect can be detected. In simple terms, below this level of noise, there is no detectable effect on health and quality of life due to the noise being assessed.
Lowest Observed Adverse Effect Level (LOAEL)	This is the level of noise above which adverse effects on health and quality of life can be detected.
Significant Observed Adverse Effect Level (SOAEL)	This is the level of noise above which significant adverse effects on health and quality of life occur.

Table 1: NPSE observed effect levels.

3.1.2 National Planning Policy Framework.

National Planning Policy Framework (NPPF, Dec 2023) sets out the Government's planning policies and how these are expected to be applied. In relation to noise and vibration, NPPF section 15 paragraphs 180, 191 and 193 are presented below:

'*180. Planning policies and decisions should contribute to and enhance the natural and local environment by:*

…

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution..'.

'*191. 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[69];
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 ..'.

'*193. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community*

facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.'

3.1.3 Planning Practice Guidance.

Online Planning Practice Guidance (PPG) (Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government, 2016) has been published online to provide greater details in relation to the relevance of noise to the planning process following the introduction of the NPPF and NPSE.

Under *Noise*, this guidance states, under the heading *'How to Determine the Noise Impact'*, that the following should be considered by local authorities:

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

In line with NPSE, this includes identifying where noise exposure is above or below the significant observed adverse effect level and the lowest observed adverse effect level for a given situation during the operation of the Proposed Development.

Further guidance on each of the various observed effect levels set out in the NPSE is provided in the '*Noise exposure hierarchy table*' which is reproduced below in Table 2. It is important to note that no specific noise parameters or target noise levels are defined in the text. Under the heading *'What factors influence whether noise could be a Concern?'*, the subjective nature of noise is discussed. It is stated that there is no simple relationship between noise levels and the impact on those affected. This depends on how various factors combine in particular situations.

Perception	Example 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 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; closing windows for some of the time because of the noise. Potential for non-awakening 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. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep.	Significant Observed Adverse Effect Level	Avoid

Perception	Example of outcomes	Increasing effect level	Action
	Quality of life diminished due to change in acoustic character of the area.		
Noticeable and very Disruptive	Extensive and regular changes in behaviour and/or 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

Table 2: PPG Observed Effects.

3.2 Local policy.

The local planning authority for the development site is Oxford City Council. The Oxford Development Plan consists of the Local Plan 2036, site specific Area Action Plans and made Neighbourhood Development Plans. The Oxford Local Plan 2036 (Oxford City Council, 2020) contains detailed policies which planning applications will be judged against. The following policy relates to noise and planning:

> '*Policy RE8: Noise and vibration*
>
> *Planning permission will only be granted for development proposals which manage noise to safeguard or improve amenity, health, and quality of life.*
>
> *Planning permission will not be granted for development that will generate unacceptable noise and vibration impacts.*
>
> *Planning permission will not be granted for development sensitive to noise in location which experience high levels of noise, unless it can be demonstrated, through a noise assessment, that appropriate attenuation measures will be provided to ensure an acceptable level of amenity for end users and to prevent harm to the continued operation of existing uses.*
>
> *Conditions will be used to secure such mitigation measures and operational commitments.*
>
> *Measures to mitigate the impacts of noise and vibration associated with demolition and construction will be secured by legal agreement through Construction Management Plans (Refer to Policy M2).'*

Policy RE8 and the supporting text in the Local Plan do not quantify what is considered an "unacceptable" noise impact.

3.3 Recognised standard guidance.

British Standard 4142:2014+A1:2019 (BS 4142) (British Standards Institute, 2014) provides guidance for assessing commercial operations and fixed building services plant noise. The British Standard provides an objective method for rating the significance of impact from industrial and commercial operations. It describes a means of determining sound levels from fixed plant installations and determining the background sound levels that prevail on a site.

The assessment of the impacts is based on the subtraction of the pre-existing background sound level ($L_{A90,Tr}$) from the rating level ($L_{Ar,Tr}$).

The standard does not give a definitive method for determining the background sound level but instead, as a commentary, states that:

> "*the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods*".

Clause 8.1.4, which discusses the monitoring duration, states "*there is no "single" background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be*

representative of the period being assessed." As a note to this clause the following commentary is given on obtaining a representative backgrounds sound level:

> "*To obtain a representative background sound level a series of either sequential or disaggregated measurements ought to be carried out for the period(s) of interest, possibly on more than one occasion. A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."*

The rating level is defined objectively as the specific source noise level in question (either measured or predicted) with graduated corrections for tonality (up to +6 dB(A)), impulsivity (up to +9 dB(A)), intermittency (+3 dB(A)) and other sound characteristics (+3 dB(A)) which may be determined either subjectively or objectively, if necessary.

The background sound level is subtracted from the rating level. The following is considered when evaluating the potential impact:

– A difference of around +10 dB is likely to be an indication of a significant adverse impact, depending on context;
– A difference of around +5 dB is likely to be an indication of an adverse impact, depending on context; and
– A difference of +0 dB or less is an indication of the specific sound source having a low impact, depending on the context, and the lower the rating is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact.

The importance of context is highlighted in BS 4142, which states that the following factors should be taken into consideration when the initial estimate of the impact needs to be modified due to the context:

"1) *The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) *The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.*

NOTE 3 Consideration should be given to evidence on human response to sound and, in particular, industrial and/or commercial sound where it is available. A number of studies are listed in the "Effects on humans of industrial and commercial sound" portion of the "Further reading" list in the Bibliography.

3) *The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:*

i) facade insulation treatment;

ii) ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and

iii) acoustic screening."

4. Basis for assessment.

Policy RE8 and its supporting text in the Oxford City Council (OCC) Local Plan does not quantify what is considered an "unacceptable" noise impact. OCC have been contacted to agree the noise assessment methodology and approach for setting operational noise emission limits. Edward Davis, Environmental Health Officer at the Council, has confirmed via email that the standard plant noise criteria is as follows:

'*The external noise levels emitted from plant/ machinery/ equipment shall ensure that the rating level of the noise emitted from the proposed installation located at the site shall not exceed the existing background level at any noise sensitive premises when measured and corrected in accordance with BS4142:2014 +A1:2019 "Methods for rating and assessing industrial and commercial sound."*'

Based on this, the following noise limit is applied as a rating level that is less than the existing background level.

Rating level ≤ Background sound level

$L_{Ar,Tr} \leq L_{A90,Tr}$

The benchmarking acoustic survey has been undertaken at a location representative of the closest identified noise sensitive receptors. The closest identified noise sensitive receptors will be used as the assessment location. The locations of the closest noise sensitive receptors are residential dwellings on Observatory Street and Walton Street, as shown in Figure 1.

Noise limits are summarised below.

Receiver.	Normal plant.
Residential noise sensitive receptor	$L_{Ar,Tr} \leq L_{A90,Tr}$ dB

Table 3: Proposed noise emission limit methodology.

5. Assessment methodology.

Figure 2 outlines the assessment strategy for controlling fixed plant noise emissions. The assessment begins with a noise survey, the results of which are used to determine noise limits at the nearby noise sensitive receptors (see Section 7).

With noise limits set at receiver locations, noise limits at source can be determined through understanding of the environmental conditions around the site. This is typically taken into consideration through a noise propagation model.

Noise limits at source can be compared to manufacturers data to determine attenuation requirements. Where plant items are in exceedance of the source noise limits, some mitigation will be required.

As shown in Figure 2, attenuation requirements can be achieved through:

- Operational mitigation – typically a reduction in plant load through BMS specification.
- Mechanical mitigation – the installation of attenuation packaging locally around plant items.
- Architectural mitigation – the installation of barrier screening or enclosures.

If sufficient mitigation cannot be achieved through these methods, reselection will typically be required via the manufacturer to identify quieter plant equipment. Reselections will require reassessment.

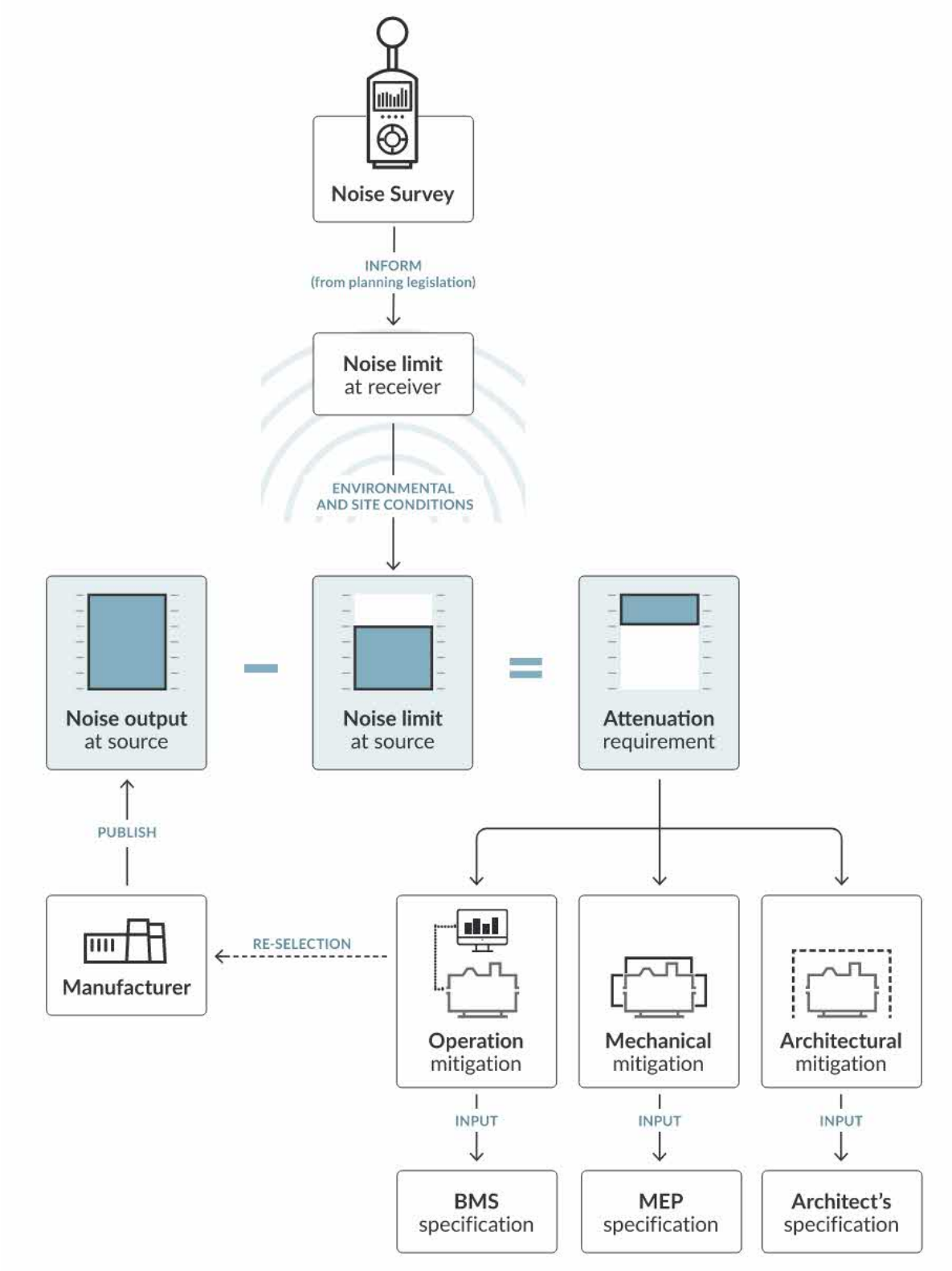

Figure 2: Fixed plant noise emissions assessment strategy.

6. Environmental noise survey.

This section summarises the environmental noise survey undertaken by Hoare Lea in July 2023. The purpose of the survey was to quantify the existing noise climate at a location deemed representative of the nearest noise sensitive receptor. Survey results are used in the determination of noise limits at receptors (Section 7).

6.1 Methodology.

The acoustic survey was undertaken to quantify the prevailing noise climate at the closest noise sensitive receptors (residential dwellings on Observatory Street). This was achieved through unattended noise monitoring at a single position on the development site. The position is shown in Figure 3. Photos of the noise monitoring positions are shown in Figure 4.

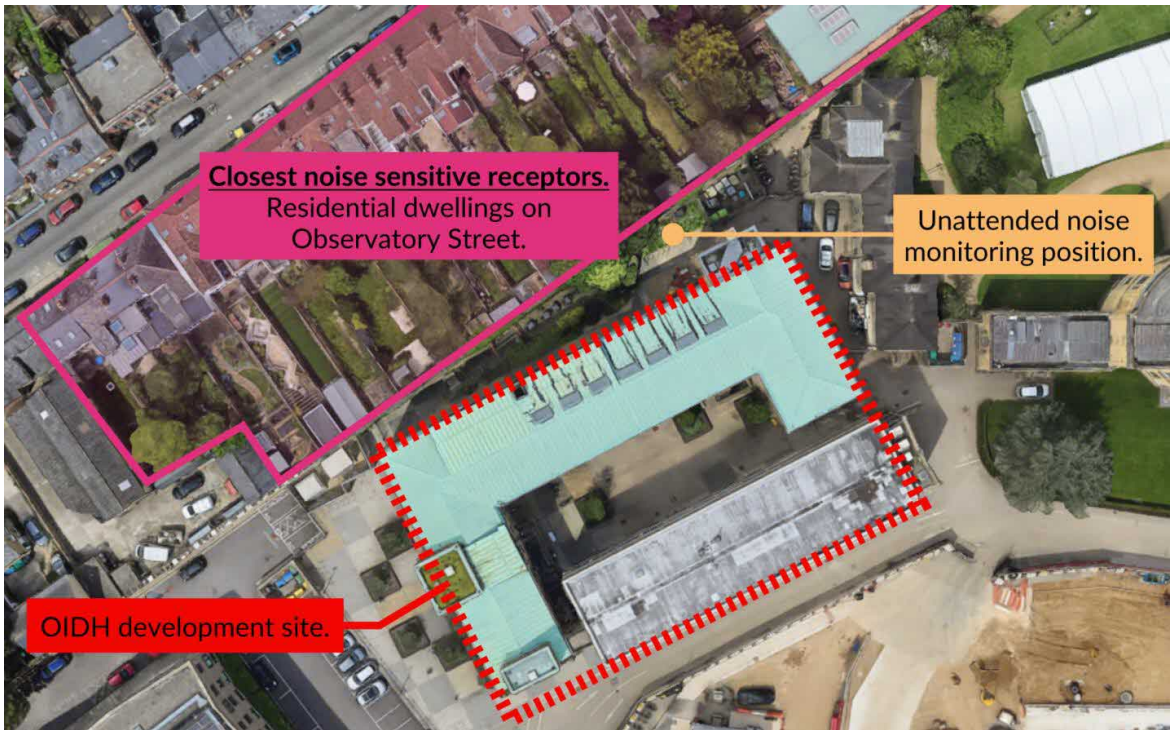

Figure 3: Unattended monitoring position in relation to development site and closest noise sensitive receptors.

Figure 4: Photos of the noise monitor in position between the Gibson Building and the rear of dwellings on Observatory Street.

The microphone of the noise monitor was positioned approximately 1.5 metres above the local ground levels and under free-field conditions. Survey measurements consisted of fifteen-minute duration samples of ambient sound levels ($L_{Aeq,15\ min}$) and background sound levels ($L_{A90,15\ min}$). Measurements were undertaken between Tuesday 13th June 2023 and Tuesday 20th June 2023.

The noise monitor was field calibrated immediately before and after the measurement period; no significant drift in level was found to have occurred. The measurement instrumentation used in listed in Appendix A.

6.2 Results.

A time history of the measured sound levels at the unattended survey location is provided in Figure 5 below.

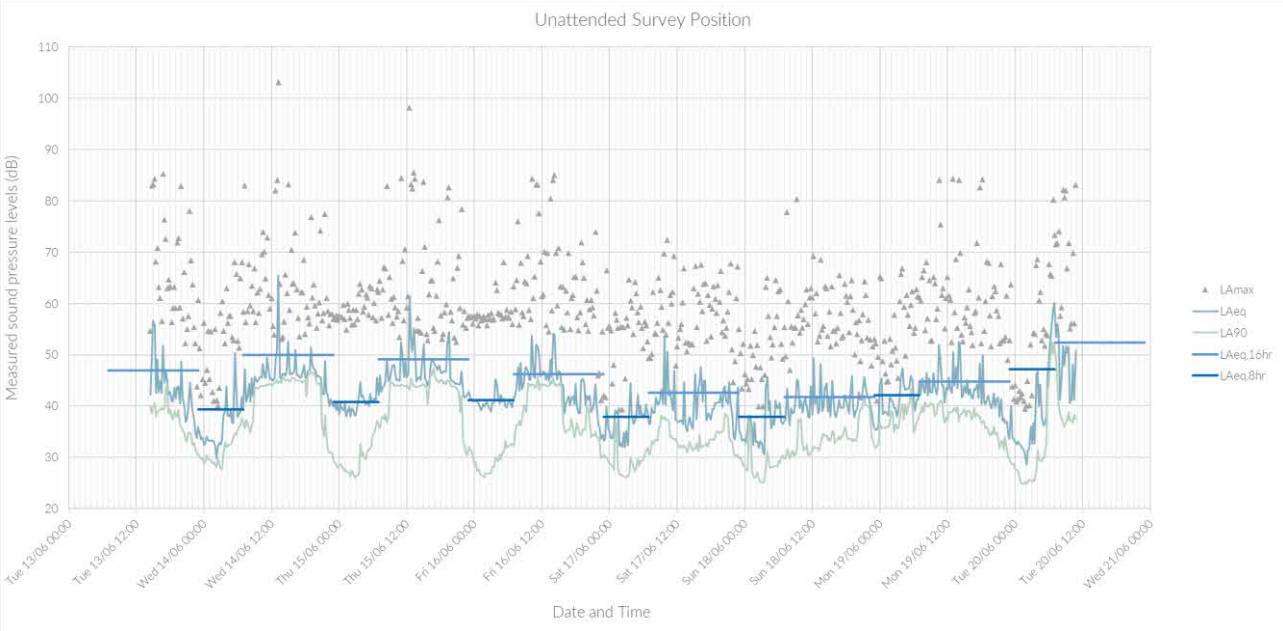

Figure 5: Time history chart of the ambient and background sound levels measured at the unattended measurement position.

6.2.1 Ambient sound levels.

The measured ambient sound levels at the survey position are summarised below. Daytime is taken as the 16-hours between 07:00 and 23:00 and night-time is taken as the 8-hours between 23:00 and 07:00.

Date	Daytime ambient sound level.	Night-time ambient sound level.
Tuesday 13th June 2023	47 dB $L_{Aeq,8\ h}$	39 dB $L_{Aeq,8\ h}$
Wednesday 14th June 2023	50 dB $L_{Aeq,16\ h}$	41 dB $L_{Aeq,8\ h}$
Thursday 15th June 2023	49 dB $L_{Aeq,16\ h}$	41 dB $L_{Aeq,8\ h}$
Friday 16th June 2023	46 dB $L_{Aeq,16\ h}$	38 dB $L_{Aeq,8\ h}$
Saturday 17th June 2023	43 dB $L_{Aeq,16\ h}$	38 dB $L_{Aeq,8\ h}$
Sunday 18th June 2023	42 dB $L_{Aeq,16\ h}$	42 dB $L_{Aeq,8\ h}$
Monday 19th June 2023	45 dB $L_{Aeq,16\ h}$	47 dB $L_{Aeq,8\ h}$
Tuesday 20th June 2023	52 dB $L_{Aeq,4\ h}$	-

Table 4: Measured residual sound levels at the unattended survey location.

Ambient noise levels were typically 46 dB $L_{Aeq,16\ h}$ (excluding the first and last measurement day as they were not full 16-hour periods), and 41 dB $L_{Aeq,8\ h}$ at night.

6.2.2 Background sound levels.

In-line with the guidance given in BS 4142, in order to "*quantify what is typical during particular time periods*", a statistical analysis of the measured background sound levels has been undertaken.

The periods of interest for this development are daytime and night-time. Daytime is taken as the 16-hours between 07:00 and 23:00 and night-time is taken as the 8-hours between 23:00 and 07:00.

The 15-minute duration background sound levels measured during the day will never be higher than the 1-hour background sound level, so the 15-minute values represent a worst-case. Therefore, the measured 15-minute values will be used in place of the daytime 1-hour reference time interval required by BS 4142.

The following chart provides an analysis of the daytime and night-time period of interest background sound levels. A time history of the measured sound levels is presented in Figure 5.

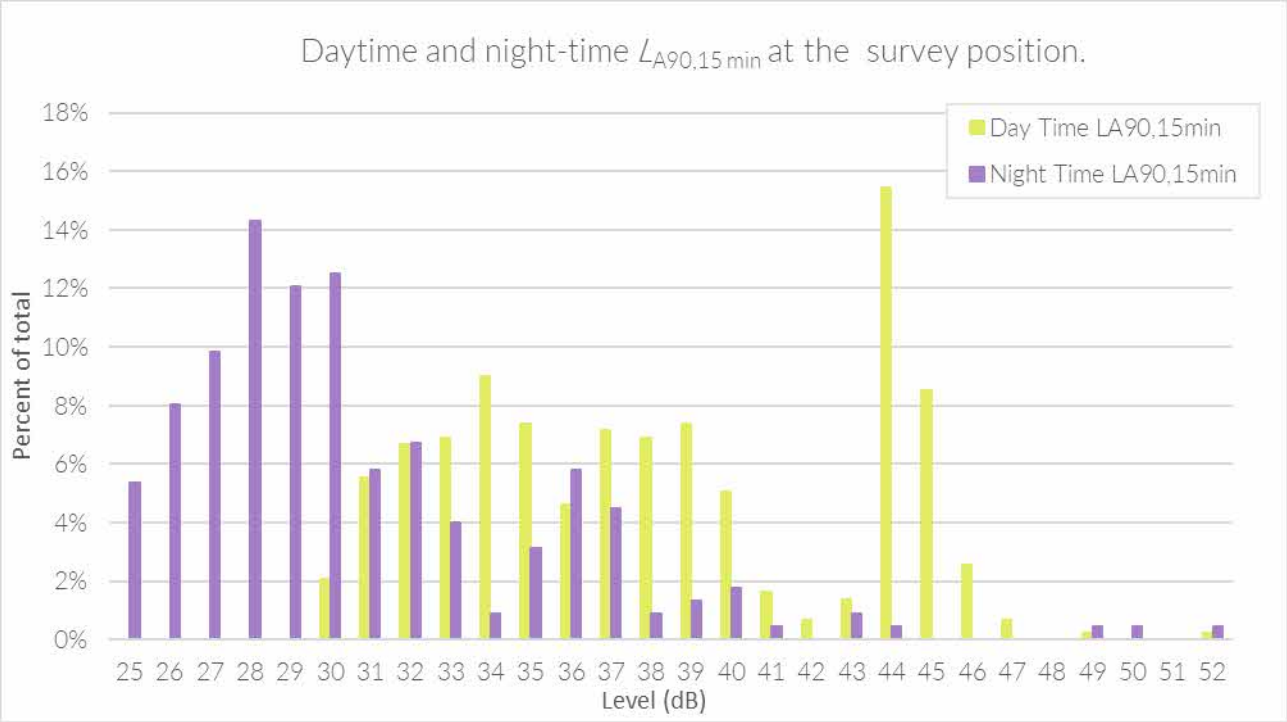

Figure 6: Statistical analysis of the background sound levels measured at the survey measurement position.

From the above statistical analysis chart and the time history, given the context of the site, the following typical lower background sound levels have been determined representative for the periods of interest.

- Daytime 34 dB $L_{A90,1\,h}$
- Night-time 30 dB $L_{A90,15\,min}$

6.2.3 Summary.

Typical 15-minute ambient and background sound levels for daytime and night-time periods are shown below.

Periods of interest.	Ambient sound pressure level.	Background sound pressure level,
Daytime (07:00 – 23:00)	46 dB $L_{Aeq,15\,min}$	34 dB $L_{A90,1\,h}$
Night-time (23:00 – 07:00)	41 dB $L_{Aeq,15\,min}$	30 dB $L_{A90,15\,min}$

Table 5: Typical ambient and background sound pressure levels for daytime and night-time periods.

7. Proposed noise emission limits.

7.1 Residential receptors.

The proposed noise emission limit is for the rating level ($L_{Ar,Tr}$) of the combined fixed plant items to not exceed the background sound level ($L_{A90,Tr}$) at the closest residential receptors. This would provide an indication of the specified sound sources having a low impact, given the context, when assessed following the BS 4142 methodology. The following plant noise emission limits are proposed.

Period of interest.	Background sound level.	Proposed noise emission limit.
Daytime (07:00 – 23:00)	34 dB $L_{A90,1\ h}$	34 dB $L_{Ar,1\ h}$
Night-time (23:00 – 0&:00)	30 dB $L_{A90,15\ min}$	30 dB $L_{Ar,15\ min}$

Table 6: Proposed noise emission limits.

The above noise limits are given as rating levels. Corrections appropriate to the character of the sound should be applied when calculating this form the specific sound level, as defined in BS 4142.

7.2 Healthcare receptors.

Different noise limits should apply at the Jericho Health Centre, given this is a healthcare facility that is not noise sensitive at night. The most onerous noise intrusion criterion in HTM 08-01 is for a meeting room. Assuming this space with an open window, the following noise limit is proposed.

Receptor.	Most onerous daytime noise intrusion criteria, from HTM 08-01.	Noise attenuation through an open window.	Proposed external noise limit.
Jericho Health Centre	35 dB $L_{Aeq,1\ h}$	+10 dB(A)	45 dB $L_{Ar,Tr}$

Table 7: Proposed noise limits on the health centre.

7.3 Substation noise.

Low frequency noise is excluded from the scope of BS 4142. Where low frequency noise requires consideration, NANR 45 is to be utilised. This sets absolute third-octave band limits for low frequency noise.

Substations are known to emit tonal noise at the 100 Hz band. It is therefore proposed that the NANR 45 criterion for the 100 Hz tone is applied here to ensure low frequency noise from the substations are controlled.

Noise limit at 100 Hz: 38 dB L_{eq}

It is predicted that with the rating levels in Table 6 achieved, the tonal 100 Hz limit will likely be achievable. This will depend on the spectral sound levels of the substations and will require detailed assessment.

8. Noise impact assessment.

8.1 Proposed MEP design.

The following equipment is proposed. Sound levels presented below are as quoted on the received technical data sheets. Air handling units are proposed internally with outdoor air in (ODA) and exhaust air out (EXH) terminations ducted to louvres. Therefore, casing breakout from AHUs is discounted from the assessment.

Plant item.	Selection.	Quantity.	Sound power level per unit, L_W dB(A)		Night-time operation.
Atrium AHU.	Swegon GOLD F RX	1	ODA	68	40% setback
			EXH	80	
Lecture theatre AHU.	Swegon GOLD F RX	1	ODA	69	Off.
			EXH	82	
Building AHUs.	Swegon GOLD F RX	5	ODA	71	40% setback
			EXH	84	
Air source heat pumps.	Mitsubishi MEHP-iS-G07-102	5	82		20% setback
Transformers.	Schneider Electric MINERA 1500 kVA	2	61		Normal.

Table 8: Fixed plant items proposed within the MEP design.

The atrium and building AHUs will be within attic space, with air terminations located at roof level over the atrium skylight. This allows for screening to the receptors to be provided by the building itself.

Lecture AHUs are proposed in a ground floor plant room, with terminations at ground level on the west façade.

ASHPs will be located in an external area on the south-west corner of the building, on the second floor slab.

Noise data has been provided for the substations. Interrogation of the data and comparison against empirical measurements undertaken by Hoare Lea indicate that the manufacturers data potentially underestimates the noise emissions of the substation. Therefore, the following spectrum has been used in the place of that provided by the manufacturer. This is based on measured data of similar substations. Only low frequency third-octave bands are shown as this is the basis of assessment for substation noise.

Frequency (Hz)	40	50	63	80	100	125	160	200	250
Sound pressure level, L_p dB	55	65	50	58	64	50	53	55	48

Table 9: Substation spectral data.

This sound pressure level equates to a sound power level of 67 dB(A) L_w.

8.2 Acoustic modelling.

The fixed plant proposals have been modelled within the CadnaA software package to predict resultant noise levels at nearby receivers. CadnaA uses the principles of ISO 9613-2 to calculate noise propagation.

A 3D visualisation of the CadnaA model is shown below in Figure 7.

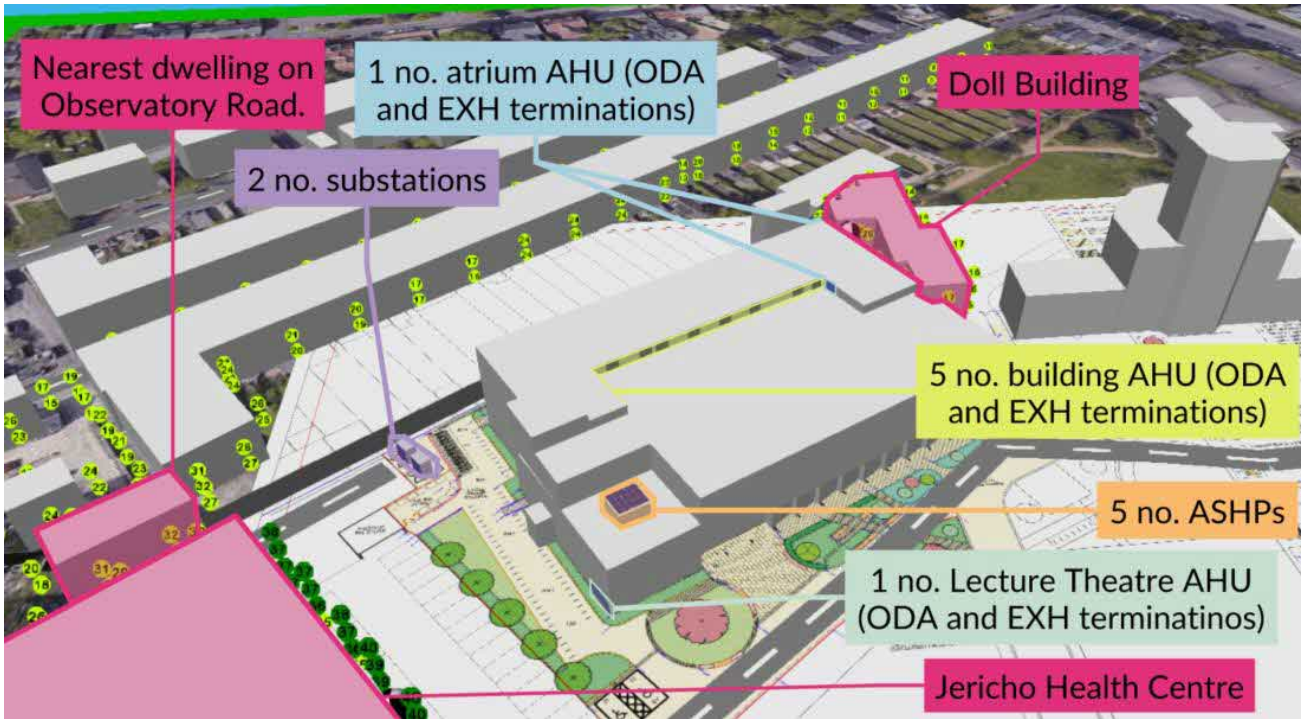

Figure 7: 3D visualisation of CadnaA noise propagation.

8.3 Preliminary assessment – before mitigation applied.

The tables below outline the results of the noise impact assessment before acoustic mitigation has been installed. Daytime and night-time periods are assessed separately due to differences in noise limits. Night-time operation of some units means that assessing for night-time only may not represent a worst-case.

Assessment period.	Daytime.	
Total specific sound level.	47 dB $L_{Aeq,1\ h}$	Result at nearest noise sensitive receiver following noise propagation modelling (Section 8.2).
Acoustic feature correction.	0 dB	Audible tonal elements and other acoustic features are not anticipated based on interrogation of spectral source data and masking provided by the ambient noise climate (46 dB $L_{Aeq,15\ min}$ at daytime).
Total rated noise level.	47 dB $L_{Ar,1\ h}$	Specific sound level plus acoustic feature corrections.
Noise emission limit.	34 dB $L_{Ar,1\ h}$	See Section 7.
Excess over noise emission limit.	+13 dB(A)	
BS 4142 assessment.	Rated level greater than background level – significant impact.	
Local Authority assessment.	Noise emissions exceed the required limit.	

Table 10: Noise impact assessment for plant items with no acoustic mitigation - daytime.

Assessment period.	Night-time.	
Total specific sound level.	42 dB $L_{Aeq,15\ min}$	Result at nearest noise sensitive receiver following noise propagation modelling (Section 8.2).
Acoustic feature correction.	0 dB	Audible tonal elements and other acoustic features are not anticipated based on interrogation of spectral source data and masking provided by the ambient noise climate (41 dB $L_{Aeq,15\ min}$ at night-time).
Total rated noise level.	42 dB $L_{Ar,15\ min}$	Specific sound level plus acoustic feature corrections.
Noise emission limit.	30 dB $L_{Ar,15\ min}$	See Section 7.
Excess over noise emission limit.	+12 dB(A)	
BS 4142 assessment.	Rated level greater than background level – significant impact.	
Local Authority assessment.	Noise emissions exceed the required limit.	

Table 11: Noise impact assessment for plant items with no acoustic mitigation - night-time.

Low frequency noise at the nearest receptor, without mitigation applied, is predicted to be 51 dB $L_{eq,T}$. This is in exceedance of the NANR 45 limit by 13 dB. Based on these results, acoustic mitigation measures will be required to reduce noise emissions during both daytime and night-time hours.

8.4 Mitigation advice.

The current fixed plant proposals exceed the noise emission limits expected to be enforced by Oxford City Council. Therefore, acoustic mitigation will be required to reduce noise emissions. Sound power level limits have been calculated for each noise source that, if followed, result in suitable levels at the nearest noise sensitive receptor. Attenuation requirements for each item are calculated through the arithmetic difference between the operational sound power level (specified by the manufacturer) and the sound power level limit. Three mitigation strategies can be adopted to achieve attenuation requirements:

- Operational mitigation – enforcement of setbacks from maximum capability.
- Mechanical mitigation – installation of acoustic packaging and attenuators.
- Architectural mitigation – installation of acoustic enclosure, louvres, and solid barrier screening.

8.4.1 Source sound power level limits.

Suitable sound power level limits have been calculated for each noise source. These are shown in Table 10 below. At these sound power levels, noise limits at receivers are predicted to be met. This assessment is detailed in Section 8.5 Source noise limits have been calculated with night-time setbacks accounted for.

Plant item.		Operational sound power level, dB(A) L_w	Sound power level limit, dB(A) L_w	Attenuation requirement, dB(A)
Atrium AHU	Outdoor air in.	68	48	20
	Exhaust air out.	80	50	30
Lecture theatre AHUs	Outdoor air in.	69	49	20
	Exhaust air out.	82	52	30
Building AHUs	Outdoor air in.	71	51	20
	Exhaust air out.	84	54	30
ASHPs.		82	74	8
Substations.		67	52	15

Table 12: Source sound power level limits for each plant item and associated noise source.

8.4.2 Operational mitigation.

The Mechanical engineer has included night-time setbacks for some plant items within the design. These support the noise assessment as equipment will be quieter at night-time when noise limits are more onerous. Night-time setbacks included in the assessment are:

- 40% setbacks on the atrium AHUs and building AHUs (all units operating at 60% capacity);
- 20% setback on the ASHPs (all units operating at 80% capacity);
- The lecture theatre AHU to be switch off during night-time hours.

The transformers are understood to operate at continuous duty during daytime and night-time hours with no operational mitigation possible.

8.4.3 Mechanical mitigation.

Mechanical mitigation can be undertaken through the installation of acoustic attenuators and / or packaging.

Air handling units.

The attenuation requirements for each AHU termination can be achieved through installation of a 1200 mm long attenuator on each atmospheric termination of the unit. It is understood that space provisions have already been allocated for these in the design. The current attenuator selection has been assessed as part of this model. The insertion loss of the current selection is suitable in reducing AHU noise levels appropriately.

Air source heat pumps.

Each ASHP requires a broadband attenuation of 8 dB(A) to be applied. This can be achieved through acoustic packaging surrounding the sides and top of the equipment. Figure 8 presents an example of the likely extent of the acoustic packaging compared to an unattenuated ASHP. The preferred ASHP / attenuator manufacturer is to confirm that the selection can achieve the required sound power level limit, or, if this is not possible, that suitable mitigation can be provided to reduce noise levels to the limit of L_{wA} 74 dB.

Figure 8: Example mechanical mitigation required on each ASHP. Left – no mitigation. Right – mitigation applied to sides and top.

The level of mitigation required is achievable with standard acoustic packaging solutions. If this strategy can be applied successfully, architectural mitigation around the ASHP plant area (barrier screening) will not be required.

Substations.

Mechanical mitigation is not possible for substation noise. Architectural mitigation will be required instead.

8.4.4 Architectural mitigation.

Architectural mitigation is required to attenuate noise from the substations. A solid enclosure should be built around each substation to reduce noise emissions. The enclosures should have a minimum sound reduction index of 39 dB R_w. The enclosures should have a minimum performance of 34 dB R at the 125 Hz octave band to control low frequency noise. This performance can be achieved with 100mm blockwork.

If louvred walls are required to provide ventilation, this should be installed on the east side of the enclosures, facing away from the receptors on Observatory Road. The louvre should have a minimum performance of 22 dB R_w. The louvre should have a minimum performance of 9 dB R at the 125 Hz octave band to control low frequency noise. This can be achieved with a 600mm deep louvre.

8.5 Noise impact assessment – with mitigation applied.

Table 13 and Table 14 present the supplementary assessment undertaken with the acoustic mitigation measures outlined in Section 8.4 applied. The predictions indicate that resultant noise levels at the nearest noise sensitive receptor are suitable based on the Local Authority's requirements.

Assessment period.	Daytime.	
Total specific sound level.	31 dB $L_{Aeq,1\ h}$	Result at nearest noise sensitive receiver following noise propagation modelling (Section 8.2).
Acoustic feature correction.	0 dB	Audible tonal elements and other acoustic features are not anticipated based on interrogation of spectral source data and masking provided by the ambient noise climate (46 dB $L_{Aeq,15\ min}$ at daytime).
Total rated noise level.	31 dB $L_{Ar,1\ h}$	Specific sound level plus acoustic feature corrections.
Noise emission limit.	34 dB $L_{Ar,1\ h}$	See Section 7.
Excess over noise emission limit.	-3 dB(A)	
BS 4142 assessment.	Rated level is 3 dB(A) less than background level. This provides an indication of the specific sound sources having less than a low impact.	
Local Authority assessment.	Local Authority noise limits are met.	

Table 13: Noise impact assessment for plant items with acoustic mitigation applied - daytime.

Assessment period.	Night-time.	
Total specific sound level.	27 dB $L_{Aeq,15\ min}$	Result at nearest noise sensitive receiver following noise propagation modelling (Section 8.2).
Acoustic feature correction.	0 dB	Audible tonal elements and other acoustic features are not anticipated based on interrogation of spectral source data and masking provided by the ambient noise climate (41 dB $L_{Aeq,15\ min}$ at night-time).
Total rated noise level.	27 dB $L_{Ar,15\ min}$	Specific sound level plus acoustic feature corrections.
Noise emission limit.	30 dB $L_{Ar,15\ min}$	See Section 7.
Excess over noise emission limit.	-3 dB(A)	
BS 4142 assessment.	Rated level is 3 dB(A) less than background level. This provides an indication of the specific sound sources having less than a low impact.	
Local Authority assessment.	Local Authority noise limits are met.	

Table 14: Noise impact assessment for plant items with acoustic mitigation applied - night-time.

The results above are shown for the nearest residential dwelling on Observatory Road. Resultant total rated noise levels at the Doll Building and Jericho Health Centre are presented below.

Noise sensitive premises.	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Doll Building.	24 dB $L_{Ar,Tr}$	17 dB $L_{Ar,Tr}$
Jericho Health Centre.	40 dB $L_{Ar,Tr}$	35 dB $L_{Ar,Tr}$

Table 15: Total rated noise level predictions at other receptors.

Predictions at all receivers are below the limits outlined in Section 7.

Prediction of low frequency noise at the nearest receptor is 21 dB $L_{eq,T}$ (17 dB less than the NANR 45 limit).

9. Conclusion.

Noise levels from the new fixed plant proposals for the Oxford Institute of Digital Health are predicted to have a low impact on nearby noise sensitive receptors provided the advice outlined in this report is adhered to. This includes the setting of sound power level limits to each plant items, and supplementary mitigation measures recommended to achieve these limits. The predicted resultant noise levels are less than the existing background noise levels, indicating that new plant will have less than a low impact in accordance with BS 4142.

This report is suitable for submission to the Local Authority as part of the planning application.

Appendix A – Survey equipment.

Table 16 outlines details of the survey equipment used on site as detailed in Section 6.

Equipment.	Manufacturer	Model (S/N)	Calibration cert. no.	Calibration date.
Sound level meter.	Rion	NL-52 (01010834)	UCRT22/1524	13/04/2022
Microphone.	Rion	UC-59 (20471)	UCRT22/1524	13/04/2022
Pre-amplifier.	Rion	NH-25 (11482)	UCRT22/1524	13/04/2022
Calibrator.	Rion	NC-75 (34324028)	UCRT23-1695	23/05/2023

Table 16: Survey equipment.

HOARE LEA

BRADLEY JOHNSTON
ACOUSTICS ENGINEER

[redacted]

HOARELEA.COM

Old Iron Works
35a Great Clarendon Street
Oxford
OX2 6AT
England