31-37 WHITFIELD STREET, LONDON

PLANT NOISE ASSESSMENT REPORT

Reference: 9536.RP01.PNA.2
Prepared: 31 July 2020
Revision Number: 2

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Plant Noise Assessment Report

31-37 WHITFIELD STREET, LONDON

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Prepared: 31 July 2020

Revision	Comment	Date	Prepared By	Approved By
0	First Issue	26 June 2020	Ignacio Alonso	Alex J Wyatt
1	Revisions to mitigation measures	20 July 2020	Ignacio Alonso	Alex J Wyatt
2	Typographic error correction	31 July 2020	Ignacio Alonso	Alex J Wyatt

Terms of contract:

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The recommendations within this report relate to acoustics performance only and will need to be integrated within the overall design by the lead designer to incorporate all other design disciplines such as fire, structural integrity, setting out, etc. Similarly, any sketches appended to this report illustrate acoustic principles only and again will need to be developed into full working drawings by the lead designer to incorporate all other design disciplines.

In line with our Environmental Policy, up to two hard copies of the report will be provided upon request. Additional copies of the report, or further hard copies of revised reports, would be subject to an administrative cost of £20.00 (+VAT) per copy.

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Contents

1.0 INTRODUCTION

The existing site and buildings at 31-37 Whitfield Street and 50a Charlotte Street are to be refurbished to enhance the office spaces. New items of plant are to be installed at roof level of 31-37 Whitfield Street.

London Borough of Camden requires an assessment to be undertaken of atmospheric noise emissions from any proposed new building services equipment to the nearest noise sensitive property.

Design criteria have been derived from the noise survey RBA Acoustics previously undertook and these are included in RBA Acoustics Environmental Noise Survey Report reference 9536.RP01.ENS.2 dated 4 November 2019.

An assessment of plant noise emissions has been undertaken to ensure the Local Authority requirements are met. This report can be used to discharge any planning condition applicable to this regard.

2.0 PLANT NOISE EMISSION CRITERIA

2.1 Plant Noise Emission Criteria

Planning Conditions 4 and 5 of Decision Notice 2019/6274/P read as follows:

> *4. Noise levels at a point 1 metre external to sensitive facades shall be at least 10dB(A) less than the existing background measurement (LA90), expressed in dB(A) when all plant/equipment (or any part of it) is in operation unless the plant/equipment hereby permitted will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or if there are distinct impulses (bangs, clicks, clatters, thumps), then the noise levels from that piece of plant/equipment at any sensitive façade shall be at least 15dB(A) below the LA90, expressed in dB(A).*
>
> *5. Before the use commences, the air-conditioning plant shall be provided with acoustic isolation, sound attenuation and anti-vibration measures in accordance with the scheme approved in writing by the local planning authority. All such measures shall thereafter be retained and maintained in accordance with the manufacturers' recommendations.*

Planning Condition 4 is in line with Section 3.1 of our Environmental Noise Survey Report reference 9536.RP01.ENS.2 dated 4 November 2019, which provides the applicable criteria, as summarised below:

Items of mechanical services be designed so that noise emissions from the plant do not exceed the following levels when assessed at the nearest noise sensitive receptors:

- Office Hours 40dB
- Daytime 40dB
- Night-time 34dB

Should the proposed plant be identified as having tonal characteristics, noise emissions from the plant should not exceed the following levels when assessed at the nearest noise sensitive location:

- Office Hours 35dB
- Daytime 35dB
- Night-time 29dB

A level of 55dB has been used for the office receptors belonging to the subject of this report. This is the typical level adopted for office receptors.

2.2 BREEAM Non-Domestic Refurbishment 2014 Pol 05

The BREEAM Pol 05 credit requires the following:

Where there are or will be noise-sensitive areas or buildings within 800m radius of the assessed development a noise impact assessment must be carried out and the following noise levels measured/determined:

a) Existing background noise levels to BS 7445 at the nearest or most exposed noise-sensitive development to the proposed development or at a location where background conditions can be argued to be similar.

b) The rating noise level resulting from the new noise-source.

The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5dB during the day (0700 hours to 2300 hours) and +3dB at night (2300 hours to 0700 hours) compared to the background noise level.

2.3 Summary

The noise criterion required by the Local Authority is more stringent than that required by BREEAM Pol 05 outlined above, so therefore satisfying the requirements of the Local Authority (Section 2.1) will also meet the requirements of BREEAM Pol 05 by default.

3.0 ATMOSPHERIC PLANT NOISE ASSESSMENT

Our assessment has been based upon the following information:

3.1 Proposed Equipment

The following equipment has been proposed to serve the office areas, as advised by GDM Partnership.

Number off / Unit Type	Make	Model
3x Heat Pump	Mitsubishi	PUMY-SP112YKMR1.TH
1x Heat Pump	Mitsubishi	PURY-EP550YNW-A
1x Heat Pump	Mitsubishi	PURY-EP500YNW-A
2x Heat Pump	Mitsubishi	PUMY-SP125VKMR1.TH
1x Heat Pump	Mitsubishi	PUHY-P300YNW-A
3x Heat Pump	Mitsubishi	PURY-EP400YNW-A (314079)
1x Heat Pump	Mitsubishi	PURY-EP350YNW-A
1x Toilet Extract Fan	Nuaire	AVT6-R
1x AHU	Energy Efficient Equipment	max.e3-09

The equipment positions are indicated on the attached Figures 1 and 2 in Appendix D

3.2 Operating Hours

We have been advised by GDM Partnership the proposed equipment will operate for the following hours.

- Equipment serving office areas: 07:00-19:00 hours

3.3 Noise Levels

The noise levels have been provided by the manufacturers of the units. These are detailed below:

Table 1 – Manufacturers Sound Levels

Equipment	L_w/L_p	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
PUMY-SP112YKMR1.TH	L_p @1m	57	55	54	52	50	45	38	32
PURY-EP550YNW-A	L_p @1m	80	69	68	64	59	56	52	47
PURY-EP500YNW-A	L_p @1m	77	68	66	61	56	54	51	44
PUMY-SP125VKMR1.TH	L_p @1m	60	58	56	53	52	47	40	33
PUHY-P300YNW-A	L_p @1m	76	63	63	60	54	50	45	40
PURY-EP400YNW-A	L_p @1m	74	64	66	64	59	55	49	45
PURY-EP350YNW-A	L_p @1m	69	64	64	62	57	52	47	40
Nuaire AVT6-R (TEF) *	Open L_w	77	80	77	76	73	70	64	55
EEE max.e3-09 (AHU)	Fresh air L_w	65	67	60	54	53	50	42	31
	Exhaust L_w	66	67	61	59	58	52	48	42
	Breakout L_w	62	56	58	57	56	48	42	35

Review of the octave band data concludes that there are no tonal characteristics associated with the proposed plant.

3.4 Location of Nearest Noise-Sensitive Windows

The rooftop where plant is proposed is located at 5th floor. All nearby receptors (except the ten-floor tower on Scala Street) are lower than this location, which provides significant acoustic screening from plant noise due to the fact there is no direct line-of-sight between plant and receptors. The following receptors are shown in Figure 1 attached in Appendix D:

40 Whitfield Street – approximately 17m distance and 4 floors
Rear of Scala Street and Goodge Street – approximately 14m horizontal distance and 2 floors
Tower on Scala Street – approximately 30m and 10 floors
Office Windows pertaining to this project – approximately 3m and one floor below plant

3.5 Plant Perimeter Screen

The site has an existing plant screen at a maximum height of 2.6m above existing roof level. The proposal is to enlarge the footprint of the plant area and provide a screen around it approximately as high as the highest item of plant (approximately 2m above plant deck). The existing screen is to be removed and replaced with a new screen/louvre. Our calculations indicate the following minimum insertion losses should be achieved by any new louvred sections of the enclosure screen:

Table 2 – Acoustic Louvre Insertion Losses

Description	Insertion Loss, IL (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
150mm deep acoustic louvre	3	4	6	10	12	13	13	14

Other than acoustic louvred openings in the screen for ventilation purposes, the rest of the enclosure screening is to be formed in proprietary acoustic plant screening; solid on the outside face and perforated to the inside face with an internal absorptive lining; typically 50-150mm thickness overall (to match louvres) with a minimum mass per unit area of 15kg/m^2. The absorptive lining should achieve the following absorption coefficients:

Table 3 – Minimum Absorption Coefficients of Perforated Plant Screen

Description	Absorption Coefficient (α) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
50-150mm deep acoustically absorbent perforated screen	--	0.35	0.70	0.90	0.80	0.85	0.85	--

The extent of the acoustic louvred openings in the screen are illustrated in Figure 2 in Appendix D attached. The connections to and from the AHU can be to a standard weather louvred section (due to potential issues of air flow and pressure drops with acoustic louvres), but all unused areas of weather louvre should be blanked off with minimum 2mm thick, sheet steel plates.

The following specialist manufacturers should be able to provide systems as described above.

Allaway Acoustics	Old Police Station 1 Queens Road Hertford SG14 1EN	01992 550825
Caice Acoustics	3 Winnersh Fields Gazelle Close Winnersh Wokingham RG41 5QS	0118 918 6470
EEC	Richmond House Churchfield Road Walton-On-Thames Surrey KT12 2TP	01938 230940
Environ Technologies Ltd	Regus House 1010 Cambourne Business Park Cambourne Cambridge CB3 6DP	0870 383 3344
Noico Ltd	Patrick House Station Road Hook Basingstoke RG27 9HU	01256 766207

3.6 Calculation of Noise Levels at Nearest Residential Window

Our calculation method for assessing noise levels from the proposed plant at the nearest residential windows, based on the information stated above, is summarised below.

- Source Term SPL / SWL
- Distance Attenuation
- Reflections
- Roof edge screening
- Insertion losses of the screen/louvres around the plant

The results of the calculations predict a worst-case cumulative noise level of 39dBA at the (worst-case) nearest affected residential windows. This level is within the target criterion of 40dBA. At all other receptors, the resultant noise levels will be lower and therefore comfortably within the criterion. The worst-case calculation is shown in Appendix B attached, as an example.

The requirements of Planning Condition 4 should therefore be met on the assumption of the implementation of the above detailed noise mitigation measures and the limiting levels stated in Section 3.7 below.

The BREEAM Pol 05 credit can also be awarded on the basis of this assessment.

3.7 Limiting Level for Plant Serving Commercial Areas

Equipment serving commercial areas has not yet been specified but a spatial allowance has been made for it on the roof plan with 4 condensers indicated.

Operation of plant serving the commercial areas shall comply with the requirements set out in Table 4 below. The following indicative limiting noise levels should not be exceeded.

Table 4 –Limiting Levels for Plant Serving A3 Areas

Type of Plant	Limiting Level Parameters	Limiting Level (dBA)
4xCondensers	Max L_p at 1m (each unit)	59

The above should be included in any commercial plant specification document.

These limiting levels will ensure that the worst-case cumulative L_{eq} plant noise level does not exceed 40dBA, as calculated at the nearest noise sensitive windows, and will maintain compliance with the requirements of the Local Authority.

4.0 ROOF CONSTRUCTION AND VIBRATION MITIGATION

There are two main acoustic issues with regards to the roof construction.

1) Airborne plant noise transfer to below directly through the construction
2) Structure-borne noise transfer associated with vibration from the plant items

4.1 Airborne Plant Noise Transfer to Below

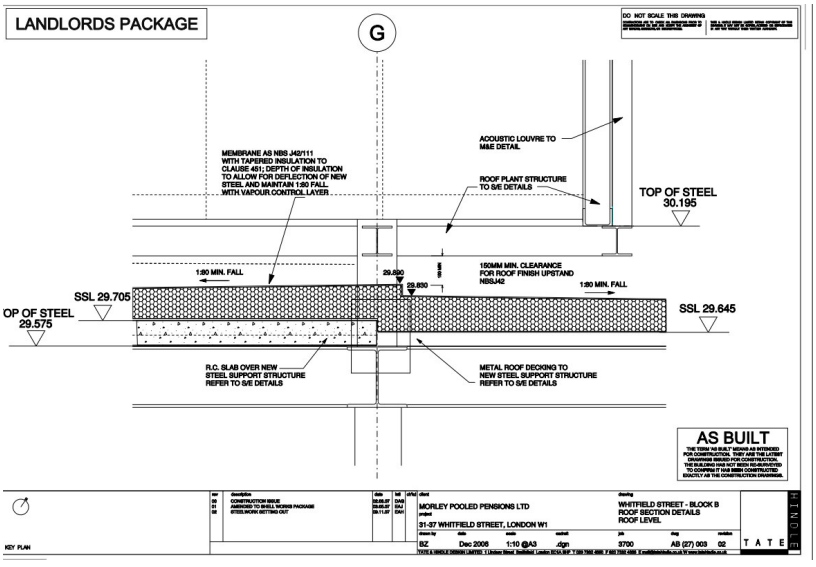
We have also considered noise break in through the roof construction from the plant area into the office space directly below. In this instance a target level of NR25-30 is recommended.
The following has been extracted from the Stage 4 Structural report draft:

> *The Whitfield Street building is of reinforced concrete frame construction over six storeys with clay pot and beam flat slab construction to the majority of the floors. The fourth floor and roof construction were extended during the late 1990's using structural steel framework and with composite concrete floor slabs. The external elevations are a mixture of brick, block and stone infill masonry. The roof is of lightweight steel decking overlaid with a waterproof membrane.*
>
> *A section of the roof has been formed as an external plant enclosure formed of steel beams and decking, a louvre screen enclosure is provided to its perimeter.*
>
> *No plans were available showing the construction of the building.*

The following works are proposed as detailed within the same report:

> *Roof / Plant deck*
>
> *Structural steel frame to allow formation of new service risers through the floor. Construction of new plant deck and enclosure off the existing plant enclosure support steelwork.*

The following drawing shows the roof construction below the plant area.



Roof construction below Plant Area

The proposed roof construction provides limited sound reduction performance, mainly due to the lightweight nature of the roof construction directly below the cantilever plant deck structure (to the right of Grid Line G) and that fact that no plasterboard ceiling is proposed to the office space below (exposed soffit).

Our assessment has been based on the following sound insulation performance, as shown below in Table 5, as is typical of lightweight roof construction comprising thermal insulation on steel deck:

Table 5 – Assumed Sound Reduction Performance of Lightweight Roof

Element	Minimum Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Roof Construction (R_w 30dB)	2	7	24	31	35	35	35	35

It is understood the roof construction to the left of Grid Line G comprises 130mm lightweight concrete on steel composite deck.

In order to improve the sound insulation properties of the lightweight roof construction, to ensure acceptable levels of break-through noise to the office space below, we propose the following mitigation measure.

It is understood there is a desire for exposed soffits throughout the office spaces, so mitigation needs to be addressed at the roof plant deck location.

A layer of 5mm thick, galvanised sheet steel should be included on or within the structural steel plant deck construction from the screen/louvre on the Whitfield Street side of the enclosure, back across the roof towards Charlotte Street, such that it overlaps Grid Line G by 1m. The layer should be imperforate except for any small perforations to allow for appropriate drainage and fixings. The sheet steel may need to be "laid to falls" for drainage purposes, or alternatively could be fixed at an angle within the steel beam zone of the plant deck.

An indication of this mitigation measure is shown in Figure 3 attached in Appendix D.

4.2 Structure-Borne Plant Noise – Vibration Control

Each item of mechanical services plant will require appropriate treatment in order to ensure vibration transfer to the building structure (which may then cause a re-radiated noise issue) is controlled to acceptable levels. The following anti vibration systems are recommended:

Table 6 – Anti-Vibration Mount Schedule

Unit	Base	Isolator type	Static Deflection of Mount (mm)
PUMY-SP112YKMR1.TH	Base Frame	Springs	20
PURY-EP550YNW-A	Base Frame	Springs	30
PURY-EP500YNW-A	Base Frame	Springs	30
PUMY-SP125VKMR1.TH	Base Frame	Springs	20
PUHY-P300YNW-A	Base Frame	Springs	20
PURY-EP400YNW-A	Base Frame	Springs	20
PURY-EP350YNW-A	Base Frame	Springs	20
Nuaire AVT6-R (TEF)	See Note 1	Rubber pads	4
EEE max.e3-09 (AHU)	See Note 1	Springs	25

Note 1: All cased fans shall have the above specified mounts internally beneath fan/motor frame and be additionally isolated externally with neoprene pads having 2 mm (min) deflection.

However, vibration mitigation measures in the form of the above specified spring isolators, etc. will only be effective on the proviso the sub-structure on which the AVMs sit is sufficiently stiff and "solid". Ideally, it is recommended the plant area roof-deck structure (steel frame) is stiffened as much as practicably possible in order to reduce its static deflection under load at mid-span and cantilever locations to a maximum of 3mm. The additional steel plate forming the deck may help in this regard.

We understand from the Structural Engineers that the roof plant deck is generally likely to only have <2mm deflection under imposed loads, albeit the cantilever to the right of Grid Line G could be up to 6mm at the edge. The main roof structure below, however, may have up to 12mm deflection, corresponding to a worst-case overall deflection of approximately 14mm at the mid-span point. The heaviest item of plant is the AHU, but this is centred over Grid Line G, i.e. at a structural "node" where the roof structure deflection is at its lowest and therefore best minimises the risk of any potential noise transfer through the roof due to vibration isolation issues.

The appointed Main Contractor should be made aware of this potential isolation and noise transfer issue, such that it can be fully considered at the detailed design stage to ensure the risks are minimised. The fall-back option is the installation of an insulated plasterboard ceiling throughout the top floor office space to reduce any residual noise transfer through the roof.

All ductwork connections to fans should be flexible and at least 75mm long. These should be constructed from sound barrier mat having a minimum superficial density of at least 5kg/m^2. These connections should be straight but not rigid, with no offset, in order to prevent turbulence.

It is important that isolated equipment is not mechanically shorted by the installation of conduit or cable trays, etc., which are rigidly connected to the structure. Electrical connections to plant should, therefore, be made via looped flexible connections.

A specialist manufacturer such as Christie & Grey, Eurovib or Mason UK should be contacted in this regard to ensure the above anti-vibration mount schedule specification is complied with.

Compliance with Planning Condition 5 would then be ensured upon implementation of the above detailed vibration mitigation measures.

5.0 INTERNAL NOISE FROM MECHANICAL SERVICES

This report addresses atmospheric noise emissions and the required mitigation measures. The M&E Consultant and Sub-Contractor are responsible for any necessary room-side attenuation measures. However, we discuss internal noise criteria for the proposed mechanical services below.

The British Council for Offices within their 2019 document advises the following for building services noise when measured under Cat A standards, which generally align with the criteria stated within CIBSE guidance.

Cellular offices	NR35 (L_{eq})
Speculative offices	NR38 (L_{eq})
Open plan offices	NR40 (L_{eq})
Reception Areas	NR40 (L_{eq})
Lift Lobbies	NR40 (L_{eq})
Circulation Spaces	NR40 (L_{eq})
Toilets	NR45 (L_{eq})

The above NR criteria can be converted approximately to dBA criteria by the addition of 5dB, i.e. NR35 ≈ 40dBA.

Due to the speculative nature of the development the NR38 criterion is the most relevant criterion at this stage. All room-side attenuation measures for ducted ventilation systems should be designed to ensure this target of NR38 is achieved. In addition, fan coil units for the air-conditioning systems should be selected to ensure this target is achieved at design duty/speed.

6.0 CONCLUSION

RBA Acoustics have undertaken a detailed plant noise assessment to comply with Planning Conditions 4 and 5, Policy A4 of London Borough of Camden and BREEAM Non-Domestic Refurbishment 2014 Pol 05.

The results of the plant noise assessment indicate atmospheric noise emissions from the equipment are within the criteria required by the London Borough of Camden for the intended operation and with the mitigation measures proposed herein implemented, which consist of a part solid, part acoustic louvred screen enclosure around the roof-top plant deck. Suitable anti-vibration mount specifications have also been provided herein. Internal noise criteria, based on the reference documents CIBSE and BCO, have also been provided.

Based on the information herein Planning Conditions 4 and 5 can be discharged and the credit awarded for BREEAM Pol 05.

Appendix A - Acoustic Terminology

dB	Decibel - Used as a measurement of sound pressure level. It is the logarithmic ratio of the noise being assessed to a standard reference level.
dB(A)	The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level. Because of being a logarithmic scale noise levels in dB(A) do not have a linear relationship to each other. For similar noises, a change in noise level of 10dB(A) represents a doubling or halving of subjective loudness. A change of 3dB(A) is just perceptible.
L_{eq}	L_{eq} is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (1 hour).
L_{Aeq}	The level of notional steady sound which, over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measured over that period.
L_{An} (e.g. L_{A10}, L_{A90})	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time, hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the average minimum level and is often used to describe the background noise.
$L_{max,T}$	The instantaneous maximum sound pressure level which occurred during the measurement period, T. It is commonly used to measure the effect of very short duration bursts of noise, such as for example sudden bangs, shouts, car horns, emergency sirens etc. which audibly stand out from the general level of, say, traffic noise, but because of their very short duration, maybe only a very small fraction of a second, may not have any effect on the L_{eq} value.

Appendix B – Example Calculation

Appendix B shows an example calculation of the resultant noise level at residential receptor (40 Whitfield Street) from the worst-case (noisiest) proposed condenser unit.

Parameter	Noise Level (dB) at Octave-band Centre Frequency (Hz)						dBA
	125	250	500	1000	2000	4000	
Mitsubishi PURY-EP550YNW-A	69	68	64	59	56	52	66
Distance losses @ 17m	-24	-24	-24	-24	-24	-24	
Acoustic louvre losses	-4	-6	-10	-12	-13	-13	
Roof edge screening (line of sight) *	-5	-5	-5	-5	-5	-5	
Noise level at receiver	36	33	25	21	14	10	28

* Worst-case (i.e. minimal) screening losses of just 'line-of-sight' from roof edge assumed in calculation. Actual screening loss likely to be greater due to plant roof deck enclosure. Therefore, resultant level likely to be lower and thus more comfortably within criterion.

In addition, the absorptive lining to the enclosure will reduce the reverberant noise level within the enclosure and further reduce the resultant noise levels at receptors.

Appendix C – CDM Considerations

The likelihood the harm will occur can be assessed by applying an indicative score (from 1 to 5) as follows:

1 – Remote (almost never)
2 – Unlikely (occurs rarely)
3 – Possible (could occur, but uncommon)
4 – Likely (recurrent but not frequent)
5 – Very likely (occurs frequently)

The severity of harm can be assessed by applying an indicative score (from 1 to 5) as follows:

1 – Trivial (e.g. discomfort, slight bruising, self-help recovery)
2 – Minor (e.g. small cut, abrasion, basic first aid need)
3 – Moderate (e.g. strain, sprain, incapacitation > 3 days)
4 – Serious (e.g. fracture, hospitalisation > 24 hrs, incapacitation > 4 weeks)
5 – Fatal (single or multiple)

The rating value is obtained by multiply the two scores and is then used to determine the course of action.

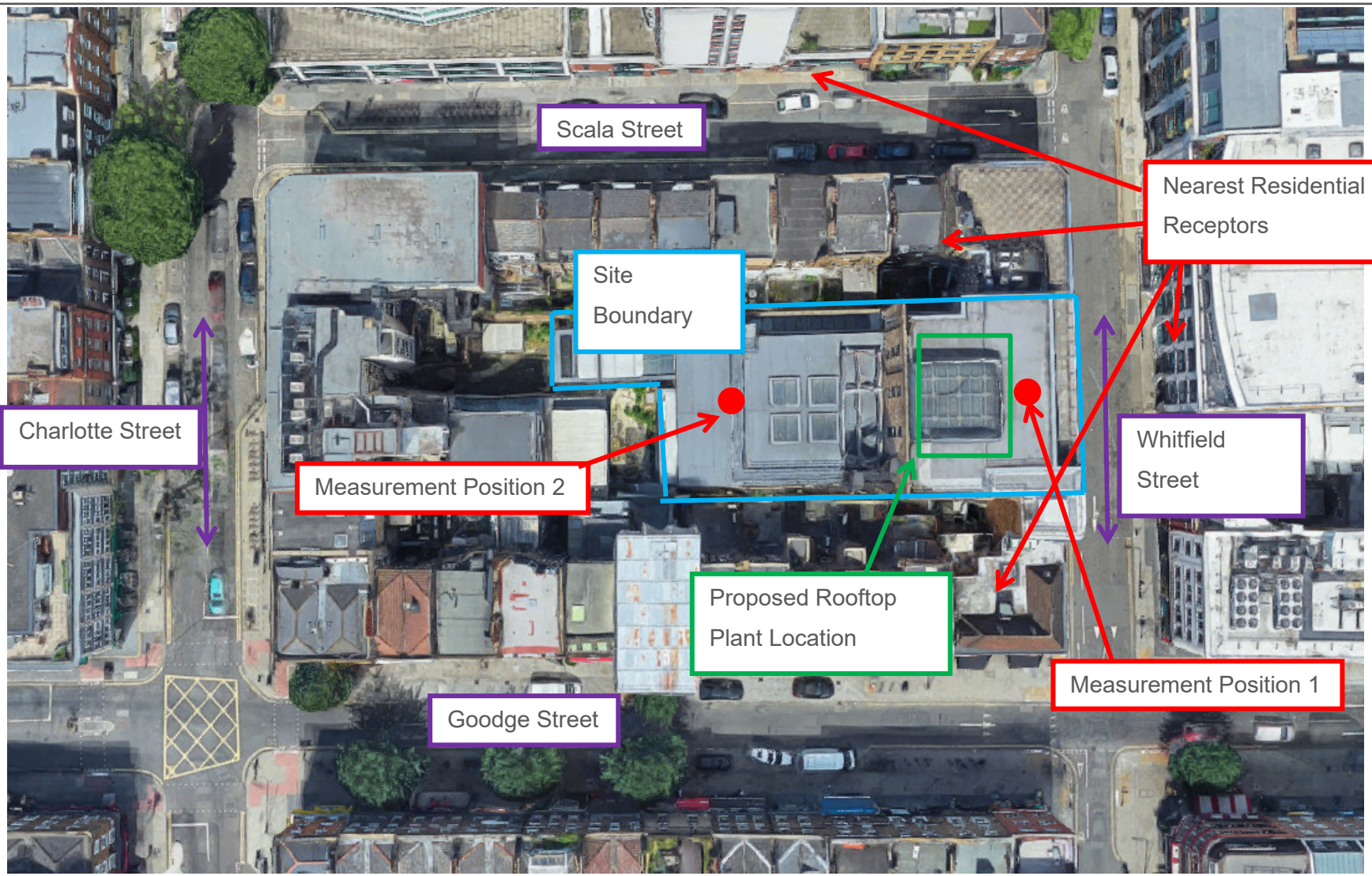
Rating Bands (Severity x Likelihood)		
Low Risk (1 – 8)	Medium Risk (9 -12)	High Risk (15 – 25)
May be ignored but ensure controls remain effective	Continue, but implement additional reasonably practicable controls where possible	Avoidance action is required; therefore, alternative design solutions must be examined. Activity must not proceed until risks are reduced to a low or medium level

The following hazards pertinent to our design input have been identified and control measures suggested:

Hazard	Risk Of	At Risk	Rating			Control Measures	Controlled		
			L	S	R		L	S	R
Mineral wool within drywalls and linings	Skin and respiratory irritation	Contractors	4	3	12	Wear gloves and mask	1	3	3
Attenuators/ Acoustic Lining	Strain of neck, limbs or back.	Contractors	3	4	12	Provide sufficient manpower/ lifting gear	1	4	4
Attenuators/ Acoustic Lining	Skin & respiratory irritation	Contractors	4	3	12	Wear gloves and mask	1	3	3
Vibration Isolators	Injury to hands	Contractors	3	3	9	Care needs to be taken during adjustment. Follow manufacturers guidance	1	3	3
Acoustic Louvres	Strain of neck, limbs or back.	Contractors	3	5	15	Provide sufficient manpower, lifting gear and structural support	1	5	5
Acoustic imperforate screen	Strain of neck, limbs or back.	Contractors	3	5	15	Provide sufficient manpower, lifting gear and structural support	1	5	5

L: Likelihood S: Severity R: Rating

Appendix D – Graphs and Site Plan



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Site Plan Showing Plant Location and and Nearest Noise-Sensitive Properties

Figure 1

31 July 2020

Not to scale

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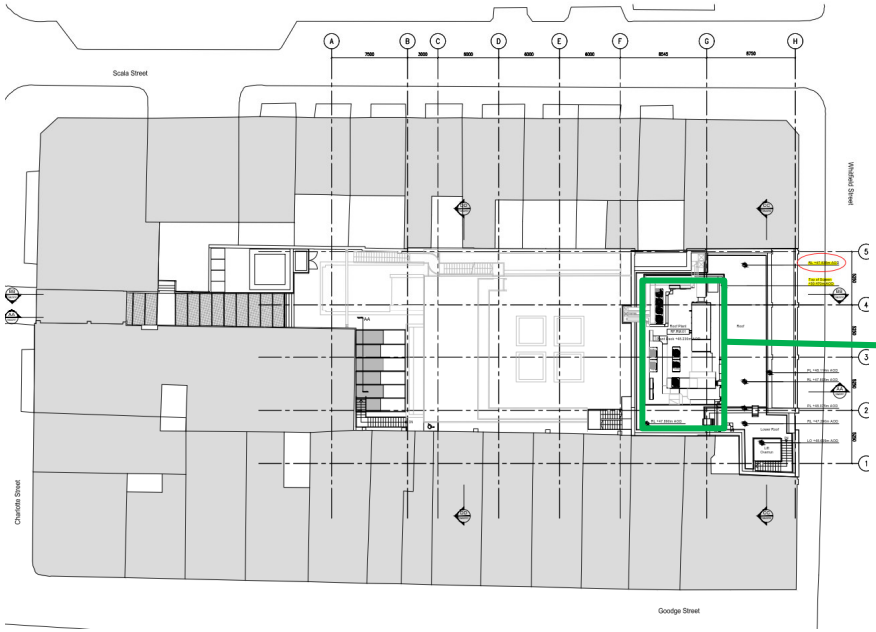

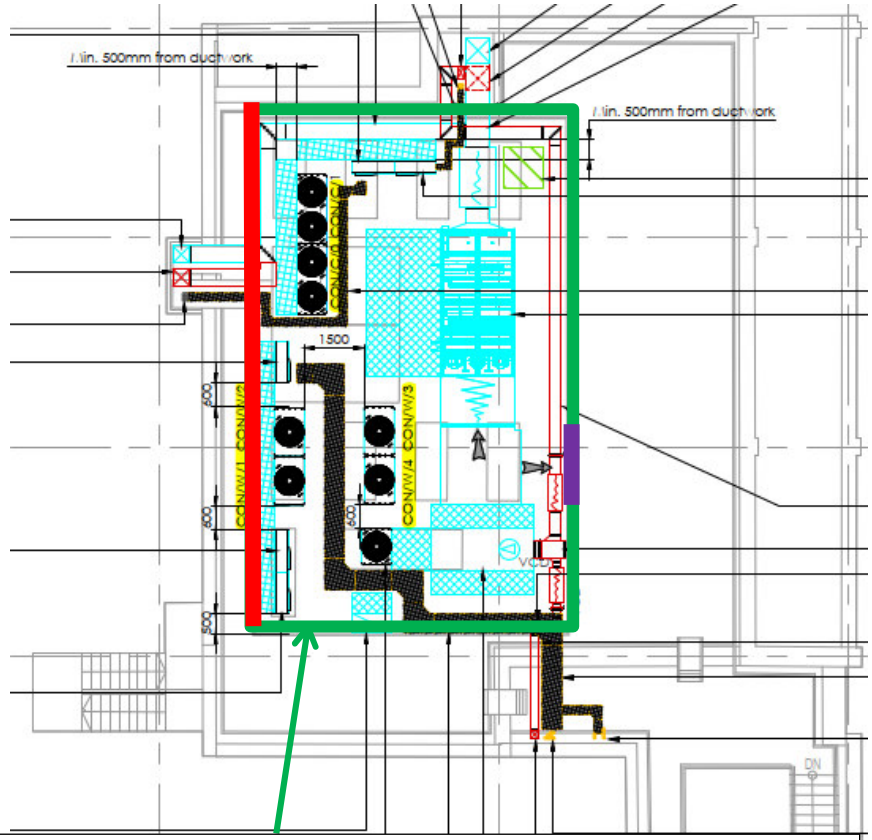

Extent of proposed acoustic **screen** (blanked off louvre plus absorptive panel internally) & plant deck
Acoustic louvred areas marked in **Red** (air into condensers)
Weather louvre to AHU in **Purple** (unused area blanked off)

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Roof Plant Area – Extent of proposed plant deck and acoustic louvred & solid screening

Figure 2

31 July 2020

Not to scale

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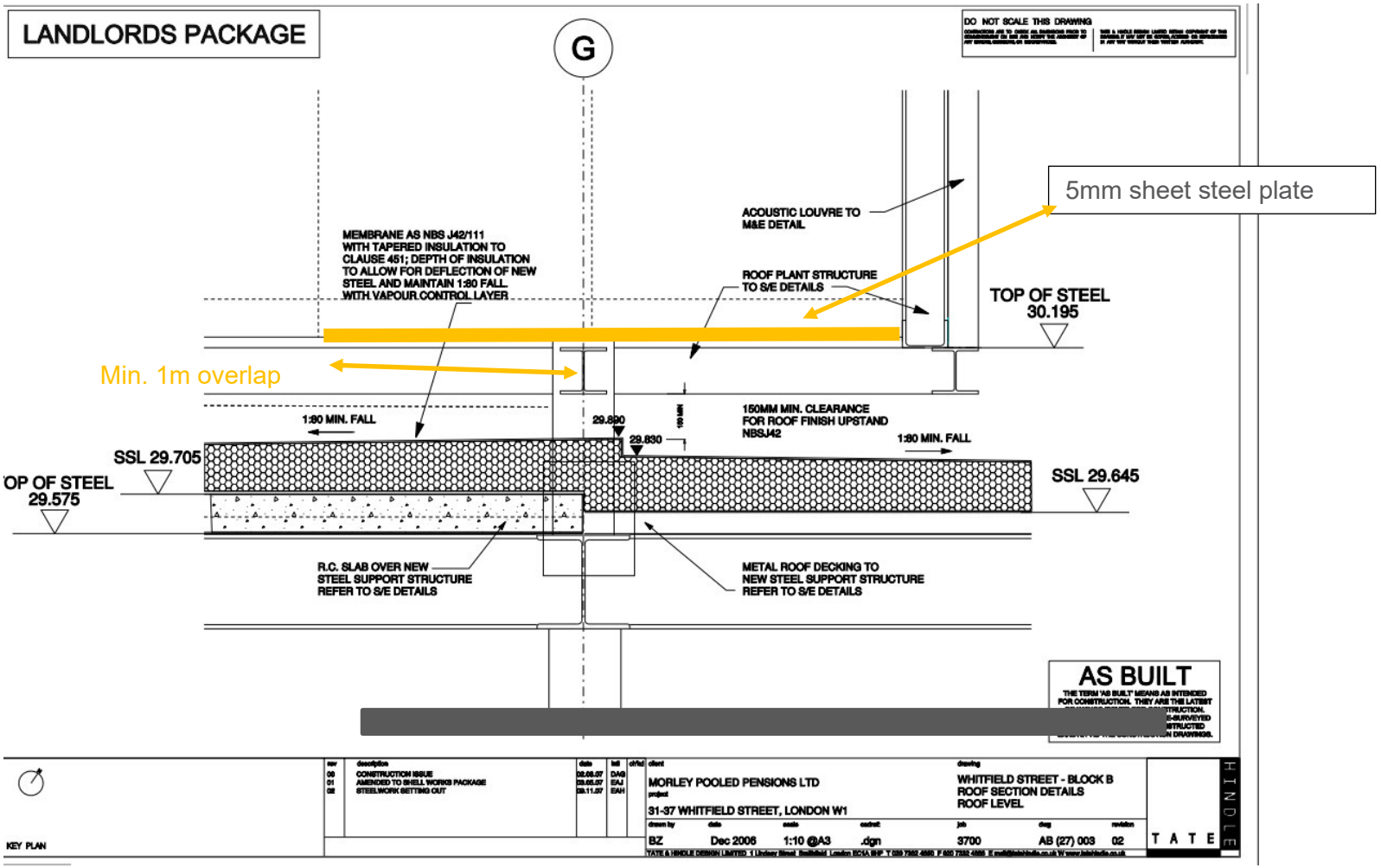

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Roof-top Plant Area – Plant Deck Upgrade

Figure 3

31 July 2020

Not to scale

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