Acoustic Consultancy Report

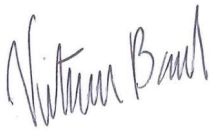
92991/3/2/2

External Plant Assessment

Report Prepared For

Butler And Young Associates
Alexandra Road, Camden
07 August 2024

Report Author



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Contents

i) Executive Summary 3

ii) Document History 3

1. Introduction 4

2. Survey 4

2.1. Site Description 4

2.2. Receiver Location 4

2.3. Local Noise Climate 4

2.4. Measurements 4

2.5. Measurement Results 5

3. Evaluation of Design Criteria 5

3.1. BS4142:2014 5

3.2. World Health Organisation Night Noise Guidelines for Europe (2009) 6

3.3. World Health Organisation (WHO) Guidelines for Community Noise (1999) 6

3.4. BS8233:2014 7

3.5. Local Authority Requirements 8

3.6. Recommended Residential Design Rating Level 8

3.7. Design Rating Levels 8

4. Review of Current Design 9

4.1. Current Design 9

4.2. Calculated Results 10

5. Conclusion 11

Appendix A: Site Plan 12

Appendix B: Proposed Plant Location 13

Appendix C: Measurement Data 20

Appendix D: Plant Data 21

Appendix E: Calculations 22

Appendix F: Glossary 32

i) Executive Summary

New mechanical plant is to be installed across the Alexandra and Ainsworth Estate, in London.

LCP has been commissioned to carry out an acoustic environment survey and to use the obtained data to assess the potential noise impact of the plant installation on surrounding noise sensitive receptors.

The design criterion is as follows:

23 dB $L_{Aeq,T}$ at 4m, nearest residential window.

The design as proposed and assessed will achieve the required criteria provided the proposed design detailed in section 4.1 of this report is implemented; the calculated rating levels are as follows:

23 dB $L_{Aeq,T}$ at 4m, nearest residential window.

This report concludes that the design criteria can be achieved.

ii) Document History

Issue	Date	Issue Details	Issued By	Checked By
1	7th August 2024	Initial Issue	VB	RM

1. Introduction

New mechanical plant is to be installed across the Alexandra and Ainsworth Estate, in London.

LCP has been commissioned to carry out an acoustic environment survey and to use the obtained data to assess the potential noise impact of the plant installation on surrounding noise sensitive receptors.

The report details recommendations for necessary noise mitigation where necessary.

The guidance in this report is on the basis that the mechanical plant will be consistently operating over a 24-hour period.

2. Survey

2.1. Site Description

The site layout together with the measurement position is shown in the drawing contained within Appendix A.

2.2. Receiver Location

The site was surveyed to determine the location of the most affected receiver.

The nearest residential receiver are located above the existing pump houses. This is shown in the site plan and proposed plant location in Appendix A and Appendix B respectively.

2.3. Local Noise Climate

The predominant local noise sources were frequent rail traffic from the adjoining London Overground train line and, to a lesser extent, road traffic from local road networks.

2.4. Measurements

The noise monitoring took place on the 24th July 2024 from 23:00hrs to 02:00hrs on the 25th July 2024. The measurement period was considered sufficient to establish the representative background sound levels corresponding to the operational period of the plant.

The weather conditions monitored during the survey are shown in the following table.

Table 1: Weather Conditions at Measurement Location

Weather	Value
Average Wind Speed	1m/s
Wind Direction	North-east
Cloud Cover	20%
Temperature	18°C
Precipitation	None

2.5. Measurement Results

The measured statistical broad-band sound pressure levels are shown within Appendix C. The representative background and ambient sound level(s) obtained being as follows:

Table 2: Representative background sound levels, dB re $2x10^{-5}$ Pa

Measurement Position	$L_{Aeq,\ 3\ hours}$ Night*	$L_{A90,\ 15\ mins}$ Night*
MP1	49	36
MP2	44	33
MP3	43	33
MP4	59	38
MP5	61	34
MP6	62	33

* Day and Night periods are defined as between 07:00 - 23.00 and 23:00 - 07:00 respectively.

3. Evaluation of Design Criteria

3.1. BS4142:2014

BS4142:2014 states that the significance of sound of an industrial and/or commercial nature 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 the sound occurs.

Table 3: BS4142 assessment based upon rating level

Difference between background noise and rating levels	Assessment
+ 10 dB	Indication of a significant adverse impact
+ 5 dB	Indication of an adverse impact
0 dB	Indication of low impact

Certain acoustic features can increase the significance of impact. The specific sound level should be corrected if a tone, impulse or other acoustic feature is expected to be present.

Table 4: Corrections for acoustic features, subjective method

Acoustic Feature	Correction, dB		
	Just Perceptible	Clearly Perceptible	Highly Perceptible
Tonality	2	4	6

Acoustic Feature	Correction, dB		
	Just Perceptible	Clearly Perceptible	Highly Perceptible
Impulsivity	3	6	9
Other Characteristics	3		
Intermittency	3		

Typically the acoustic feature correction would not be expected to exceed 10dB.

Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty.

3.2. World Health Organisation Night Noise Guidelines for Europe (2009)

The WHO's document 'Night Noise Guidelines for Europe (NNG) states the following:

"…it is recommended that the population should not be exposed to night noise levels greater than 40 dB of $L_{night, outside}$ during the part of the night when most people are in bed."

It then goes on to say *"An interim target (IT) if 55 dB $L_{night, outside}$ is recommended in the situations where the achievement of NNG is not feasible in the short run for various reasons."*

3.3. World Health Organisation (WHO) Guidelines for Community Noise (1999)

The WHO's 'Guidelines for Community Noise' gives the following relevant noise criteria:

Table 5: Guideline values for community noise, from Guidelines for Community Noise (WHO, 1999)

Specific Environment	$L_{Aeq, T}$ dB	Time Base (hours)	L_{Amax}, fast dB
Outdoor living area (serious annoyance, daytime and evening)	55	16	-
Outdoor living area (moderate annoyance, daytime and evening)	50	16	-
Dwelling, indoors	35	16	-
Inside bedrooms	30	8	45
Outside bedrooms	45	8	60
Outdoors in parkland and conservation areas*	-	-	-

* Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low

The WHO's 'Guidelines for Community Noise' also gives the following general guidance on the expected sound insulation performance of a façade with a partly open window, it states that:

"At night, sound pressure levels at the outside facades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax}, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB."

3.4. BS8233:2014

The criteria offered in BS8233 for residential buildings are largely based on the recommendations made in the Guidelines for Community Noise.

Using the general guidance from above, on the expected sound insulation performance of a façade with a partly open window, the criteria shown in the table below have been adapted from the criteria offered in table 4 of BS8233 in order to obtain acceptable external noise levels.

The noise levels shown should be treated as overall noise levels, i.e., the combination of all existing noise levels at the site, and noise levels from any proposed plant or activity.

Table 6: External ambient noise levels for dwellings, based on BS8233, dB re $2x10^{-5}$ Pa

Activity	**Location**	**Time period**	
		07:00 to 23:00	**23:00 to 07:00**
Resting	Living Room	50 $L_{Aeq,16\ hour}$	-
Dining	Dining Room/area	55 $L_{Aeq,\ 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	50 $L_{Aeq,\ 16\ hour}$	45 $L_{Aeq,\ 8\ hour}$

In addition to the above criteria, BS8233 goes on to say:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 $L_{Aeq,\ T}$, with an upper guideline value of 55 dB $L_{Aeq,\ T}$ which would be acceptable in nosier environments."

The above criteria are in line with the recommendations made in WHO's 'Guidelines for Community Noise'.

3.5. Local Authority Requirements

The Local Authority, London Borough of Camden, provided the following guidance within their Local Plan dated 2017.

"We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity."

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 57dB L_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dB 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.

3.6. Recommended Residential Design Rating Level

On the basis of the above the recommended residential design rating level should therefore be:

Residential Design Rating Level
Representative $L_{A90,\,15\,mins}$ - 10 dB

3.7. Design Rating Levels

The design levels to be adopted for this project are set out in table 7.

Table 7: Design rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Design Level (Night), $L_{Aeq, 8\ hr}$
Nearest residential window to pump room A1	28
Nearest residential window to pump room A2	24
Nearest residential window to pump room A3	24
Nearest residential window to pump room A4	23
Nearest residential window to sub-pump room A5	23
Nearest residential window to pump room B1	23
Nearest residential window to pump room B2	23
Nearest residential window to pump room B3	23
Nearest residential window to sub-pump room B	23
Nearest residential window to pump room C1	26
Nearest residential window to pump room C2	23
Nearest residential window to pump room C3	23

4. Review of Current Design

4.1. Current Design

The proposed plant shall be housed within a sub-pump/pump room. Pump rooms A1, A2, A3, A4, B1, B2, B3, C1, C2, and C3 do not require ventilation therefore the external façade shall comprise of a solid panel with solid access doors. Sub-pump room A5 and B do require ventilation therefore the external façade construction shall comprise of an acoustic louvre and access door. The advised external façade construction is provided in the table below.

Table 8: Advised external façade acoustic performance, dB

Location	Construction	Octave Band Centre Frequency (Hz)								R_w
		63	125	250	500	1k	2k	4k	8k	
Pump rooms A1, A2, A3, A4, B1, B2, B3, C1, C2, and C3	Solid panel	10	16	21	30	35	43	45	42	33
Sub-pump room A5 and B	Acoustic louvre*	7	7	10	17	29	30	27	21	21

* data based on Caice SH300.

The mechanical plant within has been discussed below relating to each sub-pump/ pump room.

Pump room A1, A2, A3, and A4 shall each house two Grundfos Hydro MPC-E 3 CRIE 5-9, which will both have the potential to operate at any one time.

Sub-pump room A5 shall house two Grundfos 20-4 N-FGJ-A-E-HQQE heat pumps and two Grundfos Hydro MPC-E 3 CRIE 5-9 all of which will have the potential to operate at any one time

Pump room B1, B2, and B3 shall each house one Grundfos Hydro MPC-E 2 CRIE 10-5.

Sub-pump room B shall house three Grundfos CRIE 10-5 A-CA-A-E-HQQE heat pumps however only two will have the potential to operate at any one time.

Pump room C1, C2, and C3 shall each house one Grundfos Hydro MPC-E 2 CRIE 5-9.

The reverberation time within each the sub-pump/pump rooms should not exceed 1.0 seconds.

The residential windows do not have direct line of sight to the sub-pump/pump rooms. Several overhang above, or in the instance of sub-pump room B, the property is set back with a balcony screen, which is included in the calculations in section 4.2.

The guidance in this report is on the basis that the mechanical plant will be consistently operating over a 24-hour period.

4.2. Calculated Results

Calculations of the predicted noise levels have been carried out with the appropriate corrections for geometric attenuation, barrier effect, reflective surfaces and multiple source addition.

The design rating levels to be adopted for this project, together with the predicted noise levels, are set out in the table below.

Table 9: Design and predicted rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	**Approximate Distance (m)**	**Design Level (Night)** $L_{Aeq,\ 8\ hr}$	**Predicted Level** $L_{Aeq,T}$
Nearest residential window to pump room A1	4	28	18
Nearest residential window to pump room A2	4	24	18
Nearest residential window to pump room A3	4	24	18
Nearest residential window to pump room A4	4	23	18
Nearest residential window to sub-pump room A5	11	23	22

Receiver Premises	Approximate Distance (m)	Design Level (Night) $L_{Aeq,\ 8\ hr}$	Predicted Level $L_{Aeq,T}$
Nearest residential window to pump room B1	4	23	23
Nearest residential window to pump room B2	4	23	23
Nearest residential window to pump room B3	4	23	23
Nearest residential window to sub-pump room B	25	23	23
Nearest residential window to pump room C1	4	26	16
Nearest residential window to pump room C2	4	23	16
Nearest residential window to pump room C3	4	23	16

Plant noise level data used in this assessment are contained within Appendix D.

Calculations are shown within Appendix E.

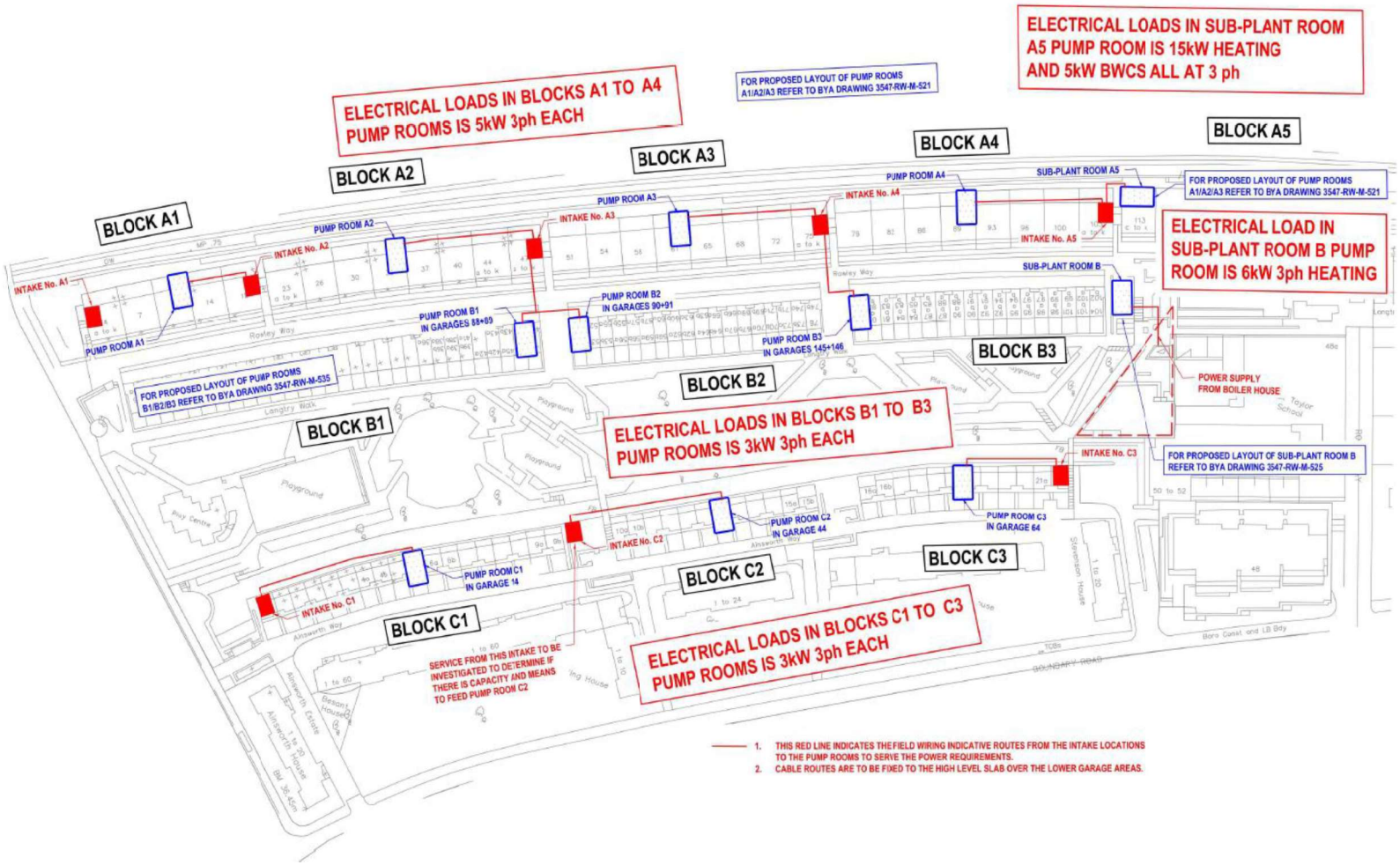
5. Conclusion

An environmental noise survey has been undertaken in order to establish the representative background sound levels local to the site generally in accordance with the method contained within BS4142: 2014.

Calculations have been carried out to determine the noise levels at the nearest receiver premises. The calculations show that with the implementation or the proposed design detailed in section 4.1 of this report the design criteria will be met.

Appendix A: Site Plan

Appendix B: Proposed Plant Location



The image below depicts the overhang of the residential dwellings above the proposed pump rooms located at ground level.

Sub pump room A5

Visualisation of Sub Plant Room A - Existing

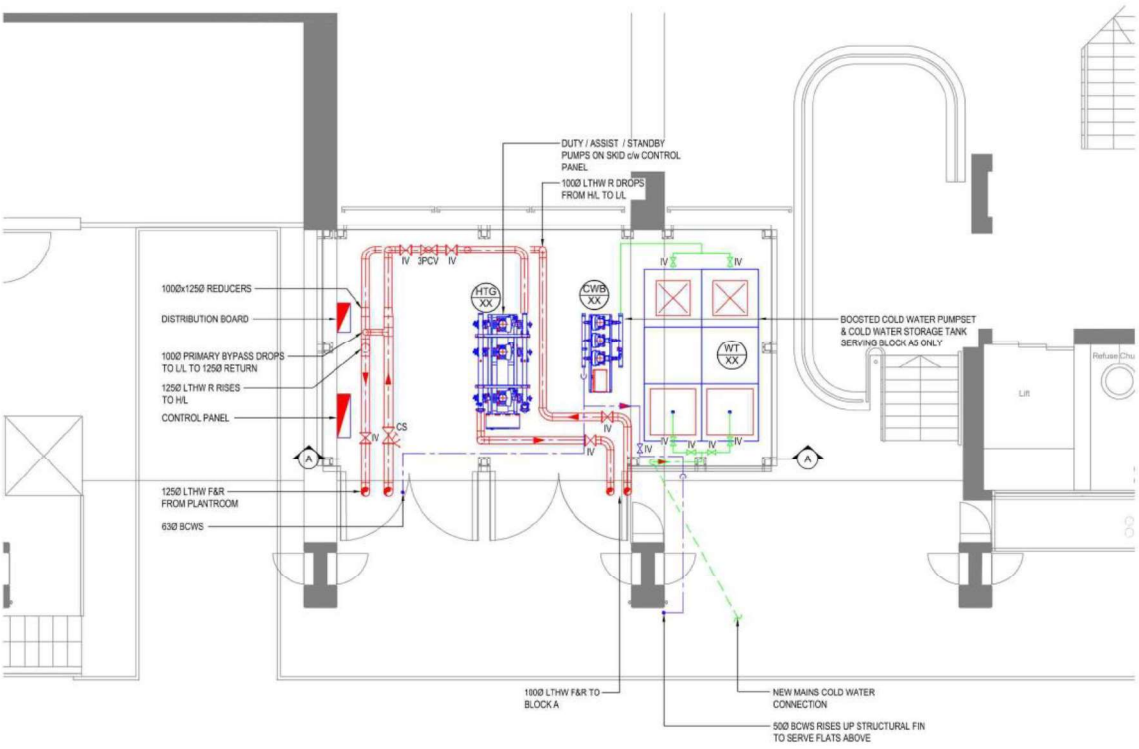
Visualisation of Sub Plant Room A - Proposed

Sub pump room B

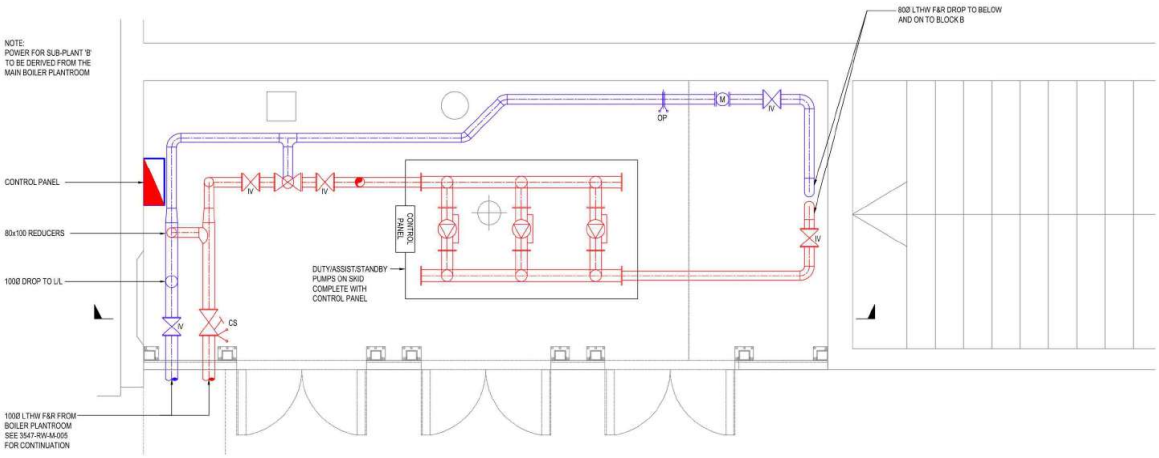
Visualisation of Sub Plant Room B (to right) - Existing

Visualisation of Sub Plant Room B (to right) - Proposed

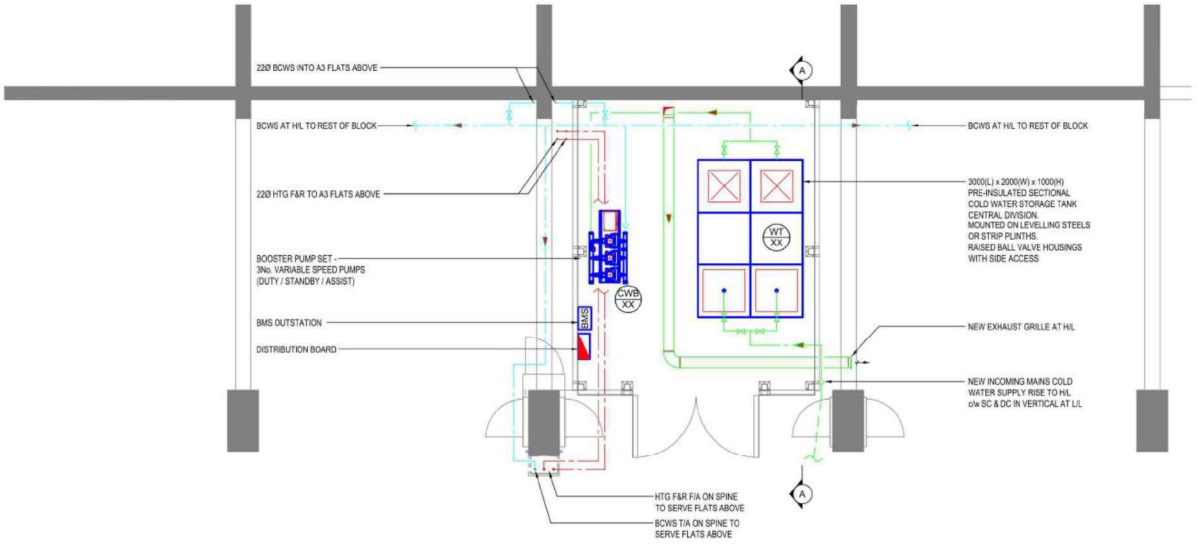
Sub-pump room A5



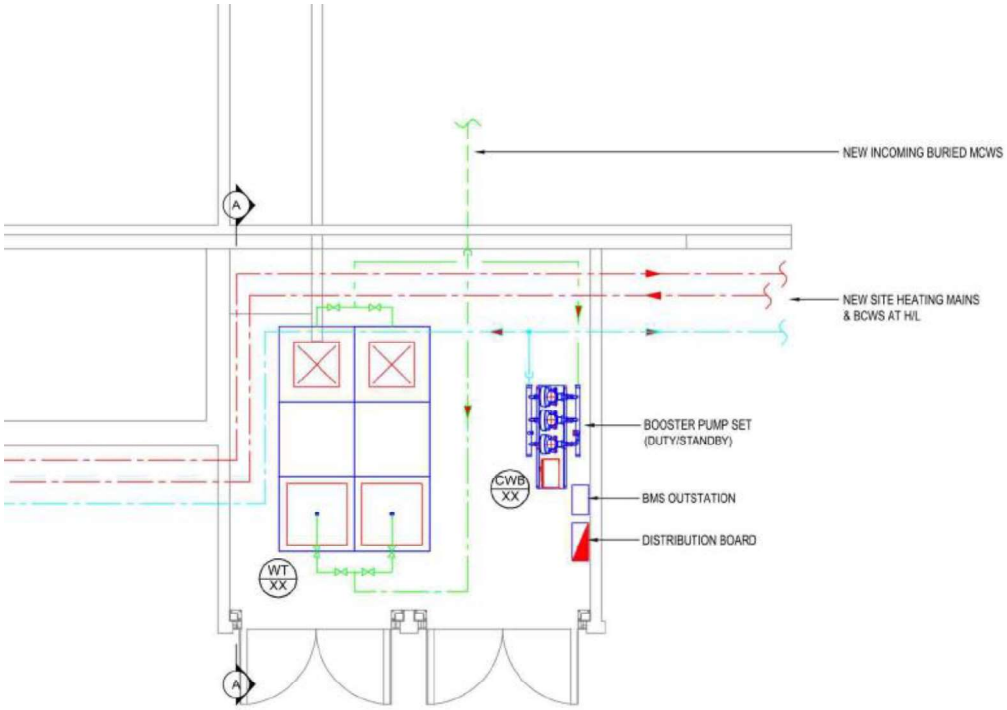
Sub-pump room B



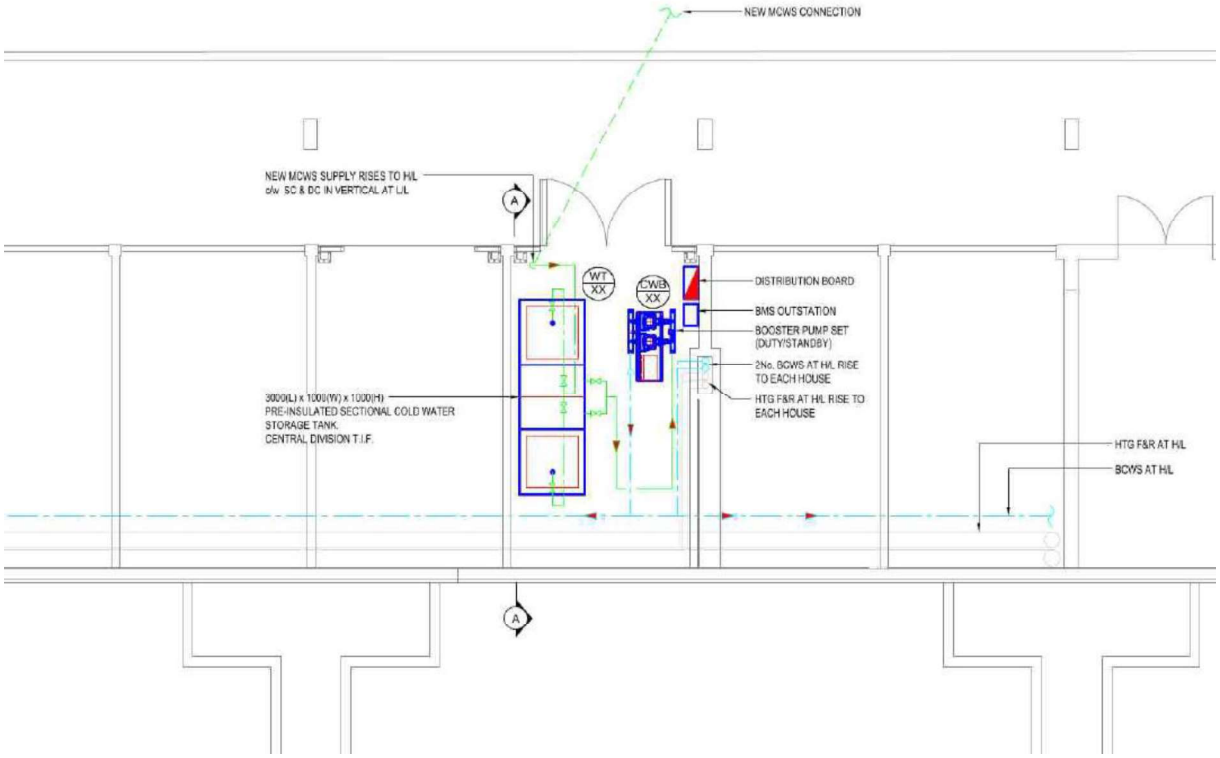
Pump rooms A1, A2, A3, and A4



Pump rooms B1, B2, and B3



Pump rooms C1, C2, and C3



Appendix C: Measurement Data

		Elapsed time	LAFmax [dB]	LASmax [dB]	1/1 Octave Lzeq								Total	1/1 Octave Lz90								Total
No.	Date & time	[hh:mm:ss]			63	125	250	500	1000	2000	4000	8000	LAeq	63	125	250	500	1000	2000	4000	8000	LA90
MP1	24/07/2024 23:16:56	00:15:00	69.2	63.2	57.6	51.6	48.6	47.7	47.4	43.4	37.5	31.2	51.1	44.2	40.7	39.8	38.7	38.4	34.8	29.0	21.6	43.3
MP1	25/07/2024 00:24:54	00:15:00	72.4	67.4	52.5	45.1	44.1	44.1	44.7	40.7	34.4	29.1	48.0	38.8	36.6	35.4	33.8	32.8	29.4	23.4	17.2	37.8
MP1	25/07/2024 01:17:30	00:15:00	58.9	54.4	52.1	44.8	42.2	40.9	41.6	37.8	29.2	20.8	44.9	38.6	36.2	35.0	32.2	30.7	26.7	21.0	15.8	36
													48.7									36
MP2	24/07/2024 23:33:38	00:15:00	63.5	58.9	50.1	45.2	42.7	41.7	39.6	38.2	36.6	31.1	45.3	40.5	38.5	36.5	34.3	33.5	31.3	28.5	22.3	39.3
MP2	25/07/2024 00:42:02	00:15:00	75.3	68.7	51.0	46.6	44.5	43.0	40.1	38.7	34.6	27.4	45.6	39.2	37.2	34.5	31.2	30.3	27.5	23.3	17.4	35.6
MP2	25/07/2024 01:34:18	00:15:00	56.8	54.8	46.3	43.6	39.1	35.0	33.3	30.4	24.8	18.2	38.3	39.1	37.7	34.8	28.9	26.7	22.3	17.1	14.5	33.4
													44.1									33
MP3	24/07/2024 23:51:18	00:15:00	63.2	60.6	53.4	54.4	48.6	41.2	37.6	36.3	36.9	31.4	45.9	41.3	38.4	35.4	32.4	30.8	27.6	24.9	18.9	37.2
MP3	25/07/2024 00:58:30	00:15:00	69.7	62.1	49.4	45.3	41.3	39.1	36.7	34.4	32.0	25.9	42.2	41.6	37.7	34.9	30.0	27.8	23.9	19.2	15.2	34.4
MP3	25/07/2024 01:51:26	00:15:00	49.7	46.9	48.1	45.0	39.9	35.1	31.6	30.3	29.2	23.0	38.6	41.8	38.6	35.2	29.3	25.3	20.5	16.5	14.5	33.1
													43.2									33
MP4	24/07/2024 23:15:00	00:15:00	77.9	77	61.3	60.3	56.9	58.2	57.7	51.5	43.7	36.3	60.7	43.8	43.1	43.1	37.7	37.0	31.9	23.8	16.2	41.7
MP4	25/07/2024 00:12:10	00:15:00	76.2	75.2	57.6	57.1	57.0	57.1	55.7	49.9	42.2	30.8	59	39.7	40.9	39.7	36.2	34.5	29.2	21.1	15.2	39.3
MP4	25/07/2024 01:16:14	00:15:00	76.4	75.4	62.0	59.4	55.9	55.1	52.8	48.4	42.4	31.6	57	38.3	40.3	39.6	34.2	31.6	26.3	19.5	15.3	37.6
													59.2									38
MP5	24/07/2024 23:33:08	00:15:00	77	76.1	62.8	58.7	56.1	55.1	54.9	52.8	50.0	38.7	59.4	39.9	40.3	38.9	36.7	34.2	28.7	21.3	15.4	39.3
MP5	25/07/2024 00:28:44	00:15:00	83.5	82.5	61.2	57.2	57.3	61.7	60.6	56.3	50.5	38.8	64	38.4	38.8	35.9	33.6	31.6	25.4	17.4	14.4	36.3
MP5	25/07/2024 01:32:44	00:15:00	75.1	74.1	64.8	59.0	55.3	55.6	54.5	48.4	43.2	35.2	57.9	37.7	38.0	35.1	31.7	28.8	22.1	15.6	14.2	34.4
													61.2									34
MP6	24/07/2024 23:50:34	00:15:00	81	80.3	63.8	63.0	61.3	62.4	60.8	56.5	50.6	40.1	64.6	40.5	40.4	37.6	35.3	34.1	28.0	18.8	14.6	38.7
MP6	25/07/2024 00:46:56	00:15:00	81.2	80.2	55.4	53.6	51.9	58.0	57.1	52.1	44.8	37.4	60.2	36.4	36.1	33.4	31.1	28.8	23.2	16.4	14.3	33.7
MP6	25/07/2024 01:49:10	00:15:00	80.9	79.8	62.4	56.8	53.8	56.9	55.4	52.4	46.5	41.7	59.4	36.0	36.6	33.6	30.6	26.8	21.2	15.9	14.3	32.9
													62.0									33

MP1, 2, and 3

Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11258 (next cal due 04/03/25) Start gain +0.04 End gain -0.01
- Svantek pre-amplifier SV12L S/N: 13111 with GRAS microphone capsule 40AE S/N: 241965

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10893 (next cal due 24/08/24) complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

MP4, 5, and 6

Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11205 (next cal due 08/04/25) Start gain +0.34 End gain 0.42
- Svantek pre-amplifier SV12L S/N: 13245 with GRAS microphone capsule 40AE S/N: 75181

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10890 (next cal due 24/01/25) complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix D: Plant Data

Plant noise data used in the preceding assessment follow.

Table 10: Manufacturer's plant sound pressure data, dB re $2x10^{-5}$ Pa

Plant	Distance (m)	Octave Band Centre Frequency (Hz)								L_{PA}
		63	125	250	500	1k	2k	4k	8k	
Grundfos CRIE 10-5 A-CA-A-E-HQQE heat pumps	1	23	40	50	62	65	62	59	50	69
Grundfos CRIE 20-4 N-FGJ-A-E-HQQE heat pumps	1	30	44	56	67	68	66	63	59	73
Grundfos Hydro MPC-E 2 CRIE 5-9	1	8	28	43	54	62	58	52	44	64
Grundfos Hydro MPC-E 2 CRIE 10-5	1	23	40	50	62	65	62	59	50	69
Grundfos Hydro MPC-E 3 CRIE 5-9	1	8	28	43	54	62	58	52	44	64

Table 11: Calculated plant sound power data used in calculations, dB re 10^{-12} W

Plant	Octave Band Centre Frequency (Hz)								L_{WA}
	63	125	250	500	1k	2k	4k	8k	
Grundfos CRIE 10-5 A-CA-A-E-HQQE heat pumps	34	51	61	73	76	73	70	61	79
Grundfos CRIE 20-4 N-FGJ-A-E-HQQE heat pumps	41	55	67	78	79	77	74	70	83
Grundfos Hydro MPC-E 2 CRIE 5-9	19	39	54	65	73	69	63	55	75
Grundfos Hydro MPC-E 2 CRIE 10-5	34	51	61	73	76	73	70	61	79
Grundfos Hydro MPC-E 3 CRIE 5-9	19	39	54	65	73	69	63	55	75

Appendix E: Calculations

Sub-pump room A5

Plant Noise Data (Sound Power Levels):

Plant Description	Length	Width	Height		Distance From Façade		Units	Octave Band Centre Frequency Hz								A	Units
								63	125	250	500	1000	2000	4000	8000		
Grundfos CRIE 20-4 N-FGJ-A-E-HQQE					1		m	41	55	67	78	79	77	74	70	83	dB
Grundfos CRIE 20-4 N-FGJ-A-E-HQQE					1		m	41	55	67	78	79	77	74	70	83	dB
Grundfos Hydro MPC-E 3 CRIE 5-9					1		m	19	39	54	65	73	69	63	55	75	dB
Grundfos Hydro MPC-E 3 CRIE 5-9					1		m	19	39	54	65	73	69	63	55	75	dB

Room Dimensions:

Description	Value	Units
Plant Room Length	8	m
Plant Room Width	4.5	m
Plant Room Height	3	m
Plant Room Volume	108	m^3

Structural Details:

Description	Value	Units
Façade Length	8	m
Façade Height	3	m
Façade Area	24	m2

Partition Sound Reduction Index:

Description	Octave Band Centre Frequency Hz								R_w	Units	Ref
	63	125	250	500	1000	2000	4000	8000			
Façade Sound Reduction Index	7	7	10	17	29	30	27	21	22	dB	

Reverberation Time:

Description	Octave Band Centre Frequency Hz								Units	Ref
	63	125	250	500	1000	2000	4000	8000		
Plant Room Reverberation Time 0.5 s	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	s	1

Resultant Sound Pressure Levels:

Description	Octave Band Centre Frequency Hz								A	Units	NR	Ref
	63	125	250	500	1000	2000	4000	8000				
Total Sound Power L_w	44.0	58.1	70.2	81.2	83.0	80.6	77.3	73.1	87	dB	83	1,6
Plant Room Reverberant L_p	34.6	48.7	60.8	71.8	73.6	71.2	67.9	63.7	78	dB	74	1,6
Façade Break-out Lw	45.2	59.3	68.4	72.4	62.1	58.8	58.5	60.3	71	dB	69	

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) (If Lp, assumes hemi-sherical radiation to convert to Lw +20*LOG(distance)+8) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)	Reciever Distance (m)	Source height	Receiver height	Ground factor (source) 0-1	Ground factor (middle) 0-1	Ground factor (receiver) 0-1	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	Reflections (additional to ground, 1=3dB)	dB	Façade correction 3dB	dB	Losses (e.g. attenuator) Negative values 63	125	250	500	1k	2k	4k	8k	Additional Attenuation (Negative values) 63	125	250	500	1k	2k	4k	8k
1	Pumproom		45	59	68	72	62	59	59	60	71	71	11.0	0.0	2.5	0.0	0.0	0.0	-32	40	1	0	110-180	-3	-5	-8	-12	-15	-18	-18	-18		0	Yes	3																

Calculations carried out in accordance with ISO9613

Ground factor. Hard ground = 0; Porous ground = 1; Mixed ground = Fraction of porous ground

Edge diffraction. Top edge = 1; Vertical edge = 2; No barrier = leave blank

All heights must be positive - set reference zero datum at ground plane. Top edge diffraction removes ground effects

Ref.	plant	Receiver Lp (excluding barrier) 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	16	28	34	34	21	14	14	15	33
	Total	**16**	**28**	**34**	**34**	**21**	**14**	**14**	**15**	**33**

Edge diffraction	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	Barrier Path Difference Loss: 63	125	250	500	1000	2000	4000	8000
1	2,5	8,0	3,0	0,10	-5	-6	-7	-8	-9	-12	-14	-17

Atmospheric conditions T °C	RH %	63	125	250	500	1k	2k	4k	8k	Ground effect 63	125	250	500	1k	2k	4k	8k
15	60	0	0	0	0	0	0	0	-1	3	3	3	3	3	3	3	3

Criteria	63	125	250	500	1k	2k	4k	8k	dB(A)
NR	63	125	250	500	1k	2k	4k	8k	dB(A)
12	45	32	23	16	12	9	6	4	23

Barrier SRI

	63	125	250	500	1k	2k	4k	8k	Rw
Manual									0
Typical 110mm brick wall	33	37	34	40	48	56	61	61	45

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	-29	-4	11	18	9	5	8	11	10
	Total	-29	-4	11	18	9	5	8	11	10

Barrier Deration

	63	125	250	500	1k	2k	4k	8k
Pumproom	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp (including barrier, if present) 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	8	19	24	23	9	-1	-3	-5	22
	Total	**8**	**19**	**24**	**23**	**9**	**0**	**-2**	**-4**	**22**

Net barrier loss (including ground effect correction)

	63	125	250	500	1k	2k	4k	8k
Pumproom	**-8**	**-9**	**-10**	**-11**	**-12**	**-15**	**-17**	**-20**

Sub-pump room B

Plant Noise Data (Sound Power Levels):

Plant Description	Length	Width	Height		Distance From Façade		Units	Octave Band Centre Frequency Hz								A	Units
								63	125	250	500	1000	2000	4000	8000		
Grundfos CRIE 10-5 A-CA-A-E-HQQE					1		m	34	51	61	73	76	73	70	61	80	dB
Grundfos CRIE 10-5 A-CA-A-E-HQQE					1		m	34	51	61	73	76	73	70	61	80	dB

Room Dimensions:

Description	Value	Units
Plant Room Length	7.5	m
Plant Room Width	3	m
Plant Room Height	3	m
Plant Room Volume	67.5	m^3

Structural Details:

Description	Value	Units
Façade Length	7.5	m
Façade Height	3	m
Façade Area	22.5	m2

Partition Sound Reduction Index:

Description	Octave Band Centre Frequency Hz								R_w	Units	Ref
	63	125	250	500	1000	2000	4000	8000			
Façade Sound Reduction Index	7	7	10	17	29	30	27	21	22	dB	

Reverberation Time:

Description	Octave Band Centre Frequency Hz								Units	Ref
	63	125	250	500	1000	2000	4000	8000		
Plant Room Reverberation Time 0.5 s	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	s	1

Resultant Sound Pressure Levels:

Description	Octave Band Centre Frequency Hz								A	Units	NR	Ref
	63	125	250	500	1000	2000	4000	8000				
Total Sound Power L_w	37.0	54.0	64.0	76.0	79.0	76.0	73.0	64.0	83	dB	79	1,6
Plant Room Reverberant L_p	29.6	46.6	56.6	68.6	71.6	68.6	65.6	56.6	75	dB	72	1,6
Façade Break-out Lw	38.9	55.9	62.9	67.9	58.9	54.9	54.9	51.9	67	dB	65	

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) (If Lp, assumes hemi-sherical radiation to convert to Lw +20*LOG(distance)+8)									Lw
			63	125	250	500	1k	2k	4k	8k	dB(A)	dB(A)
1	Pumproom		39	56	63	68	59	55	55	52	67	67

Reciever Distance (m)	Source height	Receiver height	Ground factor (source) 0-1	Ground factor (middle) 0-1	Ground factor (receiver) 0-1
25.0	3.0	4.5	0.0	0.0	0.0

dB(A)	Lp	No. off	dB
-39	28	1	0

Angular Directionality	63	125	250	500	1k	2k	4k	8k
45(-3dB)	-3	-3	-3	-3	-3	-3	-3	-3

Reflections (additional to ground, 1=3dB)	dB
	0

Façade correction 3dB	dB
Yes	3

Losses (e.g. attenuator) Negative values								
63	125	250	500	1k	2k	4k	8k

Additional Attenuation (Negative values)							
63	125	250	500	1k	2k	4k	8k

Calculations carried out in accordance with ISO9613

Ground factor.
Hard ground = 0
Porous ground = 1
Mixed ground = Fraction of porous ground

Edge diffraction
Top edge = 1
Vertical edge = 2
No barrier = leave blank

All heights must be positive - set reference zero datum at ground plane

Top edge diffraction removes ground effects

Ref.	plant	Receiver Lp (excluding barrier)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	2	19	26	31	22	18	17	13	30
	Total	**2**	**19**	**26**	**31**	**22**	**18**	**17**	**13**	**30**

Edge diffraction	Barrier height	Source to barrier distance	Barrier to receiver distance
1	4.3	22.0	3.0

Barrier Path Difference Loss:

Calculated path difference	63	125	250	500	1000	2000	4000	8000
0.00	-5	-5	-5	-5	-5	-5	-5	-5

Atmospheric conditions

T °C	RH %	63	125	250	500	1k	2k	4k	8k
15	80	0	0	0	0	0	0	-1	-2

Ground effect

63	125	250	500	1k	2k	4k	8k
3	3	3	3	3	3	3	3

Criteria								
NR	63	125	250	500	1k	2k	4k	8k	dB(A)
12	45	32	23	16	12	9	6	4	23

Barrier SRI

	63	125	250	500	1k	2k	4k	8k	Rw
Manual	5	5	7	9	13	13	13	12	12
Manual	5	5	7	9	13	13	13	12	12

Ref.	Plant	Excess								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	-43	-13	3	15	10	9	11	9	7
	Total	-43	-13	3	15	10	9	11	9	7

Barrier Deration

	63	125	250	500	1k	2k	4k	8k
Pumproom	3	3	2	1	1	1	1	1

Ref.	Plant	Mitigated Receiver Lp (including barrier, if present)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	-3	14	20	24	15	11	10	6	23
	Total	**-2**	**14**	**20**	**24**	**15**	**11**	**10**	**6**	**23**

Net barrier loss (including ground effect correction)

	63	125	250	500	1k	2k	4k	8k
Pumproom	-5	-5	-6	-7	-7	-7	-7	-7

Pump rooms A1, A2, A3, and A4

Plant Noise Data (Sound Power Levels):

Plant Description	Length	Width	Height		Distance From Façade		Units	Octave Band Centre Frequency Hz								A	Units
								63	125	250	500	1000	2000	4000	8000		
Grundfos Hydro MPC-E 3 CRIE 5-9					1		m	19	39	54	65	73	69	63	55	75	dB
Grundfos Hydro MPC-E 3 CRIE 5-9					1		m	19	39	54	65	73	69	63	55	75	dB

Room Dimensions:

Description	Value	Units
Plant Room Length	4	m
Plant Room Width	2.5	m
Plant Room Height	3	m
Plant Room Volume	30	m^3

Structural Details:

Description	Value	Units
Façade Length	2.5	m
Façade Height	3	m
Façade Area	7.5	m2

Partition Sound Reduction Index:

Description	Octave Band Centre Frequency Hz								R_w	Units	Ref
	63	125	250	500	1000	2000	4000	8000			
Façade Sound Reduction Index	10	16	21	30	35	43	45	42	33	dB	

Reverberation Time:

Description	Octave Band Centre Frequency Hz								Units	Ref
	63	125	250	500	1000	2000	4000	8000		
Plant Room Reverberation Time 0.5 s	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	s	1

Resultant Sound Pressure Levels:

Description	Octave Band Centre Frequency Hz								A	Units	NR	Ref
	63	125	250	500	1000	2000	4000	8000				
Total Sound Power L_w	22.2	42.0	57.0	68.0	76.0	72.0	66.0	58.0	78	dB	76	1,6
Plant Room Reverberant L_p	18.4	38.2	53.2	64.2	72.2	68.2	62.2	54.2	75	dB	72	1,6
Façade Break-out Lw	18.5	32.3	42.3	44.3	47.3	35.3	27.3	22.3	49	dB	47	

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) (If Lp, assumes hemi-sherical radiation to convert to Lw +20*LOG(distance)+8)									Lw
			63	125	250	500	1k	2k	4k	8k	dB(A)	dB(A)
1	Pumproom		18	32	42	44	47	35	27	22	49	49

Reciever Distance (m)	Source height	Receiver height	Ground factor (source) 0-1	Ground factor (middle) 0-1	Ground factor (receiver) 0-1
4.0	0.0	2.0	0.0	0.0	0.0

dB(A)	Lp	No. off	dB
-23	26	1	0

Angular Directionality	63	125	250	500	1k	2k	4k	8k
None	0	0	0	0	0	0	0	0

Reflections (additional to ground, 1=3dB)	dB
1	3

Façade correction 3dB	dB
Yes	3

Losses (e.g. attenuator) Negative values								
63	125	250	500	1k	2k	4k	8k

Additional Attenuation (Negative values)							
63	125	250	500	1k	2k	4k	8k

Calculations carried out in accordance with ISO9613

Ground factor.
Hard ground = 0
Porous ground = 1
Mixed ground = Fraction of porous ground

Edge diffraction
Top edge = 1
Vertical edge = 2
No barrier = leave blank

All heights must be positive - set reference zero datum at ground plane

Top edge diffraction removes ground effects

Ref.	plant	Receiver Lp (excluding barrier)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	4	18	28	30	33	21	13	8	34
	Total	**4**	**18**	**28**	**30**	**33**	**21**	**13**	**8**	**34**

Edge diffraction	Barrier height	Source to barrier distance	Barrier to receiver distance
1	2.0	2.0	2.0

Calculated path difference	63	125	250	500	1k	2k	4k	8k
0.36	-6	-7	-9	-11	-14	-17	-19	-20

Barrier Path Difference Loss:	1000	2000	4000	8000

Atmospheric conditions										
T °C	RH %	63	125	250	500	1k	2k	4k	8k
15	80	0	0	0	0	0	0	0	0

Ground effect								
63	125	250	500	1k	2k	4k	8k
3	3	3	3	3	3	3	3

Criteria								
NR	63	125	250	500	1k	2k	4k	8k	dB(A)
12	45	32	23	16	12	9	6	4	23

Barrier SRI	63	125	250	500	1k	2k	4k	8k	Rw
Manual									0
Typical 110mm brick wall	33	37	34	40	48	56	61	61	45

Ref.	Plant	Excess								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	-41	-14	5	14	21	12	7	4	12
	Total	-41	-14	5	14	21	12	7	4	12

Barrier Deration		63	125	250	500	1k	2k	4k	8k
	Pumproom	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp (including barrier, if present)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	-5	8	16	16	16	1	-9	-15	18
	Total	**-4**	**8**	**16**	**16**	**16**	**1**	**-6**	**-9**	**18**

Net barrier loss (including ground effect correction)		63	125	250	500	1k	2k	4k	8k
	Pumproom	-9	-10	-12	-14	-17	-20	-22	-23

Pump rooms B1, B2, and B3

Plant Noise Data (Sound Power Levels):

Plant Description	Length	Width	Height		Distance From Façade		Units	Octave Band Centre Frequency Hz								A	Units
								63	125	250	500	1000	2000	4000	8000		
Grundfos Hydro MPC-E 2 CRIE 10-5					0.5		m	34	51	61	73	76	73	70	61	80	dB

Room Dimensions:

Description	Value	Units
Plant Room Length	4	m
Plant Room Width	4	m
Plant Room Height	3	m
Plant Room Volume	48	m^3

Structural Details:

Description	Value	Units
Façade Length	4	m
Façade Height	3	m
Façade Area	12	m2

Partition Sound Reduction Index:

Description	Octave Band Centre Frequency Hz								R_w	Units	Ref
	63	125	250	500	1000	2000	4000	8000			
Façade Sound Reduction Index	10	16	21	30	35	43	45	42	33	dB	

Reverberation Time:

Description	Octave Band Centre Frequency Hz								Units	Ref
	63	125	250	500	1000	2000	4000	8000		
Plant Room Reverberation Time 0.5 s	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	s	1

Resultant Sound Pressure Levels:

Description	Octave Band Centre Frequency Hz								A	Units	NR	Ref
	63	125	250	500	1000	2000	4000	8000				
Total Sound Power L_w	34.0	51.0	61.0	73.0	76.0	73.0	70.0	61.0	80	dB	76	1.6
Plant Room Reverberant L_p	28.1	45.1	55.1	67.1	70.1	67.1	64.1	55.1	74	dB	70	1.6
Façade Break-out Lw	32.4	43.4	48.4	51.4	49.4	38.4	33.4	27.4	52	dB	49	

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) (If Lp, assumes hemi-sherical radiation to convert to Lw +20*LOG(distance)+8)									Lw
			63	125	250	500	1k	2k	4k	8k	dB(A)	dB(A)
1	Pumproom		32	43	48	51	49	38	33	27	52	52

Reciever Distance (m)	Source height	Receiver height	Ground factor (source) 0-1	Ground factor (middle) 0-1	Ground factor (receiver) 0-1	dB(A)	Lp	No. off	dB
4.0	0.0	2.0	0.0	0.0	0.0	-23	29	1	0

Angular Directionality	63	125	250	500	1k	2k	4k	8k
None	0	0	0	0	0	0	0	0

Reflections (additional to ground, 1=3dB)	dB
1	3

Façade correction 3dB	dB
Yes	3

Losses (e.g. attenuator) Negative values								
63	125	250	500	1k	2k	4k	8k

Additional Attenuation (Negative values)							
63	125	250	500	1k	2k	4k	8k

Calculations carried out in accordance with ISO9613

Ground factor.
Hard ground = 0
Porous ground = 1
Mixed ground = Fraction of porous ground

Edge diffraction
Top edge = 1
Vertical edge = 2
No barrier = leave blank

All heights must be positive - set reference zero datum at ground plane

Top edge diffraction removes ground effects

Ref.	plant	Receiver Lp (excluding barrier)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	18	29	34	37	35	24	19	13	38
	Total	18	29	34	37	35	24	19	13	38

Edge diffraction	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference
1	2.0	2.0	2.0	0.36

Barrier Path Difference Loss:	63	125	250	500	1000	2000	4000	8000
	-8	-7	-9	-11	-14	-17	-19	-20

Atmospheric conditions										
T °C	RH %	63	125	250	500	1k	2k	4k	8k
15	80	0	0	0	0	0	0	0	0

Ground effect								
63	125	250	500	1k	2k	4k	8k
3	3	3	3	3	3	3	3

Criteria									
NR	63	125	250	500	1k	2k	4k	8k	dB(A)
12	45	32	23	16	12	9	6	4	23

Barrier SRI	63	125	250	500	1k	2k	4k	8k	Rw
Manual									0
Typical 110mm brick wall	33	37	34	40	48	56	61	61	45

Ref.	Plant	Excess								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	-27	-3	11	21	23	15	13	9	15
	Total	-27	-3	11	21	23	15	13	9	15

Barrier Deration		63	125	250	500	1k	2k	4k	8k
	Pumproom	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp (including barrier, if present)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	9	19	22	23	18	4	-3	-10	23
	Total	9	19	22	23	18	4	-2	-7	23

Net barrier loss (including ground effect correction)		63	125	250	500	1k	2k	4k	8k
	Pumproom	-9	-10	-12	-14	-17	-20	-22	-23

Pump rooms C1, C2, and C3

Plant Noise Data (Sound Power Levels):

Plant Description	Length	Width	Height		Distance From Façade		Units	Octave Band Centre Frequency Hz								A	Units
								63	125	250	500	1000	2000	4000	8000		
Grundfos Hydro MPC-E 2 CRIE 5-9					0.5		m	19	39	54	65	73	69	63	55	75	dB

Room Dimensions:

Description	Value	Units
Plant Room Length	4	m
Plant Room Width	2.5	m
Plant Room Height	3	m
Plant Room Volume	30	m^3

Structural Details:

Description	Value	Units
Façade Length	2.5	m
Façade Height	3	m
Façade Area	7.5	m2

Partition Sound Reduction Index:

Description	Octave Band Centre Frequency Hz								R_w	Units	Ref
	63	125	250	500	1000	2000	4000	8000			
Façade Sound Reduction Index	10	16	21	30	35	43	45	42	33	dB	

Reverberation Time:

Description	Octave Band Centre Frequency Hz								Units	Ref
	63	125	250	500	1000	2000	4000	8000		
Plant Room Reverberation Time 0.5 s	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	s	1

Resultant Sound Pressure Levels:

Description	Octave Band Centre Frequency Hz								A	Units	NR	Ref
	63	125	250	500	1000	2000	4000	8000				
Total Sound Power L_w	19.5	39.0	54.0	65.0	73.0	69.0	63.0	55.0	75	dB	73	1,6
Plant Room Reverberant L_p	15.6	35.2	50.2	61.2	69.2	65.2	59.2	51.2	72	dB	69	1,6
Façade Break-out Lw	16.6	30.4	40.4	42.4	45.4	33.4	25.4	20.4	47	dB	45	

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) (If Lp, assumes hemi-sherical radiation to convert to Lw +20*LOG(distance)+8)									Lw
			63	125	250	500	1k	2k	4k	8k	dB(A)	dB(A)
1	Pumproom		17	30	40	42	45	33	25	20	47	47

Reciever Distance (m)	Source height	Receiver height	Ground factor (source) 0-1	Ground factor (middle) 0-1	Ground factor (receiver) 0-1
4.0	0.0	2.0	0.0	0.0	0.0

dB(A)	Lp	No. off	dB
-23	24	1	0

Angular Directionality	63	125	250	500	1k	2k	4k	8k
None	0	0	0	0	0	0	0	0

Reflections (additional to ground, 1=3dB)	dB
1	3

Façade correction 3dB	dB
Yes	3

Losses (e.g. attenuator) Negative values								
63	125	250	500	1k	2k	4k	8k

Additional Attenuation (Negative values)							
63	125	250	500	1k	2k	4k	8k

Calculations carried out in accordance with ISO9613

Ground factor.
Hard ground = 0
Porous ground = 1
Mixed ground = Fraction of porous ground

Edge diffraction
Top edge = 1
Vertical edge = 2
No barrier = leave blank

All heights must be positive - set reference zero datum at ground plane

Top edge diffraction removes ground effects

Ref.	plant	Receiver Lp (excluding barrier)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	3	16	26	28	31	19	11	6	32
	Total	**3**	**16**	**26**	**28**	**31**	**19**	**11**	**6**	**32**

Edge diffraction	Barrier height	Source to barrier distance	Barrier to receiver distance
1	2.0	2.0	2.0

Barrier Path Difference Loss: Calculated path difference	63	125	250	500	1k	2k	4k	8k
0.36	-8	-7	-9	-11	-14	-17	-19	-20

Atmospheric conditions		63	125	250	500	1k	2k	4k	8k
T °C	RH %								
15	80	0	0	0	0	0	0	0	0

Ground effect							
63	125	250	500	1k	2k	4k	8k
3	3	3	3	3	3	3	3

Criteria								
NR	63	125	250	500	1k	2k	4k	8k	dB(A)
12	45	32	23	16	12	9	6	4	23

Barrier SRI	63	125	250	500	1k	2k	4k	8k	Rw
Manual									0
Typical 110mm brick wall	33	37	34	40	48	56	61	61	45

Ref.	Plant	Excess								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	-42	-16	3	12	19	10	5	2	10
	Total	-42	-16	3	12	19	10	5	2	10

Barrier Deration	63	125	250	500	1k	2k	4k	8k
Pumproom	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp (including barrier, if present)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
1	Pumproom	-5	6	14	14	14	-1	-11	-17	16
	Total	**-4**	**6**	**14**	**14**	**14**	**0**	**-7**	**-9**	**16**

Net barrier loss (including ground effect correction)	63	125	250	500	1k	2k	4k	8k
Pumproom	-9	-10	-12	-14	-17	-20	-22	-23

Appendix F: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

'A' Weighting
Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).
Airborne Noise
Noise transmitted through air.
Ambient Noise
The total noise level including all 'normally experienced' noise sources.
dB or Decibel
Literally meaning 'a tenth of a bel', the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

30 dB + 30 dB ≠ 60 dB	30 dB + 30 dB = 33 dB

$D_{nTw}+C_{tr}$	
The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.	
D	Is simply L1 – L2.
D_{nT}	Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.
D_{nTw}	Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.
C_{tr}	Is a correction factor applied to the D_{nTw} to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

Frequency (Hz)
Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.
Insertion Loss, dB
The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.
$L_{A90, T}$
The 'A' weighted noise level exceeded for 90% of the time period T, described or measured. The '90' can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.
$L_{Aeq, T}$
The 'A' weighted 'equivalent' noise level, or the average noise level over the time period T, described or measured.
L_{Amax}
The 'A' weighted maximum measured noise level. Can be measured with a 'slow' (1 sec) or 'fast' (0.125 sec) time weighting.
L_{Amin}
The 'A' weighted minimum measured noise level.

NR

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

Octave

The interval between a frequency in Hz (f) and either half or double that frequency (0.5f or 2f).

Pa

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

Reverberation Time, T_{mf}, RT60, RT30 or RT20

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time, T_{mf} which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

R_w

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

Sound Power Level

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to 10^{-12} W or 1pW.

Sound Pressure Level

A noise level measured or given at a distance from a source or a number of sources. Referenced to $2x10^{-5}$ Pa.

Subjective Effect of Changes in Sound Pressure Level

The table below details the subjective effects of variations in sound pressures (adapted from Bies and Hansen).

Difference between background noise and rating levels	Increase in ambient noise level in 'real terms'	Change in apparent loudness
+ 10 dB	+ 10 dB	Twice as loud
+ 5 dB	+ 6 dB	Clearly noticeable
0 dB	+ 3 dB	Just perceptible
-10 dB	0 dB	No change

W

Watts, the SI unit to describe power, after engineer James Watt.