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LONDON 4 HAYES, BEACONSFIELD ROAD

HAYES, MIDDLESEX

NOISE IMPACT ASSESSMENT

TECHNICAL REPORT: RFE-0351-24-05-03

DATE: MARCH 2024

PROJECT TITLE: LONDON 4 HAYES, BEACONSFIELD ROAD, HAYES, MIDDLESEX

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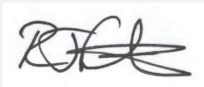
Approved By	Richard Fenton	Director		20/03/2024
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LONDON 4 HAYES, BEACONSFIELD ROAD, HAYES, MIDDLESEX
NOISE IMPACT ASSESSMENT

CONTENTS

1 EXECUTIVE SUMMARY

A noise impact assessment has been undertaken at the L4 Hayes development site on Beaconsfield Road, Hayes, within the London Borough of Hillingdon.

The assessment considered the noise impact on the nearest noise sensitive receptors, from the operation of the proposed back-up generators.

The existing sound environment has been established, which is considered representative of the development site and surrounding area, through unattended and attended sound monitoring.

Following the methodology set out in BS4142:2014+A1:2019, an assessment of the rating noise level for the back-up generators was undertaken.

The assessment has considered a worst-case scenario of all 44 no. generators operating simultaneously.

All generators will be housed within individual containers that will be acoustically treated to ensure the sound pressure levels at 1m do not exceed 80 dB.

The results indicate that during the planned testing periods, the calculated site Rating Levels at the closest noise sensitive receptors range between 6dB below and 4dB above the existing background sound level.

When considered in context, the risk of an adverse noise impact during the daytime period is low.

The criteria adopted for this assessment (based on the Local Planning Authorities noise criteria) of a rating level to be no more than 5 dB above the background sound level is met.

Therefore, no further mitigation measures, other than those already incorporated at design stage, are required.

2 INTRODUCTION

RF Environmental Ltd (RFE) was commissioned by Black and White Engineering Limited in December 2023 to provide an acoustic report to accompany an application for an Environmental Permit from the Environmental Agency (EA) for a Data Centre, located in the Brook Industrial Estate on Beaconsfield Road, Hayes, within the London Borough of Hillingdon.

Sound surveys comprised unattended and attended baseline sound measurements of the existing ambient acoustic environment. The results of these surveys have been used to assess the sound levels from the proposed diesel generators at the premises in accordance with the principles of British Standard (BS) 4142:2014+A1:2019.

The site and details of the proposed generator plant are described in the following section of this report. Legislation and criteria used for the assessment are included within Section 4. Details of the sound surveys are presented in Section 5, whilst the sound assessment of the generator plant is addressed in Section 6. Finally, the conclusions of this study are summarised in Section 7. Figures and Tables referred to in the report are presented in Appendix A and B, respectively. A description of useful acoustic terms can be found in Appendix C.

The baseline sound measurements were obtained by Jamie Pearson (MIOA) who also undertook the calculations and authored the report. Richard Fenton (MIOA) checked the calculations and reviewed the report.

Jamie and Richard are qualified and experienced in the production of noise impact assessments and have produced a significant number of noise assessments in consultancy and local authority roles.

3 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

3.1 Site Description

The site is located off Beaconsfield Road, Hayes, in the London Borough of Hillingdon.

A plan of the site and immediate area is presented in Figure A1 of Appendix A.

The eastern part of the site is occupied by a Data Centre, a co-location facility operated by Optimum Data Centres. The data centre itself was constructed in the 1980s as a warehouse with an element of office space constructed subsequently, before planning permission was granted in 2001 for the change of use to a data centre. It comprises a two-storey warehouse unit with connected two story brick built office extension to the south and plant equipment located across and adjacent to the two buildings.

To the west of the Data Centre (and forming the central element of the site) are the Tudor Works, a terrace of 16 industrial units with two storey office extensions on both the northern and southern ends. The units are occupied for a range of storage and manufacturing operations.

To the west of the Tudor Works (and forming the very western part of the site) is the Veetec Motor Group facility which comprises a three-storey office building at the front of the site, an open yard used for car storage to its rear, and an industrial unit to the rear. The site is used for the receipt, repair, storage, and maintenance of vehicles.

The proposed site sits as part of Springfield Road Industrial Area, a wider commercial area bound to the north by Uxbridge Road, the west by Springfield Road, to the east by the Yeading Brook, and to the south by Beaconsfield Road. The area comprises of a mix of commercial operations with a number of retail developments and a hotel located predominantly in the northern part closer to Uxbridge Road and industrial, storage, and manufacturing operations across much of the central and southern areas.

The north of the site is bound by Brook Industrial Estate and a larger single let distribution warehouse. Brook Industrial Estate is immediately north of the Optimum Data Centre with the single occupier unit to the north of Tudor Works and the Veetec Motor Group facility. Uses further north are also commercial and industrial in nature up until the retail uses on the southern side of Uxbridge Road.

The eastern boundary of the site is formed by Yeading Brook (with vegetation on both sides of its bank) which is a narrow watercourse that runs north-south through the wider Springfield Road site. Further commercial premises are located immediately to the east of Yeading Brook, beyond which is the Great Union Canal. On the eastern side of the Grand Union Canal is housing, the Blair Peach Primary School, and public allotments.

To the west of the site are further industrial and commercial properties. The unit immediately west of the Veetec Motor Group facility is a facility occupied by Express Reinforcements for the precision manufacturing and sale of steel products.

Immediately south of the site on the southern side of Beaconsfield Road is Hayes and Yeading Football Club. Further east of Hayes and Yeading Football Club is the Guru Nanak Sikh Academy and associated playing fields. A portion of the playing fields benefits from planning permission for the erection of an associated primary school.

The closest residential receptors are located approximately 230m to the east on Cherry Avenue and Bankside, with new residential dwellings planned for development on land approximately 200m to the south-east.

The ambient sound climate in the immediate vicinity of the site is influenced by road traffic sound, pedestrian sound and sound from pupils in the playgrounds at the nearby schools.

3.2 Proposed Development

The proposals comprise redevelopment of the site to deliver data centre campus including:

- two data centre buildings;
- associated energy and electricity infrastructure, buildings, and plant;
- security gatehouse, systems and enclosures;
- works to the highway, car parking and cycle parking;
- hard and soft landscaping; and
- associated infrastructure, ancillary office use, and associated external works.

3.3 Proposed Plant

The external plant required as part of the development, will consist of:

- 24no. individual chiller units located in a louvre screened compound at roof level of the east building;
- 18no. individual chiller units located in a louvre screened compound at roof level of the west building;
- 6no. individual chiller units located in a louvre screened compound at third floor level of the west building; and
- 44no. back-up power generators located in semi enclosed louvred compounds (22 on each building).

For the purpose of the permit application, only the back-up power generators are covered by the regulations and only these are considered further in this assessment.

The supplier of the proposed generators is understood to be AVK. The scheme will consist of the following quantities and ratings at each floor:

- 1no. 2.4MW – Ground Floor Gantry;
- 4no. 2.4MW – Level 01 Gantry;
- 4no. 2.4MW – Level 02 Gantry;
- 4no. 2.4MW – Level 03 Gantry;
- 4no. 2.4MW – Level 04 Gantry; and
- 5no. 2.6MW – Level 05 (Roof) Gantry

It is understood that the above quantities and ratings is proposed for both building 1 and building 2.

The building 1 and 2 gantries, where the generators will be located, are shown in Figure A2 of Appendix A.

All generators will be housed within individual containers that will be acoustically treated to ensure the sound pressure levels at 1m do not exceed 80 dB.

The typical layout of the generators inside the containers is shown in Figure A3 of Appendix A.

Further details of the units are presented in Section 5.

3.4 Generator Test Protocol

The data centre will be powered by mains electricity and the back-up generators are only to be used in an emergency. However, there will be a requirement to operate a testing regime for the generators for maintenance and quality purposes.

It is anticipated that a full Testing Regime will be as follows:

- Black Building Test (parallel operation)
  The simulation of a mains failure to test. All generators for a maximum of 1 hour per month (maximum 12 hours per calendar year) to test its operational readiness in the "black building test".

- Function test operation 1 (solo operation) tested for a maximum of 2 hours per calendar year.

- Function test operation 2 (solo operation) tested for a maximum of 2 hours, three times per calendar year (a maximum of 6 hours in total per calendar year).

- Operation for carrying out emission measurements (solo operation)
  Each standby generator may be operated individually to carry out emission measurements.

In the solo operating states above, no more than one standby generator of the data centre may be operated, i.e. no parallel operation is permitted.

An example of the annual testing schedule is provided below in Table 3.1. This provides an indication of how the annual testing may occur.

Month	Parallel Test (1 hour/month)	Functional Test 1 (Max. 2 hour/year)	Functional Test 2 (Max. 2 hour, x3/year)
January	✓		
February	✓		✓ (2 hour)
March	✓		
April	✓	✓ (1 hour)	
May	✓		
June	✓		✓ (2 hour)
July	✓		
August	✓	✓ (1 hour)	
September	✓		
October	✓		✓ (2 hour)
November	✓		
December	✓		

TABLE 3.1: EXAMPLE OF ANNUAL TESTING REGIME FOR BACK-UP GENERATORS

Testing will only occur during daytime hours.

Based on information provided by Black & White Engineering Ltd, the estimated availability of the dual utility supply is ~99.99999%, meaning the generators would only be required for unplanned operation statistically for approximately ~3.1536 seconds per year.

As such, the unplanned operation of the generator is not considered part of the sites typical operations and has been scoped out of the assessment.

3.5 Noise Sensitive Receptors

The closest residential receptors to the proposed external generator plant are located on Cherry Avenue and at the newly proposed Gas Works development to the south-east of site. To understand how the sound from the sources propagate over distance, residential receptors located on Woodlands Road, beyond Cherry Avenue to the east of the development site, has also been considered. The assessment locations for these receptors have been labelled as R1 for the Gas Works Development, R2 for Cherry Avenue and R3 for Woodlands Road.

It is understood that three phases of the Southall Gas Works development have been permitted, the location of the R1 reflects what will be the closest element of the development to the application site.

The closest noise sensitive receptors are presented in Table 3.2 below and shown in Figure A1 of Appendix A.

The closest sensitive receptors also include local schools, which have been listed below for information, however, owing to restrictions introduced under planning consent for the development, the generator plant will not be tested within school hours, and therefore the school will not form part of the assessment.

Receptor I.D.	Address	Receptor Type	Approx. Distance from Centre of Site (m)	Direction from Site
R1	New Gas Works Development	Residential	220	SE
R2	Properties on Cherry Avenue	Residential	230	E
R3	Woodland Road	Residential	350	E
R4	Bankside	Residential	230	NE
R5	Blair Peach Primary School	School	180	E
R6	Guru Nank Sikh Academy	School	225	SW

TABLE 3.2: NOISE SENSITIVE RECEPTORS AND APPROXIMATE DISTANCES FROM SITE

4 ASSESSMENT CRITERIA

4.1 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (March 2010)[1], sets out the long-term vision of Government noise policy.

The vision of the NPSE is to 'Promote good health and a good quality of life through the effective management and control of noise within the context of Government policy on sustainable development.' This vision is supported by three key aims:

- avoid significant adverse impacts on health and quality of life;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life.

The NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise but does not apply to noise in the workplace (occupational noise).

The NPSE had adopted the following concepts, to help consider whether noise is likely to have 'significant adverse' or 'adverse' effects on health and quality of life:

NOEL – No Observed Effect Level

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

LOAEL – Lowest Observed Adverse Effect Level

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

SOAEL – Significant Observed Adverse Effect Level

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

However the NPSE goes on to state that:

'it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.'

[1] Department for Environment, Food and Rural Affairs (DEFRA). Noise Policy Statement for England (NPSE), 2010.

4.2 The Environmental Permitting (England and Wales) Regulations 2016

The new Environmental Permitting Regulations (England and Wales) Regulations (EPR) 2016 came into force in January 2017. These new Regulations revoke the 2007 and 2010 Regulations and amend some other Acts including the Control of Pollution Act 1974.

For data centres with a standby generating capacity of over 50Mw, a permit is required under the Industrial Emissions Directive (IED) and Environmental Permitting Regulations for 1.1A Combustion Activities 'Chapter II' sites aggregated to >50MWth input.

When considering the noise impact from the back-up generators, the methodology for assessing other industrial noise sources should be followed. The guidance document 'Noise and Vibration management: environmental permits' states that:

'The aim should be to achieve the underpinning of good practice, the prevention of creeping ambient noise levels, and the prevention of reasonable cause for annoyance to persons in the vicinity. The assessment of reasonable cause for annoyance is dependent on many factors including the type of noise, the time of day or night, the nature of the area, the existing noise climate and the contribution made by the noise source under consideration.'

The guidance document presents the required methodology for undertaking an appropriate sound assessment and states: *'you must use 'BS4142: Methods for rating and assessing industrial and commercial sound' to quantify the level of environmental noise impact from industrial processes.'*

4.3 British Standard BS4142:2014+A1:2019

Guidance on the rating and assessing of sound of an industrial and/or commercial nature is contained in British Standard (BS) 4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'[2]

The standard states that:

This standard is applicable to the determination of the following levels at outdoor locations

a) rating levels for sources of sound of an industrial and/or commercial nature; and

b) ambient, background and residual sound levels

for the purposes of:

1. *investigating complaints;*
2. *assessing sound from proposed, new, modified or additional source(s) of sound of an industrial nature and/or commercial nature; and*

[2] British Standard BS4142:2014: Methods for rating and assessing industrial and commercial sound.

3. *assessing sound at proposed new dwellings or premises used for residential purposes.*

The determination of noise amounting to a nuisance is beyond the scope of this British Standard.

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.

Typically, the greater the difference between rating level and background noise level, the greater the magnitude of the impact:

- a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- a difference of around +5 dB is likely to be an indication of an adverse impact depending on context; and
- the lower the rating level is relative to the measured background sound level, the less likely it is that the specific source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Certain acoustic features can increase the significance of the impact of a specific sound source. These features include tonality and impulsivity, as well as additional characteristics and intermittency of the sound.

Where appropriate, a rating penalty for sound based on a subjective assessment of its characteristics should be established. In other circumstances an objective appraisal of tonal and/or impulsive characteristics may be appropriate.

It is also stated in the Standard that *'where a new noise sensitive receptor is introduced and there is extant industrial and/or commercial sound, it ought to be recognized that the industrial and/or commercial sound forms a component of the acoustic environment. In such circumstances other guidance and criteria in addition to or alternative to this standard can also inform the appropriateness of both introducing a new noise sensitive receptor and the extent of required mitigation'.*

4.4 Local Authority Criteria

Planning permission for the development was granted on 25th November 2022. A total of 36 planning conditions were attached to the decision notice and included noise related planning conditions for the operation of the standby generators.

Conditions 24 and 25 of the decision notice, relating to the standby generators, are produced below.

<u>Condition 24</u>

"Prior to the operation of the development, or each development phase, full and final details of the standby generator plant and any associated noise control for the development, or each development phase, shall be submitted to and approved in writing by the Local Planning Authority. The plant shall be selected and installed so as to minimise sound externally to a practicable minimum, such that the daytime (07-23) and night-time (23-07) rating levels, determine in accordance with BS 4142 at 1 m from any residential premises, including those associated with the Gas Works development, are no more than 5 dB above the relevant background sound levels, to within a tolerance of 1 dB at night. Unless agreed otherwise, the background sound levels adopted should be 44 dB (day) and 41 dB (night)."

Condition 25

"Prior to operation of the development, or each development phase, a schedule for the testing of standby generators for the development, or each development phase, shall be submitted to and approved in writing by the Local Planning Authority. This shall confirm that testing during school hours and noise sensitive times of day does not occur."

It is understood that the testing of the standby generators will only be undertaken during daytime hours, however, the specific permitted testing hours are currently being agreed with the Local Authority.

4.5 Criteria Summary for the Noise Impact Assessment

Considering the standard and guideline criteria discussed above, the noise impact assessment at residential receivers is to be undertaken in accordance with BS 4142:2014+A1:2019 to achieve a rating level of no more than 5dB above the background sound levels.

As the generator testing is only planned for the daytime period, the assessment will only consider the daytime period. As instructed in planning Condition 24, the background sound levels adopted for the daytime period is 44 dB $L_{A90,T}$.

5 ENVIRONMENTAL SOUND SURVEY

5.1 Introduction

Baseline sound surveys were undertaken in April 2021 and January 2022 for the purpose of the planning noise impact assessment[3].

The results of the baseline sound survey were accepted by the London Borough of Hillingdon. As such, this assessment is deemed robust and appropriate for the purpose of the Permit assessment, and it replicated below for information.

5.2 Unattended Baseline Sound Survey

Unattended continuous monitoring of existing sound levels was undertaken at the monitoring location shown as LT1 on Figure A1 of Appendix A. The equipment used during the survey is presented in Table 5.1 below.

Manufacturer	Model No.	Description	Serial No.	Calibration Due Date[1]
Larson Davis	LxT	Sound Level Meter	0004968	April 2022
Larson Davis	CAL200	Calibrator	12981	April 2022

TABLE 5.1: SOUND MONITORING EQUIPMENT

Note: [1] Sound monitoring equipment was within laboratory calibration at the time of the survey.

The sound level meter was powered by dry cell batteries and stored inside a weatherproof security box.

Measurements were obtained using the 'F' time weighting and A-weighting frequency network. The equipment was calibrated before and after the survey to generate a calibration level of 114.0 dB at 1 kHz.

15-minute measurements of $L_{Amax,F}$, $L_{Aeq,15min}$, and $L_{A90,15min}$ sound levels were obtained at this monitoring location between 11:15hrs Tuesday 13th April 2021 and 12:00hrs Saturday 17th April 2021, with the microphone position set at a height of approximately 2.0 m above local ground level in free-field conditions. The monitoring position was chosen as it is considered representative of the closest residential properties to the site. The monitor was sited in a location where measured sound levels would not be directly influenced by plant sound on the existing site.

A photograph of the monitoring equipment can be seen below in Figure 4.1.

[3] London 4 Hayes, Beaconsfield Road, Hayes, Middlesex. Noise Impact Assessment. Technical Report: RFE-0351-21-03-09

FIGURE 4.1: PHOTOGRAPH SHOWING UNATTENDED MONITORING EQUIPMENT

5.3 Attended Sound Measurements

Supplementary attended short-term sound measurements were obtained on Tuesday 13th April 2021 and Wednesday 21st April 2021 at monitoring locations ST1, ST2 and ST3 as shown on Figure A1 of Appendix A, to understand the variation in sound levels at different noise sensitive receptors.

Further attended short-term sound measurements were obtained during a weekday night-time period between 23:00hrs and 03:10hrs on Tuesday 5th January 2022 at monitoring locations labelled on Figure A1 of Appendix A as ST2, ST4, ST5 and ST6.

All sound measurements were made in free-field conditions. The microphone was approximately 1.5 m above local ground. The sound level meter was configured to measure A-weighted sound indices, which included $L_{Amax,F}$, $L_{Aeq,T}$ and $L_{A90,T}$ levels. The equipment used during the survey's is presented in Table 5.2 below.

Manufacturer	Survey Date	Model No.	Description	Serial No.	Calibration Due Date[1]
Rion	13/04/21 and 21/04/21	NL-32	Sound Level Meter	0861874	March 2022
Larson Davis	13/04/21 and 21/04/21	CAL200	Calibrator	12981	April 2022
Norsonic	05/01/22	140	Sound Level Meter	0004968	December 2024
Norsonic	05/01/22	1251	Calibrator	0034540	December 2022

TABLE 5.2: SOUND MONITORING EQUIPMENT

Note: [1] Sound monitoring equipment was within laboratory calibration at the time of the survey.

5.4 Weather Conditions

Weather conditions during the site visits are presented below in Table 5.3.

Site Visit	Date and Time	Noted Weather
Setup/attended	13/04/21 10:00am	Sunny, no rain, 14 °, average windspeed <1m/s
Collection/attended	21/04/21 08:30am	Sunny, no rain, 15°, average windspeed <1m/s
Attended	05/01/22 23:00pm	Clear and calm, air temperatures ranged between -2 to 1°, average windspeed <0.5m/s

TABLE 5.3: WEATHER CONDITIONS DURING SITE VISITS

A history of the weather conditions during the continuous survey period has been obtained from an internet source (Hammersmith IHAYES7 www.wunderground.com). Analysis of the data shows steady, settled weather with no incidents of rain during the survey. The weather conditions obtained for the survey period are summarised in Figure A4 of Appendix A.

5.5 Continuous Sound Survey Results

The results of the unattended sound measurement survey are presented graphically in Figure A5 of Appendix A, tabulated in Table B1 of Appendix B, and summarised overleaf in Table 5.4. A period of spurious data was noted during the night-time period on Tuesday 13th April and is highlighted in Table 5.4.

Date	Measured Sound Levels, dB					
	Daytime (07:00 - 23:00)			Night-time (23:00 - 07:00)		
	$L_{Amax,F}$	$L_{Aeq,16hr}$	$L_{A90,16hr}$	$L_{Amax,F}$	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Tues 13/04/21[1]	66(57-79)	52	47	67(56-95)	57	48
Wed 14/04/21	69(51-82)	51	44	60(47-86)	52	42
Thurs 15/04/21	67(54-83)	50	44	59(45-76)	51	43
Fri 16/04/21	68(54-79)	51	44	60(46-79)	50	43
Sat 17/04/2021[2]	71(62-91)	52	42	-	-	-
Average	***68(66-71)***	***51***	***44***	***62(59-67)***	***53***	***44***
Average (Spurious Data Excluded)	***68(66-71)***	***51***	***44***	***60(59-60)***	***51***	***43***

TABLE 5.4: SUMMARY OF UNATTENDED SOUND MEASUREMENTS AT LT1

Notes:
[1] incomplete daytime period due to equipment setup;
[2]incomplete daytime period due to depleted battery; and
- Grey highlight indicates periods of spurious data.

The results of the unattended sound measurement show that ambient day time $L_{Aeq,16hr}$ sound levels produced an arithmetic average of 51 dB $L_{Aeq,16hr}$. During the night-time period, excluding periods of spurious data, ambient night-time $L_{Aeq, 8hr}$ sound levels produced an arithmetic average of 51dB $L_{Aeq, 8hr}$.

During the daytime period, an arithmetic average of the background sound levels produced a sound level of 44 dB $L_{A90,16hr}$. The night-time $L_{A90,8hr}$ sound levels, excluding periods of spurious data, produced an arithmetic average of 43 dB $L_{A90, 8hr}$.

5.6 Attended Sound Survey Results

The results of the daytime attended sound measurements obtained on Tuesday 13th April 2021 and Wednesday 21st April 2021 are summarised in Tables 5.5 and 5.6 below, respectively.

The results of the night-time attended sound measurements obtained on Tuesday 5th January 2022 are summarised overleaf in Table 5.7.

Monitoring Location	Date	Start Time (hh:mm)	Dur. (mins)	Measured Sound Levels, dB			Observations
				$L_{Amax,F}$	$L_{Aeq,T}$	$L_{A90,T}$	
ST1	13/04/2021	10:52	15	94.7	61.8	50.5	Outside Guru Nak Sikh School. Trolleys moving in/out of film studio. Generator on construction site. Car passes. Impact wrench on construction site
ST2		11:19	15	70.0	47.6	44.2	Near closest residential on Bankside. People walking past, talking. Distant road traffic.
ST3		11:37	15	67.7	49.2	43.9	On footpath adjacent to Blair Peach Primary School. Some sound from school playground.
ST3		12:08	15	73.3	51.4	45.0	Outside Blair Peach school. As above.
ST2		12:30	15	76.8	52.1	42.9	Outside residential at Bankside. People on barge talking. Lorry idling opposite, across the canal.

TABLE 5.5: SUMMARY OF SHORT-TERM DAYTIME ATTENDED SOUND SURVEY – TUESDAY 13TH APRIL 2021

Monitoring Location	Date	Start Time	Duration	Measured Sound Levels, dB			Observations
				$L_{Amax,F}$	$L_{Aeq,T}$	$L_{A90,T}$	
ST2	21/04/2021	12:41	00:15:00	62.2	48.5	45.7	Bankside. People walking on footpath.
ST3		13:01	00:15:00	80.8	59.3	48.3	Outside school. Pupils in playground. Dominant sound source.

TABLE 4.6: SUMMARY OF SHORT-TERM DAYTIME ATTENDED SOUND SURVEY – WEDNESDAY 21ST APRIL 2021

Monitoring Location	Date	Start Time (hh:mm)	Dur. (mins)	Measured Sound Levels, dB			Observations
				$L_{Amax,F}$	$L_{Aeq,T}$	$L_{A90,T}$	
ST4	05/01/2022	23:00	15	81.5	53.7	49.9	Canal side, adjacent to Gas Works Construction site. Continuous plant sound, noted to be an almost 'hissing' sound from the Gas Works Development site, dominated the $L_{A90,T}$ sound levels at this location during this period ~ 49 dB (A). Prior to the measurement, the consultant tried to investigate the source of the sound, but due to the construction site being closed during the night-time period, they were unable to identify the exact sound source but noted the source to be located towards the east of the construction site; Continuous road traffic sound from the A312 and A4020 also contributed to the $L_{A90,T}$ background sound levels at this location; distant aircraft rumble from Heathrow was observed for approximately 30 seconds during the period. This is likely to be due to a grounded aircraft due to no airborne aircrafts observed; there were 5 no. train passing at speed on the railway line to the south that influenced the ambient $L_{Aeq,T}$ sound levels ~ 57 dB (A) and last approximately 10 seconds per pass by; wildlife also contributed to the ambient $L_{Aeq,T}$ and $L_{Amax,F}$ sound levels.
ST2		23:20	15	69.1	48.7	46.2	Bankside. Plant sound was not audible at this location and the background sound was driven by road traffic mainly on the A4020 but also A312 ~45 dB $L_{A90,T}$; Wildlife throughout the period, aircraft rumble from Heathrow for approximately 20 seconds. As per the previous period, this is likely to be due to a grounded aircraft as no airborne aircraft was observed; 3 no. train passes to the south contributed to the ambient $L_{Aeq,T}$ sound levels; nearby door slams were also heard.
ST6		23:39	15	71.4	54.1	46.0	Woodlands Road. Distant road traffic on the A4020 was main sound source driving the background sound levels at this location, approximately 44 dB $L_{A90,T}$. Woodlands Road, and the surrounding roads, are one way streets and local vehicle passes (10 in total) were noted during this period; during periods of low residual sound, the plant sound observed to be present on the Gas Works site was just audible.

TABLE 5.7: SUMMARY OF SHORT-TERM NIGHT-TIME ATTENDED SOUND SURVEY – TUESDAY 5TH JANUARY 2022

Monitoring Location	Date	Start Time (hh:mm)	Dur. (mins)	Measured Sound Levels, dB			Observations
				$L_{Amax, F}$	$L_{Aeq,T}$	$L_{A90,T}$	
ST5	05/01/2022	00:04	15	62.9	46.8	45.1	Beaconsfield Road adjacent to Cherry Avenue. The plant sound from the Gas Works site is audible and contributes to the background sound $L_{A90, T}$; road traffic from the A312 is higher and continuous in this location and the road traffic on the A4020 also contributes ~44 dB; Local vehicle passes (4 in total) contributes to the ambient $L_{Aeq,T}$ sound levels; distant train is also heard ~ 47 dB (A).
ST4		00:22	15	74.4	49.7	46.6	The continuous sound from the Gas Works site is still audible at this location but is noted to be approximately 3 dB lower than the previous measurement resulting in the distant road traffic from the A312 and A4020 being more prominent; 2 no train passes lasting for approximately 10 seconds each ~ 47 dB; 1 no. engineering train pass at minute 9 for approximately 40 seconds 48 dB (A); Distant aircraft rumble noted at minute 10 for 2 minutes; Distant PA system audible, possibly from Southall Station; wildlife sound still present and contributing to the ambient sound.
ST2		00:50	15	64.6	47.1	44.6	Road traffic on the A4020 noted to be sightly lower during this measurement but still dominates the background sound; distant PA system and 1 no. train pass can be heard; wildlife also contributes.
ST6		01:09	15	74.4	54.5	42.4	Road traffic is noted to be lower due to less traffic on the A4020; A total of 6 car passes on Woodlands Road contributes to the ambient environment; sound from Gas works not audible.
ST5		01:25	15	62.8	46.2	43.6	Distant road traffic dominates background sound environment, however the traffic on the A4020 is noticeably lower during this period; Sound from plant on the Gas Works site is no longer audible; 1 no train pass in distance; 2no. local vehicle passes.

TABLE 5.7 (CTD): SUMMARY OF SHORT-TERM NIGHT-TIME ATTENDED SOUND SURVEY – TUESDAY 5TH JANUARY 2022

Monitoring Location	Date	Start Time (hh:mm)	Dur. (mins)	Measured Sound Levels, dB			Observations
				$L_{Amax,F}$	$L_{Aeq,T}$	$L_{A90,T}$	
ST4	05/01/2022	01:43	15	73.7	47.6	43.9	Plant sound from Gas Works site is much lower and just audible; Distant road traffic is now the dominating sound source contributing to the $L_{A90,T}$ sound levels which is noted to mainly be from the A312 ~ 43-44 dB; 1 no. train pass in period 47 dB $L_{Aeq,T}$; Nearby swans in canal influence $L_{Aeq,T}$ and $L_{Amax,F}$ sound levels.
ST2		02:03	15	62.9	46.1	43.1	Road traffic dropped off more during this measurement period but still dominates the background sound; 1 no. train pass heard is distance; wildlife.
ST6		02:21	15	70.0	50.7	43.1	Road traffic is noted to be lower due to less traffic on the A4020; 3 local car passes on Woodlands Road; nearby baby crying for 2 minutes of period; Sound from Gas Works not audible.
ST5		02:38	15	71.7	45.1	40.8	Distant road traffic dominates background; no local traffic passes noted in this period, Distant PA system audible for 5 seconds; Gas Works sound is not audible.
ST4		02:55	15	65.5	49.0	45.9	Gas Works sound is now very low and just audible; distant road traffic has increased and is still the sound source mainly influencing the background $L_{A90,T}$; Distant PA system audible; wildlife.

TABLE 5.7 (CTD): SUMMARY OF SHORT-TERM NIGHT-TIME ATTENDED SOUND SURVEY – TUESDAY 5TH JANUARY 2022

5.7 Derivation of Background Sound Assessment Levels

<u>Analysis of Measured Background Sound Level Data</u>

The results of the continuous unattended sound monitoring at LT1 provide an indication of the diurnal variation in sound levels in the vicinity of the site, while the short-term daytime attended sound measurements provide an indication of the variation in sound levels between the long-term position and attended monitoring locations.

Review of the time history of the continuous sound monitoring data presented in Figure A5 of Appendix A indicates that at times, background $L_{A90,15min}$ sound levels may have been influenced by fixed plant sound or other industrial or commercial sound in the surrounding area. These periods have therefore been removed from any further analysis and are highlighted in grey in Table B1 of Appendix B.

Modal statistical analysis of the background $L_{A90,T}$ sound levels, excluding periods of spurious data and the periods described above, is presented in Figure A6 of Appendix A for the daytime and night-time periods.

This statistical analysis indicates that the most commonly occurring $L_{A90,15min}$ sound levels during the daytime and night-time periods at the unattended monitoring location were 44 dB and 41 dB, respectively.

It should be noted that the background sound monitoring was undertaken during the ongoing COVID-19 pandemic. A reduced level of air and road traffic is expected during this period and the background sound levels may be lower as a result.

The additional attended night-time sound monitoring, undertaken on Tuesday 5th January 2022, produced mean average $L_{A90,15min}$ sound levels at ST4, ST2, ST6 and ST5 of 46.6 dB, 44.6 dB, 43.8 dB and 43.2 dB, respectively. These mean averages are at least c. 2 dB higher than the derived night-time $L_{A90,15min}$ sound level of 41 dB. Observations made during the attended sound survey identified that the difference in sound levels was due to the location of the unattended monitor being partially screened from the main sound sources i.e. local and distant road traffic, which influence the background sound levels.

Notwithstanding the outcome of the attended night-time sound monitoring, for assessment purposes, the derived sound level of 41dB has been used in this assessment as a worse-case scenario, however, a level of 43dB may be considered more representative.

It should also be noted that the derived daytime value of 44 dB $L_{A90, 15min}$ is also likely to be an under-estimate and should be considered a worse case value.

The calculation receptor locations (R) used for the assessment, along with the unattended and attended monitoring locations are displayed in Figure A1 of Appendix A.

It should also be noted that the Gas Works Development site (R1) is in an early phase of construction. This is a major development and its introduction may result in an increase in background sound levels at the identified noise sensitive receivers.

6 ASSESSMENT OF PLANT SOUND LEVELS

6.1 British Standard 4142 – Assessment of Commercial Sound Levels

The method for predicting the significance of noise of an industrial and/or commercial nature in accordance with the principles of BS 4142:2014+A1:2019 is based on a comparison of the rating level, defined as the specific sound level plus any adjustment for the characteristic features of the sound, with the background sound level, $L_{A90,T}$.

6.2 Derivation of Background Sound Levels

The $L_{A90,T}$ background sound level is the sound level exceeded for 90% of the time in the absence of any sound from the specific source of interest.

'Typical' background sound levels observed over the period of interest, as described in BS4142:2014+A1:2019, are usually established for assessing plant and activities of this kind, with BS4142 stating that 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 background sound levels derived for the assessment, as described in Section 5.7, are presented below in Table 6.1.

Receptor Reference	Address	Receptor Type	Background Sound Assessment Levels, dB $L_{A90,T}$	
			Daytime (07:00hrs to 23:00hrs)	Night-time (23:00hrs to 07:00hrs)
R1	New Gas Works Development	Residential	44	41
R2	Properties on Cherry Avenue	Residential		
R3	Woodland Road	Residential		
R4	Properties on Bankside	Residential		

TABLE 6.1: BACKGROUND SOUND ASSESSMENT LEVELS

6.3 Specific Sound Levels

The specific sound level is the level equivalent continuous A-weighted sound pressure level produced by the specific sound source(s) at the assessment location over a given time.

There will be a total of 22no. generators on each building (44 in total). The supplier of the proposed generators is understood to be AVK and consist of the following quantities and ratings at each floor:

- 1no. 2.4MW – Ground Floor Gantry;
- 4no. 2.4MW – Level 01 Gantry;
- 4no. 2.4MW – Level 02 Gantry;

- 4no. 2.4MW – Level 03 Gantry;
- 4no. 2.4MW – Level 04 Gantry; and
- 5no. 2.6MW – Level 05 (Roof) Gantry.

Black & White Engineering Ltd has indicated that all generators will be housed within containers and the containers will incorporate acoustic treatment to ensure that a sound pressure level 1m from the container does not exceed 80 dB.

It is understood that noise from the end of the exhaust flue will match the external container noise level at 1m i.e. the sound pressure level will not exceed 80 dBA.

An example of the sound pressure measurement test report, provided by Black & White Engineering Ltd for a typical unit, is displayed in Figure A7 of Appendix A. This measurement data has been used for in the sound model for predicting the generator sound levels at the closest noise sensitive receptors.

Details on the derivation of sound power levels for the generators provided in the following subsection.

The typical sound pressure levels for the generators, 1m from the containers, are set out below in Table 6.2.

Plant	Make/Model	Location	No.	Typical Individual SPL, dB (A) Daytime Operation
Generator	AVK	Ground -5th Floor – Building 1	22	79.4 [1]
Generator	AVK	Ground -5th Floor – Building 2	22	79.4 [1]
Generator	Exhaust Flue	Associated Exhaust Flue – 1m above roof level – Building 1	22	79.4
Generator	Exhaust Flue	Associated Exhaust Flue – 1m above roof level – Building 2	22	79.4

TABLE 6.2: SUMMARY OF EXTERNAL PLANT DATA

Notes:
[1] Based on the SPL at 1m for a typical generator within an acoustically treated container.

Sound Prediction Model

A computer-generated sound model of the site including all acoustically important surrounding land topography has been generated using SoundPLAN Essential 5.1. This proprietary software implements the sound propagation calculation specified in ISO 9613-2[4] as follows:

[4] ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation'.

$$L_{fT}(DW) = L_w + D_c - A$$

where

$L_{ft}(DW)$	=	equivalent continuous downwind octave-band sound pressure level at a receiver location
L_w	=	sound power level of the sound source
D_c	=	directivity correction
A	=	attenuation that occurs during propagation from the point sound source to the receiver. $A = A_{div} + A_{atm} + A_{gr} + A_{bar} + A_{misc}$
A_{div}	=	attenuation due to geometrical divergence
A_{atm}	=	attenuation due to atmospheric absorption
A_{gr}	=	attenuation due to the ground effect
A_{bar}	=	attenuation due to a barrier
A_{misc}	=	attenuation due to miscellaneous other effects

The following assumptions have been made for the sound modelling exercise:

- The containers housing the back-up generators (44 in total) are represented as area sources within the model and are based on the following dimensions:
    - 17m length;
    - 3.8m width; and
    - 3m height.

- A sound model of the generator container was modelled using the above dimensions. Area sources were then applied to each face of the container in the model. The area sources were then calibrated to the source-term SPL levels presented in Table 6.2 at multiple locations around the source, in free-field conditions, at the given reference distance of 1m, to derive representative sound power levels for each individual area source. This was advised to be the preferred approach of the Local Authority at planning stage;

- The derived sound power levels for each face of the container are summarised below in Table 6.3.

Plant Item	Plant Area	1/1 Octave Band Frequency, Sound Power Level dB L_w								L_{WA}, dB
		63	125	250	500	1 k	2 k	4 k	8 k	
Back-Up Generator	Top	107.9	99.6	85.0	73.4	73.3	80.8	88.5	99.5	99.3
	Front / Back	106.7	98.4	83.8	72.2	72.1	79.6	87.3	98.3	98.1
	Sides	102.1	93.8	79.2	67.6	67.5	75.0	82.7	93.6	93.4

TABLE 6.3: DERIVED SOUND POWER LEVELS FOR EACH CONTAINER FACE

- Following the calibration derivation of the sound power levels for the individual faces, the containers were then incorporated into the noise model. To incorporate all exposed elements of the containers in the model, separate models were created for each floor. The calculated receptor sound levels were then logarithmically summed to provide a cumulative specific sound level at each receptor;

- The number of generators per floor level, per building, is set out below:

  - 1no. 2.4MW – Ground Floor Gantry;
  - 4no. 2.4MW – Level 01 Gantry;
  - 4no. 2.4MW – Level 02 Gantry;
  - 4no. 2.4MW – Level 03 Gantry;
  - 4no. 2.4MW – Level 04 Gantry; and
  - 5no. 2.6MW – Level 05 (Roof) Gantry.

- It is assumed all 44 units will operate simultaneously under the parallel test requirements. (This will only occur once per month for up to one hour). It should be noted that it is understood that the testing will be split per building, depending on time scheduling, so 22 generators will run at any one time for the testing. As such, this assessment provides a worse case assessment;

- It is understood that noise from the end of the exhaust flue will match the external container noise level at 1m i.e. limited to 80 dBA;

- 44 no. point sources have been added to the model (fifth floor model only) to represent the 44 no. exhaust flues (1 for each generator) 1m above roof level, in the locations shown in Figure A2 of Appendix A;

- The spectrum presented in Figure A7 of Appendix A was used to derive a sound power level for an exhaust flue. The following equation was used to convert from sound pressure to sound power:

$$SWL = SPL + 20Log(1)+8$$

- The derived sound power levels for the exhaust flue is presented in Table 6.4 below.

Item	Plant	1/1 Octave Band Frequency, Sound Power Level dB L_w								L_{WA}, dB
		63	125	250	500	1 k	2 k	4 k	8 k	
Back-Up Generator	Exhaust Flues	70.1	71.9	64.8	58.6	61.7	70.4	77.8	70.1	86.5

TABLE 6.4: DERIVED SOUND POWER LEVELS FOR EXHAUST FLUE

- The above sound power levels were applied to all point sources representing the exhaust flues;
- the surrounding area included in the modelling exercise, such as buildings and other structures, have been based on Ordinance Survey mapping and site plans;
- ground absorption has been modelled as a mixture of hard and soft ground with the site modelled entirely as hard ground;
- topography of the surrounding area has been modelled as flat;
- sound levels calculated at the sensitive receptors are in free-field conditions. Floor heights of 2.4m has been assumed;
- residential property building heights have been calculated based on the observed number of floors;
- a receptor with an assumed 6 no. storeys, has been modelled at a location representative of the closest point on the new Gas Works residential development (R1);
- the maximum calculated floor is presented for each receptor for assessment purposes;
- receptor positions are located one metre from the centre of the façade in free-field conditions;
- the 2 no. site buildings have been modelled at a height of 34.8m; and
- Only buildings and features which may affect the sound propagation to the nearest residential receptors are modelled.

A screenshot of the computer noise model is presented below in Figure 5.1.

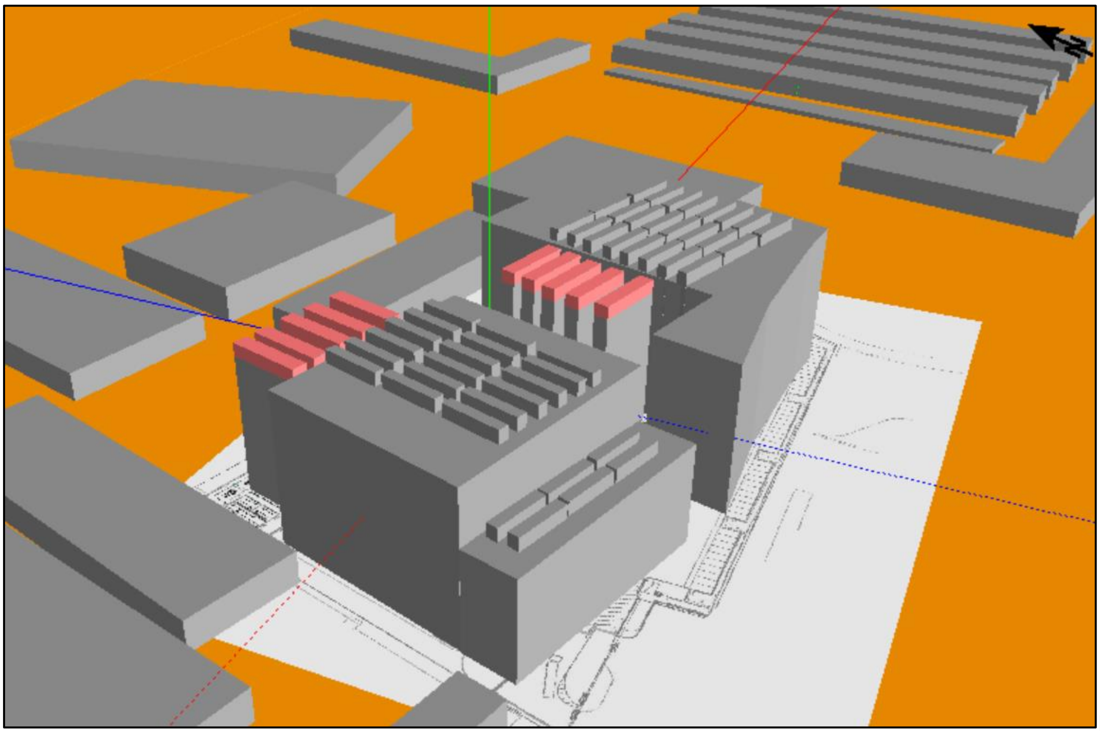


FIGURE 5.1: SCREENSHOT OF SOUND MODEL

As 6 no. separate models were utilised, it has not been possible to produce noise contours for all generators operating simultaneously from the development. However, noise contours for the generators operating on the fifth floor (10 generators in total) has been produced and is presented in Figure A8 of Appendix A.

6.4 Rating Level Assessment

Where appropriate, a rating penalty for sound based on a subjective assessment of its characteristics should be established and added to the specific sound level.

The generators are not considered to be impulsive, will not run intermittently and are unlikely to contain tones. To account for the risk that the generators may be readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied, as instructed by BS 4142:2014+A1:2019.

The rating level assessment is set out in Table 6.5 below.

Item	Nearest Noise Sensitive Receptors			
	R1	R2	R3	R4
Specific Sound Level (dB $L_{Aeq, Tr}$)	38	41	35	45
Rating Penalty (dB)	+3	+3	+3	+3
Rating Level (dB $L_{Ar, Tr}$)	41	44	38	48
Relevant Background Sound Level (dB $L_{A90, T}$)	44			
BS4142 Assessment Level	-3	0	-6	4

TABLE 6.5: ASSESSMENT OF BACK-UP GENERATOR RATING LEVELS

The results presented in Table 6.5 show that the rating levels at R1, R2 and R3 are calculated to be 3 dB below, equal to and 6dB below the existing background sound level at closest receptors, respectively. This could be an indication of low noise impact, depending on context, according to the criteria set out in BS4142: 2014+A1:2019.

At R4, the rating level is calculated to be 4 dB above the existing background sound level. This could be an indication of adverse noise impact, depending on context, according to the criteria set out in BS4142: 2014+A1:2019.

The adopted noise criteria for the assessment, of a rating level to be no more than 5 dB above the background sound level is achieved.

6.5 Context

When considering the significance of an impact, BS 4142 advises that the context of the impact should be taken into account. The context of the impact should consider factors such as: the absolute level of sound; the character and level of the residual sound compared to the character and level of the specific sound; 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.

An important contextual consideration is that the testing of all generators simultaneously, will only occur for up to 1-hour per month, during the daytime period, outside of school hours. This noise generating activity is limited in duration and frequency and in this context, will not lead to adverse noise impact.

The testing operations which involve only single generators (functional test) will produce noise levels which fall significantly below the background sound level and will not therefore lead to adverse noise impact.

Furthermore, the previous use of the building at the site was also a data centre, and the site is positioned on the edge of an operating industrial estate. The presence of sound sources of this nature is not therefore new to the area and are less likely to lead to adverse effect at the surrounding receptors.

Average measured $L_{Aeq,15min}$ sound level during the unattended daytime baseline sound monitoring at LT1 was 51 dB. The highest specific sound level from the generators, of 45 dB falls 6 dB below the average measured $L_{Aeq,15min}$ sound levels.

Assuming a 13 dB reduction for an open window, the highest calculated specific sound level of 45 dB would fall 3 dB below the desirable internal guideline level of 35 dB set out in BS8233:2014: *Guidance on sound insulation and noise reduction for buildings*[5] for daytime resting.

[5] BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings'

It is important to note that this internal guideline level is based on continuous noise over a 16hr daytime period. These results are based on a worst-case scenario which assumes continuous use of the generators. As the generators will only run for up to an hour during the daytime, once a month, the resulting daytime 16hr noise level would be even lower.

When considered in context, the risk of an adverse noise impact during the daytime testing of the back-up generators is low.

6.6 Uncertainty

There are a variety of factors that inevitably limit the accuracy associated with all steps of any noise assessment, including measurement, calculation or prediction. Factors include, but are not limited to:

- the background sound monitoring was undertaken during the ongoing COVID-19 pandemic. A reduced level of air and road traffic was expected during this period and the background sound levels may have been lower as a result. The derived daytime adopted background sound assessment level are considered to be worse case assessment levels and representative $L_{A90,T}$ levels could higher;
- The assessment scenario is based on all generators operating simultaneously. It is understood that this is only likely to occur once per month for up to one hour and the assessment is therefore considered to be of a worse case daytime operation; and
- The outdoor propagation calculations are based on ISO 9613-2 1996. This states that calculations are made with attention restricted to downwind conditions of propagation. Other limitations include other meteorological and non-material limitations such as winds speeds being limited between 1-5 ms^{-1} . It is also noted in ISO 9613-2 1996 that the estimated errors for octave-band sound pressure levels, calculated under the same conditions as the broadband calculation, may be somewhat larger than the errors for A-weighted broadband sources. Between 0-100 m and 100-1000 m the estimated accuracy is displayed in Table 6.6.

Height	Distance	
	0 < d < 100m	100m < d < 1000m
0 < h < 5m	+/-3 dB	+/-3 dB
5m < h < 30m	+/-1 dB	+/-3 dB

TABLE 6.6: ESTIMATIONS OF UNCERTAINTY IN ISO 9613-2

Notes: h – mean height of source and receiver;
d – distance between source and receiver; and
estimates made from situations where there are no effects due to reflection or attenuation due to screening.

- the positioning of sound sources in the sound model is based on information provided by the client;

- The inherent limitation of calculation/prediction methodology in Standards and guidance;

- The accuracy of sound source input data of a calculation or noise model.

It is imperative to minimise the uncertainty to a level commensurate with the intention of the assessment objective. Measures taken in this assessment to minimise uncertainty are:

- Sound level measurements were undertaken in accordance with recognised Standards. Measured sound data has been discounted where adverse weather may have influenced the noise dataset;

- Field calibration checks were undertaken prior and after measurements to record acceptable drift;

- The sound source data is deemed to provide a representative measure of the proposed plant; and

- Recognised sound prediction calculations have been used to calculate sound levels at sensitive locations and any assumptions have been stated.

7 CONCLUSIONS

A noise impact assessment has been undertaken at the L4 Hayes development site on Beaconsfield Road, Hayes, within the London Borough of Hillingdon.

The assessment considered the noise impact on the nearest noise sensitive receptors, from the operation of the proposed back-up generators.

The existing sound environment has been established, which is considered representative of the development site and surrounding area, through unattended and attended sound monitoring.

Following the methodology set out in BS4142:2014+A1:2019, an assessment of the rating noise level for the back-up generators was undertaken.

The assessment has considered a worst-case scenario of all 44 no. generators operating simultaneously.

All generators will be housed within individual containers that will be acoustically treated to ensure the sound pressure levels at 1m do not exceed 80 dB.

The results indicate that during the daytime hours, the calculated site Rating levels at the closest noise sensitive receptors range between 6dB below and 4dB above the existing background sound level.

When considered in context, the risk of an adverse noise impact during the daytime period is low.

The criteria adopted for this assessment (based on the Local Planning Authorities noise criteria), of a rating level to be no more than 5 dB above the background sound level is met.

Therefore, no further mitigation measures, other than those already incorporated at design stage, are required.

APPENDIX A: FIGURES

FIGURE A1: PLAN SHOWING SITE LOCATION, SOUND MONITORING LOCATIONS AND CLOSEST NOISE SENSITIVE RECEPTORS

Mapping obtained from google maps

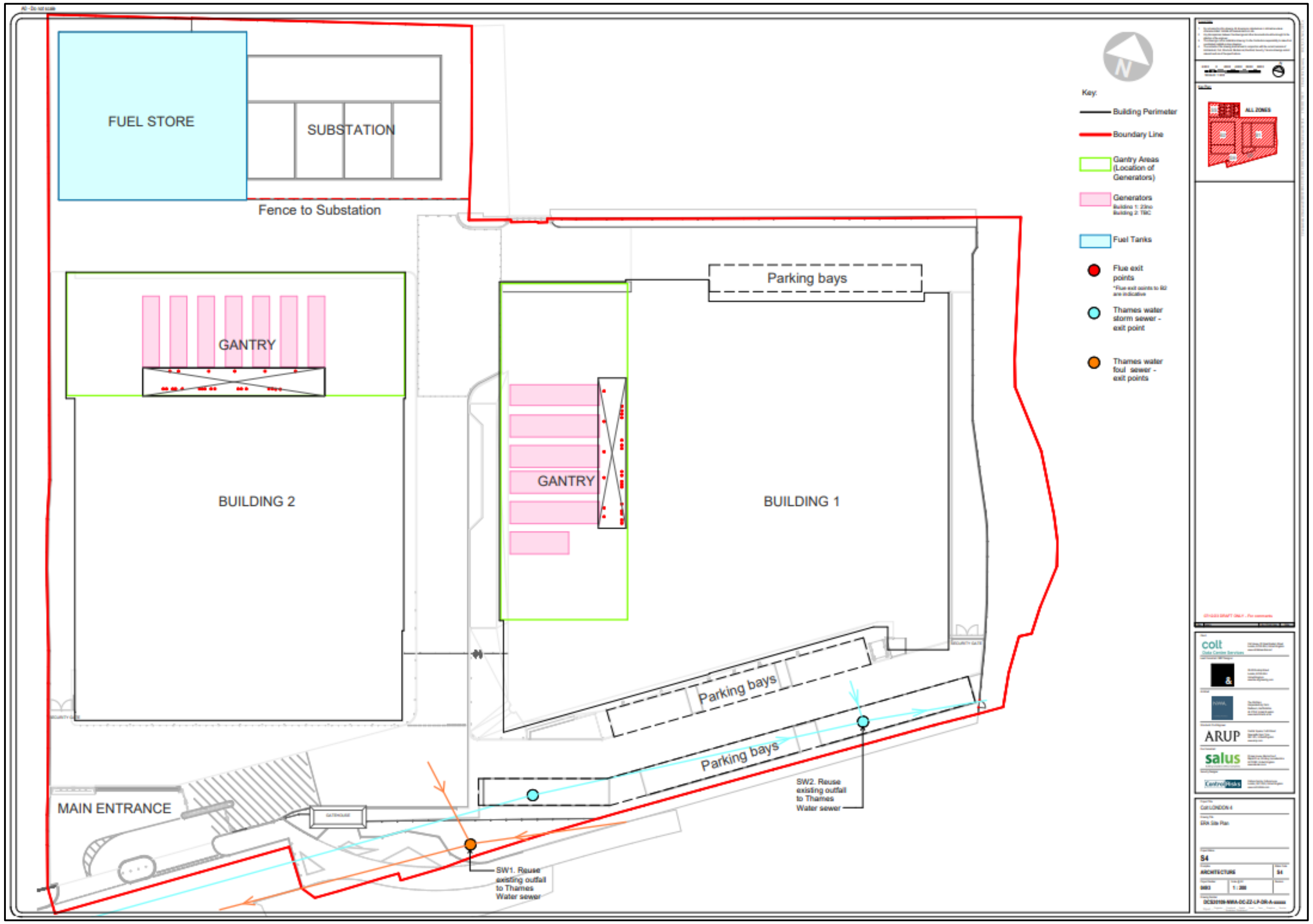


FIGURE A2: PLAN SHOWING LOCATION OF BUILDING 1 AND BUILDING 2 GANTRY LOCATIONS, WHERE GENERATORS ARE LOCATED

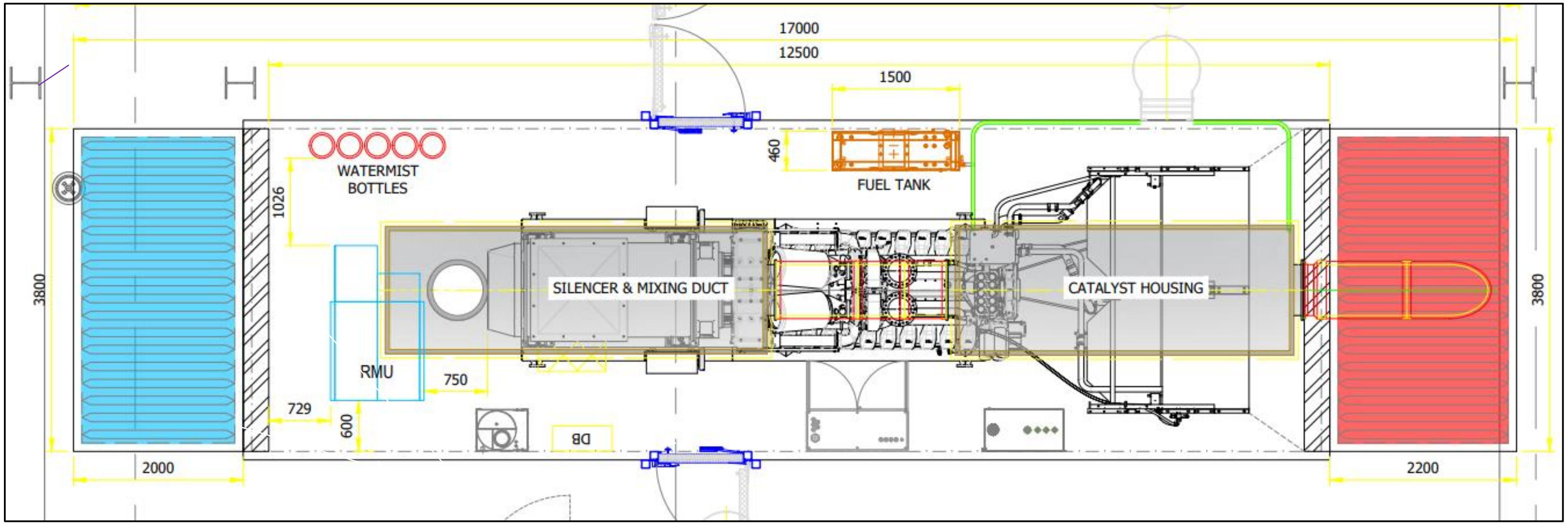


FIGURE A3: TYPICAL LAYOUT OF GENERATOR INSIDE CONTAINERS

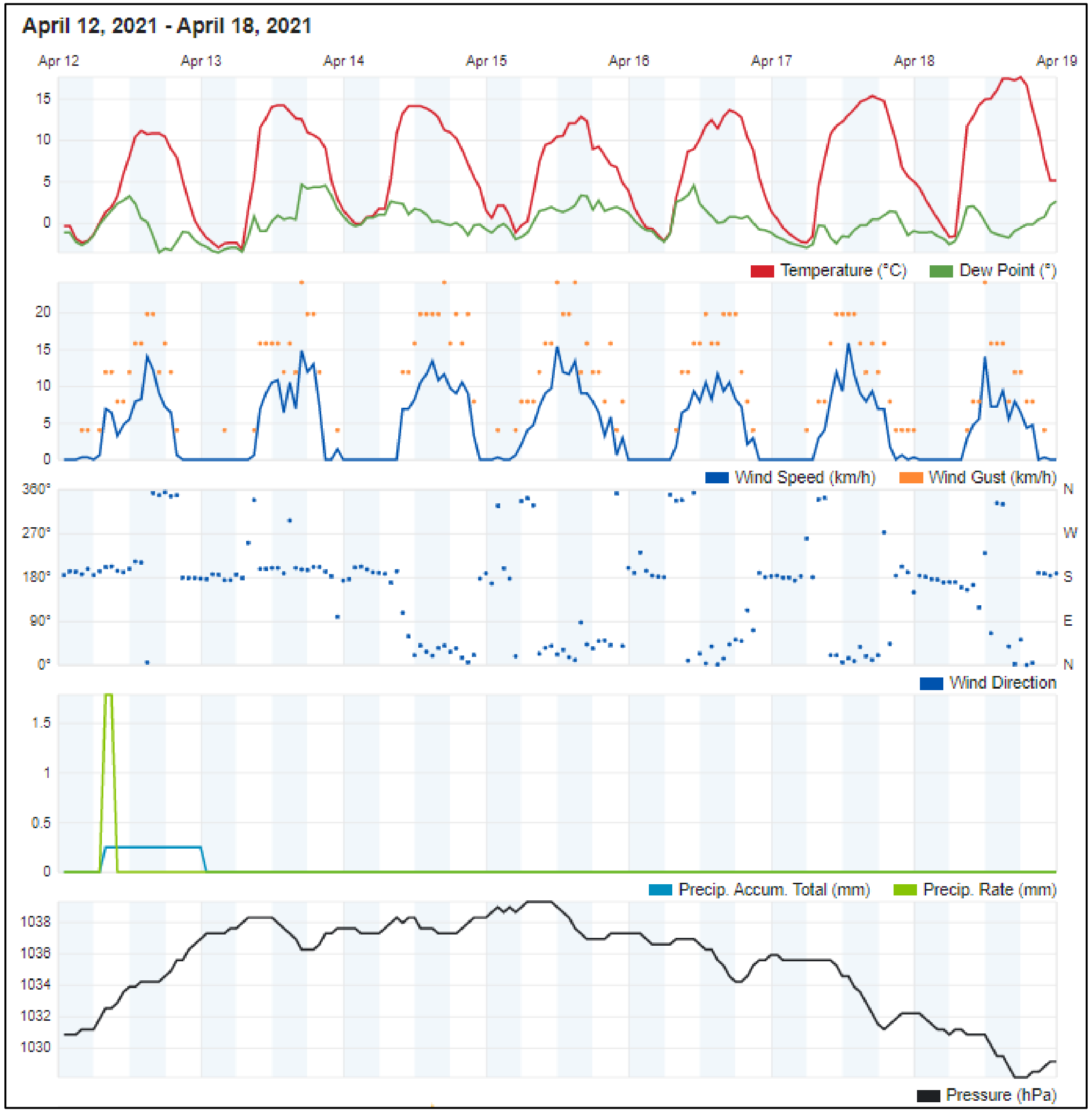


FIGURE A4: SUMMARY OF WEATHER DATA DURING UNATTENDED SOUND MONITORING PERIOD

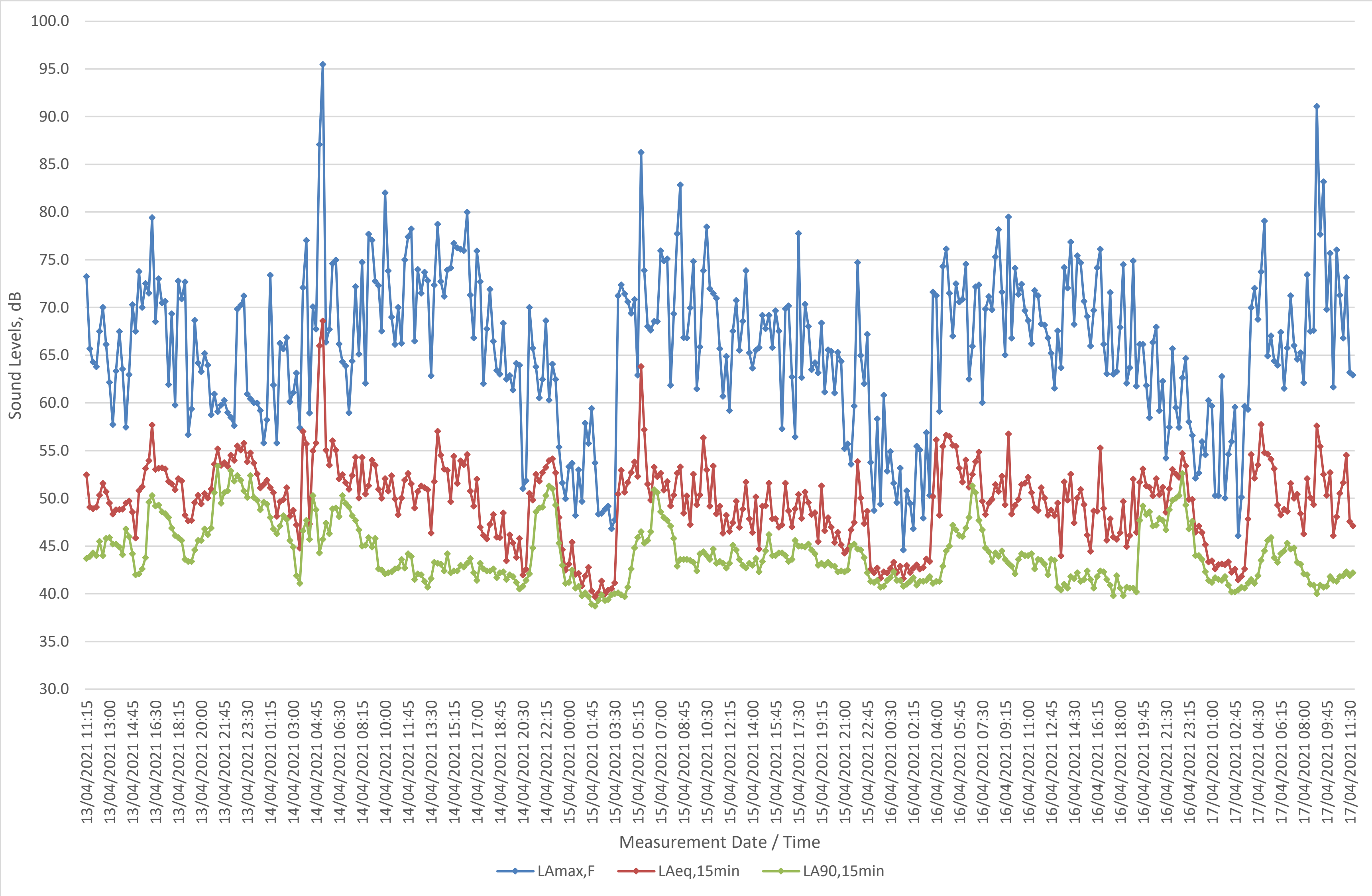


FIGURE A5: TIME HISTORY OF CONTINUOUS SOUND MONITORING DATA, LT1,

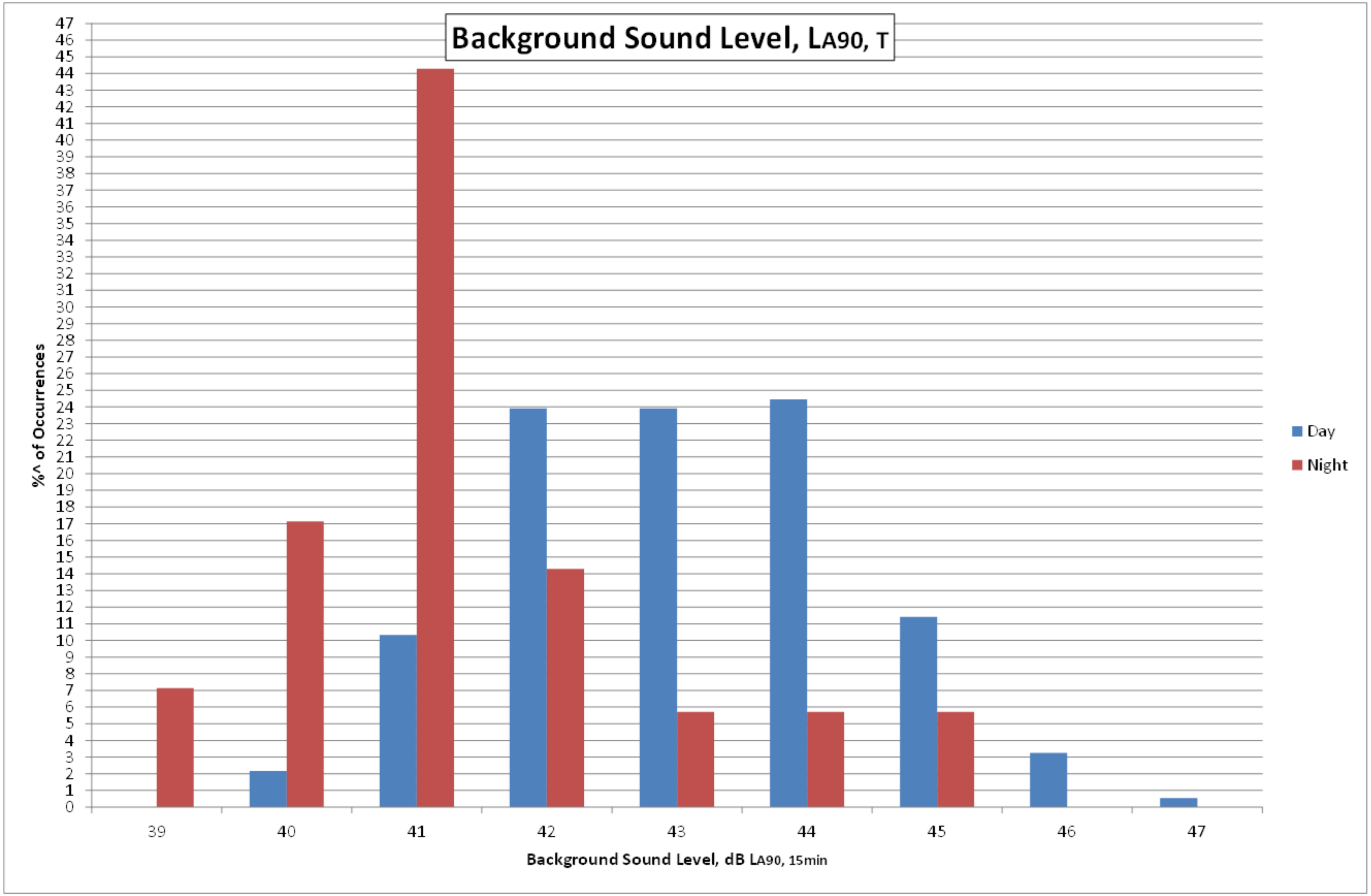


FIGURE A6: DERIVATION OF BACKGROUND NOISE LEVELS

mtu	**12V 4000 G63/G84F** AIRBORNE NOISE ANALYSIS **1750 kW / 1500 rpm**	TWE Hopt Drawing No.: 733 669e Date: 20.03.2018

Engine Surface Noise Analysis - 1/3-Octave

ENGINE TYPE:	**12V 4000 G63/G84F**	ENGINE NO.:	V42.3
POWER / SPEED:	**1750 kW / 1500 rpm**	TEST CELL:	128
ORDER / PROJECT NO.:		DATE MEASURED:	28.02.2006

TURBOCHARGER: 4 x GT50
INTAKE AIR OPENING: Paper filters without housing

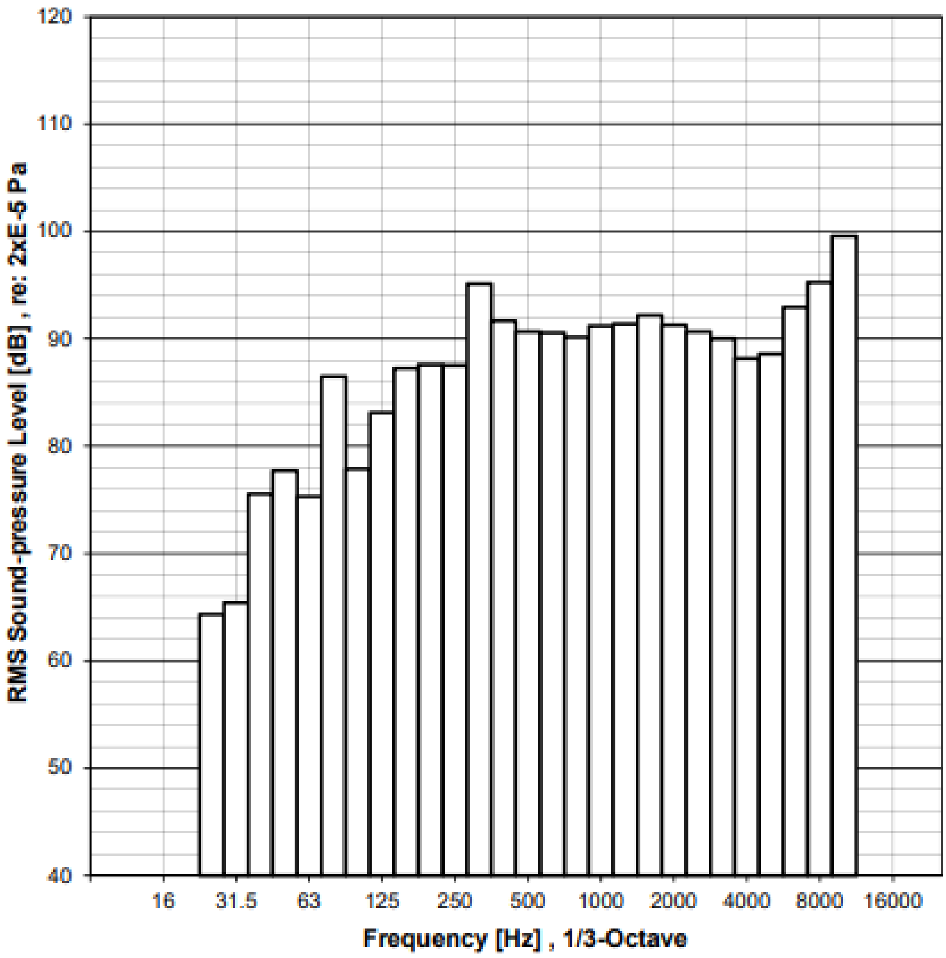
MEASURING DISTANCE: 1 m
MEASURING SURFACE DIMENSION: 18.3 dB
NO. OF MEASURING POINTS: 12
SOUND PROPAGATION: Free-Field
MEASUREMENT STANDARD: ISO 6798
TOLERANCE: +5 dB for single 1/3-octave band, +2 dB(A) for total A-weighted level.

Energy mean free-field levels of the airbome noise that is emitted by the engine surface.
For project purposes only.

Energy mean free-field levels, 1750kW @ 1500rpm (be-opt) Total: L =105.3 dB LA =103.9 dB(A)

f [Hz]	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
LpF [dB				64.3	65.4	75.5	77.7	75.3	86.5	77.9	83.1	87.3	87.6	87.5	95.1	91.7	90.7

f [Hz]	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
LpF [dB	90.6	90.1	91.2	91.4	92.2	91.3	90.7	90.0	88.2	88.6	92.9	95.3	99.6			



G:\Twe\Twes\HT\Beim\Diesel\TVU_Vorlage.xls

FIGURE A7: REFERENCE MEASURED SOUND PRESSURE LEVELS FOR GENERATORS

Heber GmbH
Rotthalmünster / Weihmörting

Heber Lüftungsgeräte Klimageräte

Schallleistungswerte im Luftstrom am Stutzen

Firma:	0		Datum:	09.08.2021
Angebotsnummer:	0			
Bauvorhaben:	0		Position:	1

Anordnung	**Inlet Attenuation**	Bemerkung:
Luftmenge [m3/h]	128,160	

Frequenz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Ventilator	95,3	97	104,4	103,8	103,7	104,2	101,8	109,6
Schalldämpfer	7	17	39	50	50	43	33	30
A-Bewertung	-26	-16	-9	-3	0	1	1	-1
Zwischensumme	62	64	56	51	54	62	70	79

Summenpegel **79** [dB(A)]

Anordnung	**Outlet Attenuator**	Bemerkung:
Luftmenge [m3/h]	120600	

Frequenz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Ventilator	95,3	97	104,4	103,8	103,7	104,2	101,8	109,6
Schalldämpfer	13	19	42	50	50	50	41	30
A-Bewertung	-26	-16	-9	-3	0	1	1	-1
Zwischensumme	56	62	53	51	54	55	62	79

Summenpegel **79** [dB(A)]

FIGURE A7 (CTD.): REFERENCE MEASURED SOUND PRESSURE LEVELS FOR GENERATORS

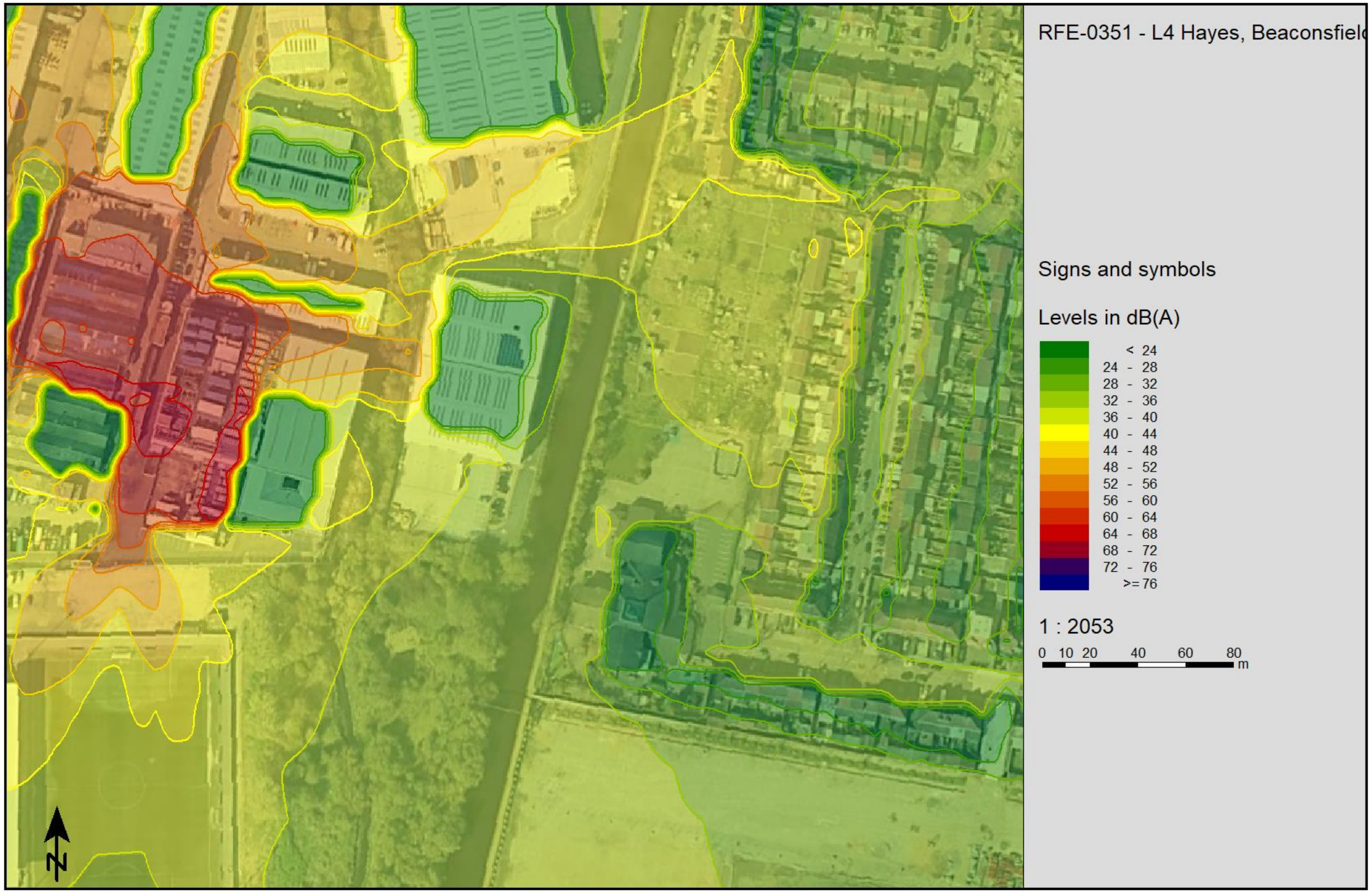


FIGURE A8: NOISE CONTOUR PLOT OF FIFTH FLOOR GENERATORS

Note: Contours calculated 1.5m above terrain at 5m grid distances

APPENDIX B: TABLES

Date of Meas.	Start Time	Measured Sound Levels, dB		
		$L_{Amax,F}$	$L_{Aeq,15min}$	$L_{A90,15min}$
Tuesday 13th April 2021	11:15	73.2	52.5	43.7
	11:30	65.7	49.1	43.9
	11:45	64.3	48.9	44.3
	12:00	63.8	49.1	44.0
	12:15	67.5	50.4	45.5
	12:30	70.0	51.6	44.0
	12:45	66.1	50.7	45.8
	13:00	62.2	49.5	45.9
	13:15	57.7	48.4	45.2
	13:30	63.4	48.8	45.2
	13:45	67.5	48.8	44.9
	14:00	63.5	48.9	44.1
	14:15	57.5	49.5	46.8
	14:30	63.0	49.7	46.0
	14:45	70.3	48.6	44.2
	15:00	67.5	45.9	42.0
	15:15	73.8	50.8	42.1
	15:30	70.0	51.2	42.6
	15:45	72.5	53.1	43.8
	16:00	71.5	54.0	49.6
	16:15	79.4	57.7	50.3
	16:30	68.5	53.0	49.2
	16:45	73.0	53.2	49.3
	17:00	70.5	53.2	48.6
	17:15	70.6	53.1	48.4
	17:30	61.9	51.8	48.0
	17:45	69.4	51.5	46.9
	18:00	59.8	50.9	46.1
	18:15	72.8	52.1	45.9
	18:30	70.9	51.8	45.6
	18:45	72.7	48.2	43.6
	19:00	56.7	47.6	43.4
	19:15	59.4	47.7	43.4
	19:30	68.7	49.6	44.6
	19:45	64.2	50.3	45.6
	20:00	63.3	49.4	45.6
	20:15	65.2	50.5	46.8
	20:30	64.0	50.0	46.2
	20:45	58.8	51.0	46.9
	21:00	60.9	53.6	50.6
	21:15	59.1	55.2	53.4
	21:30	59.8	53.5	49.5
	21:45	60.3	53.7	50.6

	22:00	59.0	53.4	50.8
	22:15	58.5	54.5	52.9
	22:30	57.6	54.0	51.8
	22:45	69.8	55.5	52.4
	23:00	70.3	55.1	51.9
	23:15	71.2	55.8	50.8
	23:30	60.9	53.8	50.1
	23:45	60.4	54.8	52.4
Wednesday 14th April 2021	00:00	60.0	53.7	50.1
	00:15	60.0	52.6	49.8
	00:30	59.2	51.1	48.8
	00:45	55.8	51.5	49.6
	01:00	58.2	51.9	49.4
	01:15	73.4	51.1	48.0
	01:30	61.9	50.6	46.8
	01:45	55.8	48.1	46.3
	02:00	66.3	49.7	47.1
	02:15	65.7	49.9	48.2
	02:30	66.8	51.1	47.8
	02:45	60.1	48.1	45.6
	03:00	61.1	48.8	44.9
	03:15	63.1	47.2	41.9
	03:30	57.4	44.8	41.1
	03:45	72.1	57.0	46.6
	04:00	77.0	55.7	47.7
	04:15	58.9	47.3	45.7
	04:30	70.1	55.0	50.3
	04:45	67.7	55.8	48.8
	05:00	87.1	66.0	44.3
	05:15	95.5	68.6	45.7
	05:30	66.4	55.1	47.4
	05:45	67.7	53.5	46.3
	06:00	74.6	56.0	48.9
	06:15	75.0	55.0	49.0
	06:30	66.2	52.0	48.1
	06:45	64.3	52.5	50.3
	07:00	63.9	51.6	49.5
	07:15	59.0	51.0	49.1
	07:30	64.4	52.4	48.2
	07:45	72.2	54.3	47.7
	08:00	65.1	50.0	46.7
	08:15	74.7	54.3	45.0
	08:30	62.1	50.5	45.1
	08:45	77.7	51.3	45.9
	09:00	77.1	54.0	44.9
	09:15	72.7	53.5	45.8
	09:30	72.3	51.0	42.6
	09:45	67.5	50.0	42.5

10:00	82.0	52.1	42.1
10:15	73.8	50.8	42.2
10:30	69.0	52.4	42.3
10:45	66.1	49.9	42.6
11:00	70.0	48.3	42.7
11:15	66.3	50.0	43.6
11:30	75.0	51.9	42.7
11:45	77.4	52.6	44.2
12:00	78.2	51.5	43.9
12:15	66.5	49.0	41.5
12:30	74.0	50.7	42.1
12:45	71.5	51.3	42.0
13:00	73.7	51.1	41.3
13:15	72.8	50.9	40.7
13:30	62.9	46.4	41.6
13:45	72.3	51.8	43.3
14:00	78.7	57.0	43.2
14:15	72.7	54.5	43.1
14:30	71.2	53.1	42.4
14:45	73.9	52.9	44.2
15:00	74.1	49.6	42.2
15:15	76.7	54.4	42.4
15:30	76.3	51.6	42.4
15:45	76.1	53.9	43.0
16:00	76.0	53.5	42.8
16:15	80.0	54.6	43.2
16:30	71.3	50.8	43.7
16:45	66.8	49.2	42.2
17:00	75.9	52.0	41.4
17:15	72.7	47.0	43.2
17:30	62.0	46.1	42.6
17:45	67.8	45.8	42.4
18:00	71.9	47.3	42.4
18:15	66.5	48.3	42.6
18:30	63.4	46.0	41.7
18:45	63.0	45.9	42.2
19:00	68.3	48.5	42.3
19:15	62.5	43.5	41.5
19:30	62.9	46.2	42.0
19:45	61.4	45.3	41.8
20:00	64.2	43.8	41.2
20:15	64.0	45.8	40.5
20:30	51.0	42.0	40.8
20:45	51.8	42.6	41.4
21:00	70.0	50.5	42.1
21:15	65.7	49.8	44.8
21:30	63.8	52.5	48.6
21:45	60.5	51.8	49.0

	22:00	62.5	52.7	49.1
	22:15	68.6	53.2	50.3
	22:30	60.3	54.0	51.3
	22:45	64.1	54.2	51.0
	23:00	62.5	52.7	49.3
	23:15	55.4	48.0	45.3
	23:30	51.6	44.6	43.0
	23:45	50.0	42.5	41.1
Thursday 15th April 2021	00:00	53.3	43.1	41.2
	00:15	53.7	45.4	42.5
	00:30	48.2	42.0	40.6
	00:45	53.0	42.1	40.8
	01:00	49.7	40.8	39.8
	01:15	57.9	41.8	40.1
	01:30	55.7	42.8	39.7
	01:45	59.4	40.3	38.9
	02:00	53.7	39.7	38.7
	02:15	48.3	40.1	39.3
	02:30	48.4	41.3	39.9
	02:45	48.9	40.0	39.3
	03:00	49.2	40.4	39.4
	03:15	46.8	40.5	39.9
	03:30	47.7	41.1	40.0
	03:45	71.2	50.5	40.1
	04:00	72.4	52.9	39.9
	04:15	71.4	50.7	39.7
	04:30	70.6	51.7	40.7
	04:45	69.4	52.7	42.6
	05:00	70.8	53.8	44.8
	05:15	62.9	52.3	45.9
	05:30	86.2	63.8	46.5
	05:45	73.9	57.2	45.3
	06:00	68.0	51.5	45.6
	06:15	67.6	49.8	46.5
	06:30	68.5	53.3	50.9
	06:45	68.5	52.3	50.6
	07:00	75.9	52.6	48.6
	07:15	74.9	50.9	48.0
	07:30	75.1	51.8	47.7
	07:45	61.9	49.2	47.1
	08:00	69.3	50.3	45.8
	08:15	77.7	52.6	42.9
	08:30	82.8	53.3	43.6
	08:45	66.8	48.4	43.6
	09:00	66.8	50.3	43.6
	09:15	70.0	47.3	43.5
	09:30	74.8	52.5	43.3
	09:45	61.5	49.3	42.4

	10:00	65.9	50.4	44.2
	10:15	73.9	56.3	44.4
	10:30	78.4	53.0	44.0
	10:45	72.0	49.2	43.6
	11:00	71.5	53.4	44.7
	11:15	71.0	48.4	43.2
	11:30	65.7	49.2	43.4
	11:45	60.7	46.3	43.2
	12:00	64.9	48.2	42.7
	12:15	59.2	46.5	43.2
	12:30	67.5	47.5	45.1
	12:45	70.7	49.7	44.6
	13:00	65.5	47.0	43.6
	13:15	68.6	48.9	43.0
	13:30	73.9	51.7	42.7
	13:45	65.3	47.8	43.2
	14:00	63.7	46.4	43.0
	14:15	65.5	50.2	43.7
	14:30	65.8	44.7	42.3
	14:45	69.2	49.2	43.4
	15:00	67.8	49.2	44.5
	15:15	69.2	51.6	46.2
	15:30	65.8	47.9	44.0
	15:45	69.6	47.9	44.0
	16:00	67.5	47.0	44.3
	16:15	57.3	47.2	44.3
	16:30	69.9	51.6	44.0
	16:45	70.2	48.7	43.4
	17:00	62.7	47.0	43.6
	17:15	56.4	48.9	45.6
	17:30	77.8	50.4	45.0
	17:45	62.7	47.9	45.0
	18:00	70.3	50.7	44.9
	18:15	68.0	49.6	45.2
	18:30	63.5	48.3	44.6
	18:45	64.2	48.5	44.2
	19:00	63.2	45.5	43.0
	19:15	68.4	51.3	43.2
	19:30	61.2	46.6	43.0
	19:45	65.6	48.0	43.3
	20:00	65.4	47.0	43.0
	20:15	61.1	45.4	42.9
	20:30	65.3	46.4	42.3
	20:45	64.4	45.1	42.4
	21:00	55.2	44.3	42.3
	21:15	55.7	44.7	42.5
	21:30	53.6	46.7	45.0
	21:45	59.7	47.5	45.2

	22:00	74.7	53.9	44.7
	22:15	65.0	50.0	44.6
	22:30	62.0	47.4	43.8
	22:45	67.2	48.7	42.2
	23:00	53.8	42.6	41.3
	23:15	48.7	42.2	41.2
	23:30	58.3	42.7	41.4
	23:45	49.4	41.6	40.7
Friday 16th April 2021	00:00	60.8	42.3	40.8
	00:15	52.9	42.2	41.4
	00:30	54.9	42.7	41.7
	00:45	51.6	43.3	42.3
	01:00	49.6	42.2	41.4
	01:15	53.2	42.9	41.4
	01:30	44.6	41.6	40.8
	01:45	50.8	43.0	41.0
	02:00	49.5	42.2	41.3
	02:15	46.8	42.7	41.7
	02:30	55.5	43.0	40.9
	02:45	55.1	42.6	41.3
	03:00	47.9	42.8	41.3
	03:15	56.9	43.7	41.4
	03:30	50.3	43.4	41.8
	03:45	71.6	50.2	41.1
	04:00	71.2	56.1	41.3
	04:15	59.1	48.2	41.3
	04:30	74.3	55.5	42.9
	04:45	76.1	56.6	44.5
	05:00	71.5	56.5	45.0
	05:15	67.0	55.6	47.2
	05:30	72.5	55.5	46.7
	05:45	70.6	53.2	46.1
	06:00	70.9	51.7	46.0
	06:15	74.5	54.0	46.9
	06:30	62.5	51.2	48.0
	06:45	65.9	52.5	51.3
	07:00	72.2	53.8	50.6
	07:15	72.4	54.9	47.7
	07:30	60.0	49.7	46.7
	07:45	69.8	48.3	44.8
	08:00	71.1	49.5	44.4
	08:15	69.8	49.9	43.4
	08:30	75.3	51.4	44.3
	08:45	78.2	50.7	43.9
	09:00	71.6	52.3	44.5
	09:15	65.0	49.3	43.6
	09:30	79.5	56.8	43.2
	09:45	66.8	48.4	42.9

10:00	74.1	49.3	42.1
10:15	71.4	49.9	43.6
10:30	72.4	51.5	44.2
10:45	69.7	51.6	44.0
11:00	68.6	52.2	44.0
11:15	66.2	50.6	44.2
11:30	71.8	49.0	42.6
11:45	71.2	48.7	43.6
12:00	68.3	51.1	43.5
12:15	68.2	50.0	43.1
12:30	66.8	48.2	42.0
12:45	65.2	48.8	43.6
13:00	61.5	48.2	43.5
13:15	67.6	49.5	40.7
13:30	63.7	44.0	40.4
13:45	74.2	51.7	41.0
14:00	72.1	49.8	40.6
14:15	76.9	52.5	41.8
14:30	68.2	47.4	41.6
14:45	75.4	50.0	42.2
15:00	74.7	50.9	41.3
15:15	70.7	49.3	41.5
15:30	69.1	46.2	42.4
15:45	66.0	44.5	41.5
16:00	69.7	48.7	40.6
16:15	74.2	48.7	41.8
16:30	76.1	55.3	42.4
16:45	66.2	48.9	42.3
17:00	63.1	45.6	41.5
17:15	71.6	47.9	40.9
17:30	63.0	46.0	39.8
17:45	63.3	45.7	41.9
18:00	67.9	46.4	40.6
18:15	74.5	49.7	39.8
18:30	62.1	44.9	40.7
18:45	63.7	46.1	40.6
19:00	74.9	52.0	40.6
19:15	61.8	46.4	40.2
19:30	66.1	51.7	47.7
19:45	66.1	53.1	49.2
20:00	61.8	51.3	48.3
20:15	58.5	51.2	48.6
20:30	66.4	50.3	47.1
20:45	68.0	52.1	47.2
21:00	59.2	50.4	47.9
21:15	62.3	51.2	47.7
21:30	54.2	48.6	46.7
21:45	57.5	51.0	48.8

	22:00	65.7	53.0	49.8
	22:15	59.5	52.6	50.0
	22:30	57.4	52.2	50.3
	22:45	62.6	54.7	52.6
	23:00	64.7	53.4	49.3
	23:15	58.0	49.9	46.8
	23:30	56.6	49.9	47.6
	23:45	52.1	46.5	44.0
Saturday 17th April 2021	00:00	52.7	47.1	44.0
	00:15	56.0	46.4	43.6
	00:30	54.6	45.1	42.3
	00:45	60.3	43.3	41.4
	01:00	59.7	43.5	41.2
	01:15	50.3	42.6	41.7
	01:30	50.3	43.1	41.5
	01:45	62.8	43.1	41.4
	02:00	50.0	43.1	41.8
	02:15	54.6	43.3	40.9
	02:30	55.9	42.3	40.2
	02:45	59.6	42.6	40.2
	03:00	46.1	41.5	40.4
	03:15	50.1	41.8	40.7
	03:30	59.7	42.6	40.6
	03:45	59.3	47.8	41.1
	04:00	70.0	54.6	41.5
	04:15	72.0	52.1	41.1
	04:30	68.8	53.5	41.9
	04:45	73.7	57.8	43.5
	05:00	79.1	54.8	44.5
	05:15	64.9	54.6	45.6
	05:30	67.0	54.1	45.9
	05:45	64.4	53.1	43.8
	06:00	64.0	49.3	43.3
	06:15	67.4	48.3	44.2
	06:30	61.5	48.9	44.5
	06:45	65.8	48.6	45.3
	07:00	71.3	51.6	44.7
	07:15	66.0	50.0	44.8
	07:30	64.6	50.4	43.3
	07:45	65.3	48.4	43.1
	08:00	62.1	46.3	42.1
	08:15	73.4	52.1	42.0
	08:30	67.5	50.1	41.0
	08:45	67.6	49.3	40.9
	09:00	91.1	57.6	40.0
	09:15	77.7	55.5	40.9
	09:30	83.2	52.5	40.7
	09:45	69.8	50.3	40.8

	10:00	75.7	52.7	41.8
	10:15	61.7	46.1	41.4
	10:30	76.0	48.1	41.3
	10:45	71.3	50.5	41.8
	11:00	66.8	51.6	41.9
	11:15	73.1	54.5	42.3
	11:30	63.2	47.6	41.9
	11:45	62.9	47.1	42.2

TABLE B1: UNATTENDED NOISE MONITORING DATA AT LT1

APPENDIX C: GLOSSARY

Noise

Noise is defined as unwanted sound. The range of audible sound is from 0 to 140 dB. The frequency response of the ear is usually taken to be around 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dBA weighting. This is an internationally accepted standard for noise measurements.

For variable sources, such as traffic, a difference of 3 dBA is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dBA. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/ decrease of 10 dBA corresponds to a doubling/ halving in perceived loudness. Noise is measured on a logarithmic scale in decibels (dB) because of the ears' sensitivity to a wide range of pressure changes. The sound pressure level (SPL) of a signal is denoted by the symbol Lp and defined by the equation Lp = 10 log (p/po)2 where p is the root mean square pressure of the signal and po is the reference sound pressure (2 x 10-5 Pa).

An indication of the range of sound pressure levels commonly found in the environment is given below:

Location	L_{pAdB}(A)
Normal threshold of hearing	-10 to 20
Music halls and theatres	20 to 30
Living rooms and offices	30 to 50
Inside motor vehicles	50 to 70
Industrial premises	70 to 100
Burglar alarms at 1 m	100 to 110
Jet aircraft on take-off	110 to 130
Threshold of pain	130 to 140

External noise levels are rarely steady, but rise and fall according to activities within an area. In attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

i) The L_{Amax} noise level

This is the maximum noise level recorded over the measurement period.

ii) The L_{Aeq} noise level

This is "equivalent continuous A-weighted sound pressure level, in decibels" and is defined in British Standard BS 7445 as the " value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time internal, T, has the same mean square sound pressure as a sound under consideration whose level varies with time".

It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.

iii) The L_{A10} noise level

This is the noise level that is exceeded for 10% of the measurement period and gives an indication of the noisier levels. It is a unit that has been used over many years for the measurement and assessment of road traffic noise.

iv) The L_{A90} noise level

This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during the quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.

Community response to environmental noise sources is dependent on both acoustic and non-acoustic factors. The acoustic factors include absolute noise level, changes or exceedances of background and ambient levels as well as the characteristics, time, duration and frequency of noise.