Ark Estates Spring Park Ltd

Spring Park Data Centre – Full Site, Corsham

Acoustic Technical Report

MLM. Group

Part of Sweco

© MLM Consulting Engineers Limited

Notice

This document and its contents have been prepared and intended solely for Ark Estates Spring Park Ltd information and use in relation to Spring Park Data Centre, Corsham and any other information.

MLM Consulting Engineers Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

Certifying Body

MLM are full members of the ANC:

Document History

Client: Ark Estates Spring Park Limited
Project: Spring Park Data Centre – Full Site, Corsham
Document Title: Acoustic Technical Report
Document Reference: 66200077-MLM-ZZ-XX-RP-YA-0002
MLM Reference: DP/66200077/MA

Revision	Status	Description	Author	Checked/Approved	Date
00	I	For Information	Mercedes Astrain	Victor R. Valeron	23/11/2020

© MLM Consulting Engineers Limited

Contents

1 Introduction 1

2 Assessment Methodology and Criteria 3

2.1 British Standard 4142:2014 3
2.2 British Standard 8233:2014 3
2.3 Noise Planning Conditions 4

3 Site and Development Description 6

3.1 Spring Park Data Centre Facilities 6
3.2 Site Operation 11
3.3 Nearest Noise-Sensitive Receptors (NNSRs) 12

4 Existing Conditions 14

4.1 Sound Survey Results 16

5 Sound Predictions and Assessment 18

5.1 Operational Scenarios 18
5.2 Sound Data Assumptions 18
5.3 Assessment of the Normal Operation 26
5.4 Assessment of Not Normal Operational Scenarios 28

6 Conclusion 39

Appendix A - Glossary of Acoustic Terminology

Appendix B - Full Sound Measurements Results

Appendix C - Noise Maps

© MLM Consulting Engineers Limited

1 Introduction

MLM Consulting Engineers has been commissioned by Ark Estates Spring Park Limited to undertake a noise assessment, in order to assess the impact of noise associated with full Data Centre site operations at Spring Park, Corsham, to support an Environmental Permit application for the extension of the current consented site.

The exercise is based on previous baseline sound survey and noise source measurements undertaken on site for previous Assessments, at SQ17, P1, P2, P3 and the HV Gen Farm, as reported in MLM document reference 102789-MLM-ZZ-XX-RP-YA-0001 dated 1 August 2019. Data provided by the plant design engineers and plant manufacturers have also been used for the assessment of the extension of SQ17 and the new building P5.

Document reference 102767-MLM-ZZ-XX-RP-U-0001 dated 01 April 2019 assessed the cumulative noise impact of the full site (including existing SQ17, P1, P2, P3 and P4), and the Environmental Permit was approved for the whole site, including P3 and P4 buildings (reference EPR/DP3731YL/A001).

Further report 102789-MLM-ZZ-XX-RP-YA-0001 dated 1 August 2019, evaluated and compared the results for 102767-MLM-ZZ-XX-RP-U-0001 based on the results of updated noise surveys at the receptors locations, and sound measurements undertaken on site for the operation of the different noise sources. The necessary reductions/mitigations were set out in order to meet the levels within the planning condition for the site, for the 'Normal Operation' Scenario.

The current assessment considers the necessary mitigations to be applied to SQ17, P1, P2, P3 and P4 set out in the aforementioned report.

The current Assessment considers noise from the external fixed plant associated with the development and noise breakout from equipment running within the buildings, based on source noise measurements carried out at the existing Data Centres SQ17, P1, P2 and P3, during the sites visits undertaken on site in May and June 2019, along with the historical data measured at P1 in 2014, and complemented by data provided by the design team for P5 and the extension of SQ17. The Assessment methodology contained in British Standard 4142[1] and British Standard 8233[2] has been considered in the Assessment.

The current assessment is intended to evaluate the operation of the full site including the addition of P5 and the extension of SQ17 in support of an Environmental Permit application.

The following Report presents the results of the sound monitoring exercise carried out at three positions to determine the existing ambient sound climate at the nearest noise-sensitive receptors (NSRs) to the development. The Environmental Sound Survey was conducted by MLM Consulting Engineers between Friday 17 May and Thursday 23 May 2019. This sample is considered sufficient to provide details of representative and typical prevailing sound levels during the potential hours of operation.

The sound levels from the external and internal plant associated with the development has been predicted using the noise-modelling suite Cadna/A, which implements the ISO 9613[3] prediction methodology, and compared to relevant UK guidance criteria.

This Report contains references of a technical nature, a glossary of acoustic terminology has therefore been provided in Appendix A to assist in any interpretation.

---

[1] British Standard 4142:2014: Method for Rating and Assessing Industrial and Commercial Sound

[2] British Standard 8233:2014: Guidance on sound insulation and noise reduction for buildings

[3] ISO9613-1:1993 Acoustics – Attenuation of Sound During Propagation Outdoors – Part 1: Calculation of the Absorption of Sound by the Atmosphere; and ISO9613-2:1996 Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation

Full tabulated and charted measurement results for the relevant periods are presented in Appendix B.

Noise maps in Appendix C graphically articulate the propagation of noise from the site to the surrounding area.

2 Assessment Methodology and Criteria

The Assessment will be made in accordance with the following references and standard, which relevance will be explained in the Assessment text:

- ISO9613-1:1993 Acoustics – Attenuation of Sound During Propagation Outdoors – Part 1: Calculation of the Absorption of Sound by the Atmosphere;
- ISO9613-2:1996 Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation;
- BS4142:2014 Method for Rating and Assessing Industrial and Commercial Sound;
- BS8233:2014 Guidance on sound insulation and noise reduction for buildings.

2.1 British Standard 4142:2014

BS 4142 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS 4142 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,}T$ 'specific sound level', immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ 'rating sound level'. A correction to include consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

BS 4142 states: "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". An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

- "Typically, the greater this difference, the greater the magnitude of the impact."
- "A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context."
- "A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context."
- "The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound 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."

For the daytime, the Assessment is carried out over a reference time period of one hour, but at night-time it is carried out over a 15-minute period. The periods associated with day or night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

Based on the operational nature of the proposed development, both night-time and daytime periods have been considered.

2.2 British Standard 8233:2014

BS 8233:2014 draws on the results of research and experience to provide information on achieving internal acoustic environments appropriate to their functions. The guideline values provided are in terms of an average (L_{Aeq}) level.

The standard advises that, for steady external noise sources, it is desirable for internal ambient noise levels to not exceed the existing guidelines issued by the WHO, as detailed in Table 1 below.

Table 1: BS8233:2014 Indoor Ambient Noise Levels			
Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq,16hours}$	-
Dining	Dining Room	40 dB $L_{Aeq,16hours}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16hours}$	30 dB $L_{Aeq,8hours}$

BS 8233:2014 goes on to suggest 'where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".

In respect of external noise levels, the guidance in BS 8233:2014 suggests that "it is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments". The standard also suggests that "if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB'

The guidance contained within BS 8233 is almost identical to that presented in the WHO guidelines. With respect to internal noise levels with windows open, the WHO guidelines state "…that the noise reduction from outside to inside with the window partly open is 15dB".

2.3 Noise Planning Conditions

The Planning Permission 17/08760/FUL for the site includes a Noise Condition for the operation of P3 and P4.

10. During normal operational conditions, all plant (including generation plant, air conditioning units, extraction systems or other air handling plant etc.) shall be so sited and designed in order to achieve a Rating Level (BS4142:2014) of at least 5dB below the background noise level (LA90T) determined at the nearest noise sensitive receptor, when the plant is intended to operate.

At the request of the Local Planning Authority (LPA), the plant operator shall, at their own expense, employ a suitably competent and qualified person to measure and assess, whether noise from the plant meets the specified level. The assessment shall be commenced within 21 days of the notification, or such longer time as approved by the LPA. The consultant should use BS4142:2014 methodology to carry out the assessment and provide further details on the generators expected frequency of use and duration.

The standby generators shall be used only if mains power is not available and will be designed to achieve good internal standards set out in BS8233:2014 and WHO at the nearest sensitive receptors.

REASON: To ensure the creation/retention of an environment free from intrusive levels of noise and activity in the interests of the amenity of the area.

The Planning Permission 19/11352/FUL for the proposed Data Centre P5 includes a Noise Condition for the operation of P5:

10. During normal operational conditions, all plant (including generation plant, air conditioning units, extraction systems or other air handling plant etc.) shall be so sited and designed in order to achieve a Rating Level (BS4142:2014) of at least 5dB below the background noise level (LA90T) determined at the nearest noise sensitive receptor, when the plant is intended to operate.

At the request of the Local Planning Authority (LPA), the plant operator shall, at their own expense, employ a suitably competent and qualified person to measure and assess, whether noise from the plant meets the specified level.

The assessment shall be commenced within 21 days of the notification, or such longer time as approved by the LPA. The consultant should use BS4142:2014 methodology to carry out the assessment and provide further details on the generators expected frequency of use and duration.

Good internal standards set out in BS8233:2014 and WHO will need to be achieved at the nearest sensitive receptors.

REASON: To ensure the creation/retention of an environment free from intrusive levels of noise and activity in the interests of the amenity of the area.

Based on the above, the planning conditions set out the limit of Rating Level (BS4142:2014) of at least 5dB below the background noise level (LA90T) determined at the nearest noise sensitive receptor, during normal operation, for P3-P4 and P5 respectively.

Based on this, it is considered that a limit of a Rating Level (BS4142:2014) not exceeding the background noise level (LA90T) would be appropriate for the cumulative operation of the full site (SQ17, P1, P2, P3, P4 and P5).

3 Site and Development Description

The development is located at Spring Park in Hawthorn, Corsham, Wiltshire, SN13 9GB. The site is bound by Ministry of Defence (MOD) facilities to the north and Westwells Road to the east. To the south, the site is bound by woodland, with Wadswick Green residential development further south. To the west, the site is bound by woodland areas and open land, with some residential properties' further west along Bradford Road.

3.1 Spring Park Data Centre Facilities

There are currently five Data Centres, known as SQ17, P1, P2, P3 and P4 at the site. Additional P5 building and extension of SQ17 (modules 4 and 5) are also included in the masterplan of the full site presented below.

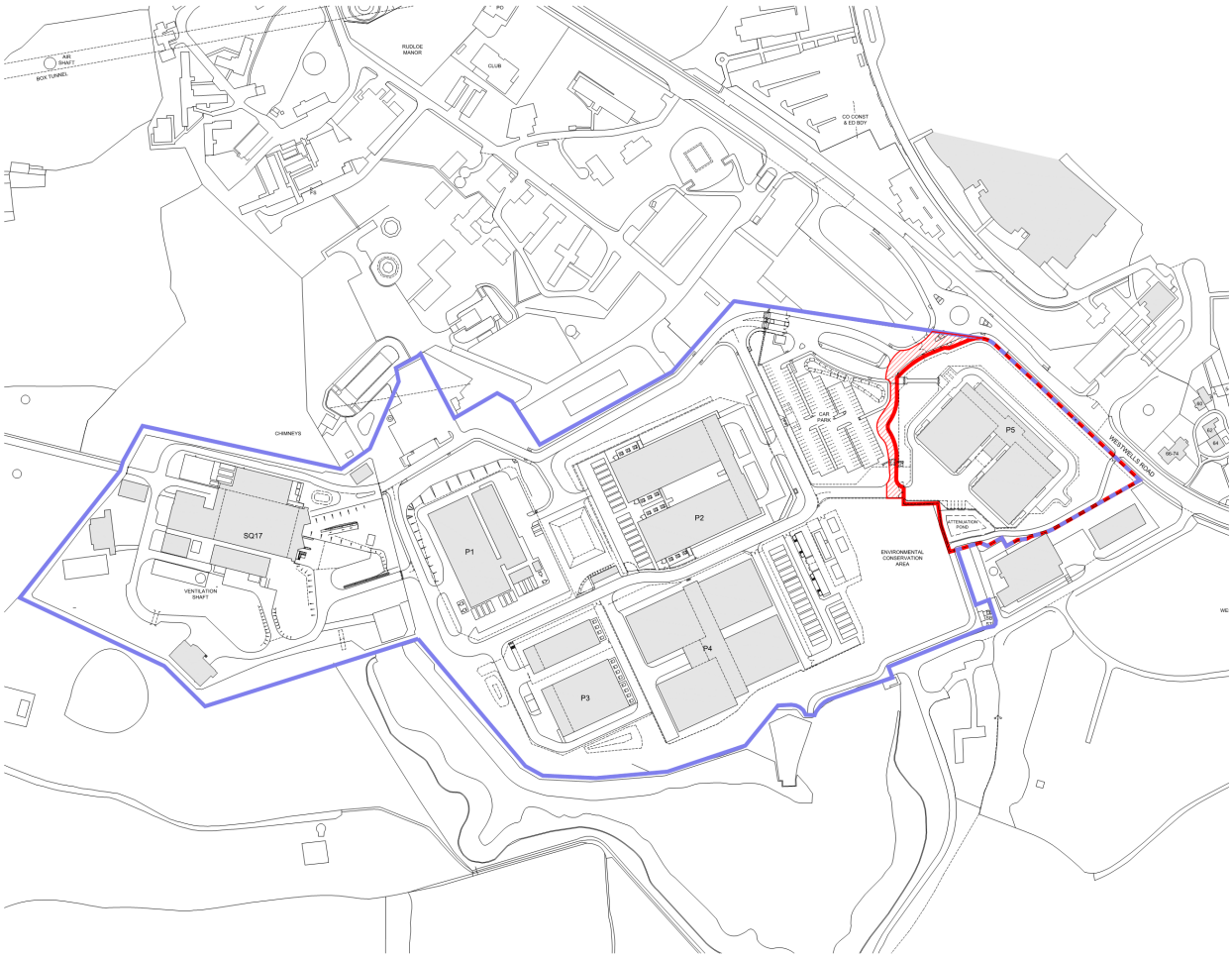


Figure 1: Full site masterplan

In addition, the facility plans for each Data Centre building are presented below. Proposed plans for SQ17 extension and P5 are also presented. It is understood that only 'directly associated' standby generators need to be assessed at this point (shown in yellow in figures below), along with the three standby generators associated with SQ17 Modules 4 and 5, and the whole HV Farm.

© MLM Consulting Engineers Limited

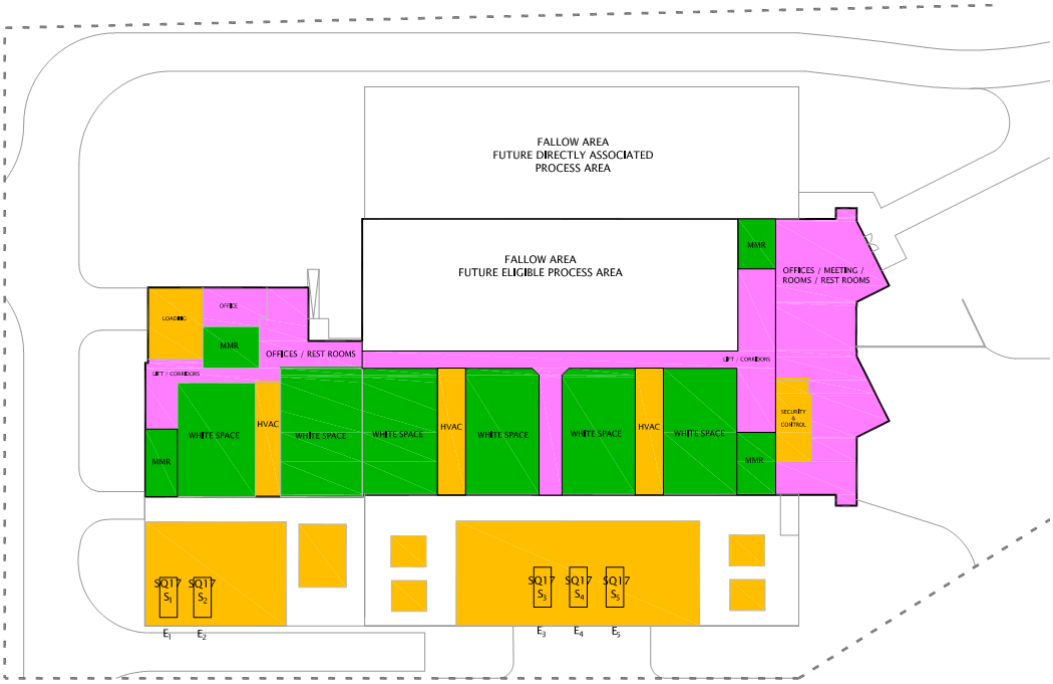


Figure 2: Existing SQ17 Facility Plan

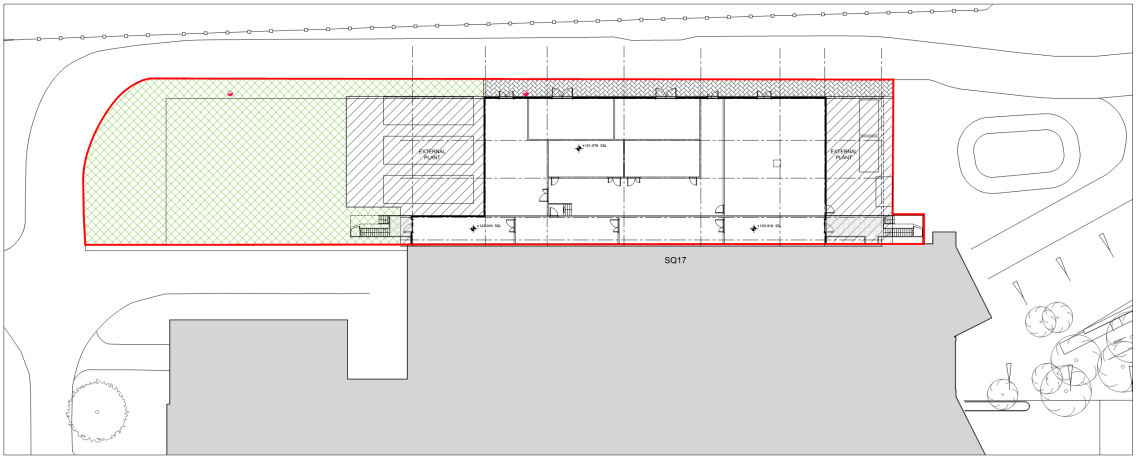


Figure 3: Proposed SQ17 Extension Plan – Modules 4 and 5

© MLM Consulting Engineers Limited

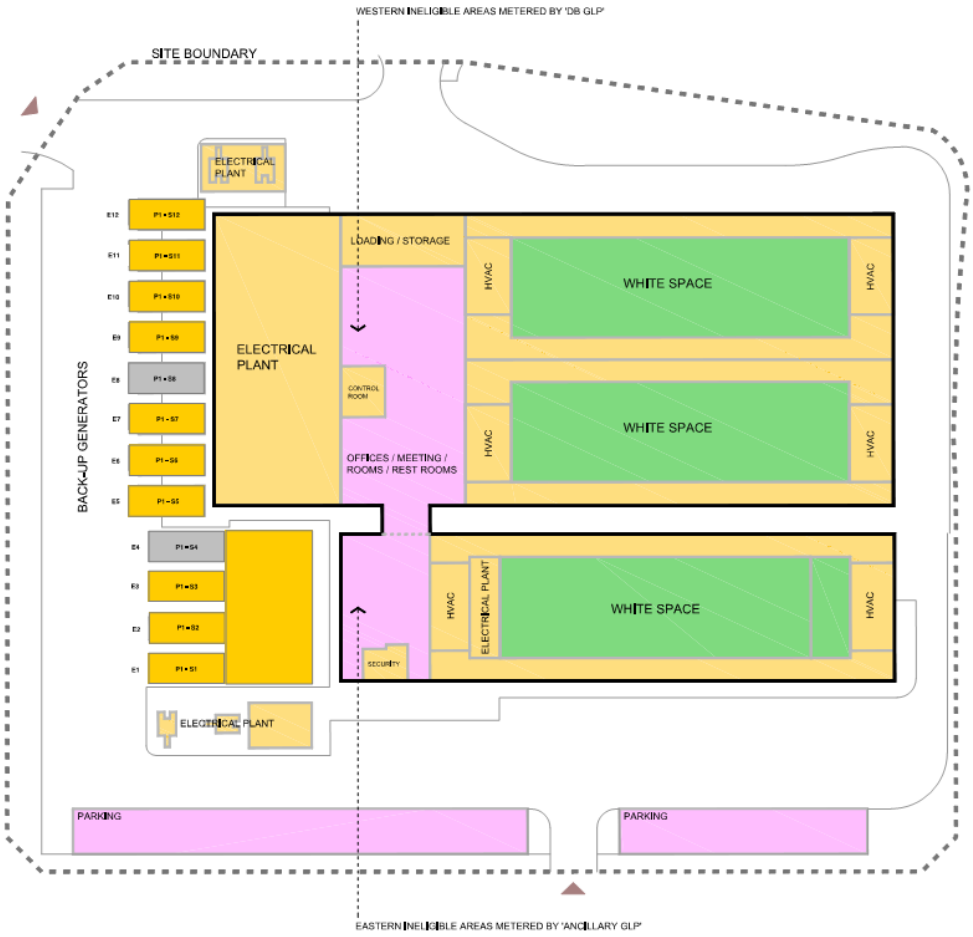


Figure 4: P1 Facility Plan

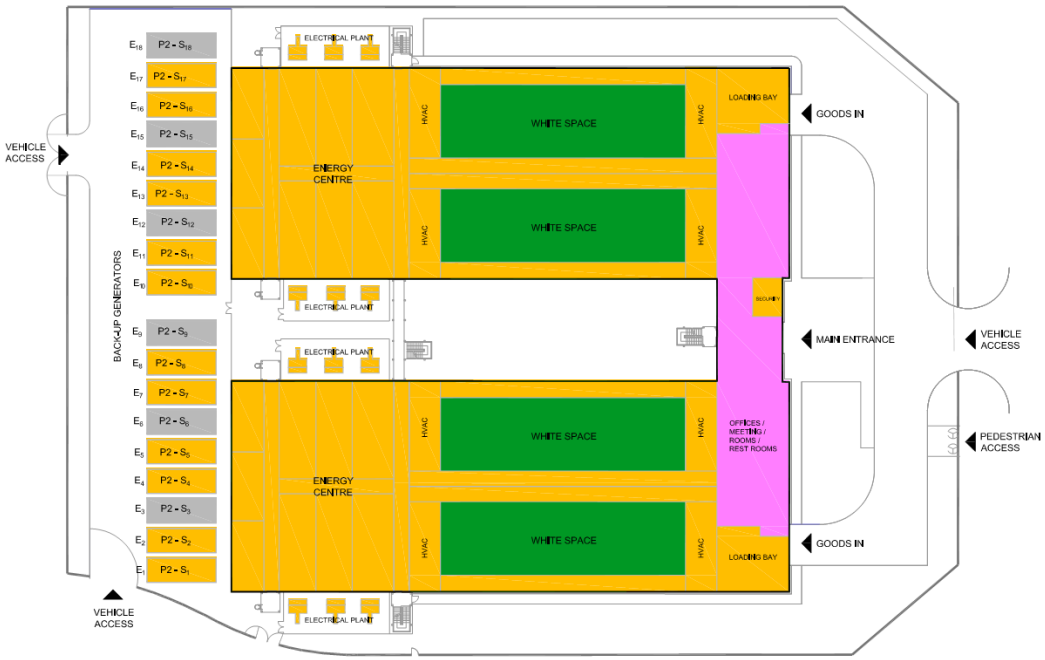


Figure 5: P2 Facility Plan

© MLM Consulting Engineers Limited

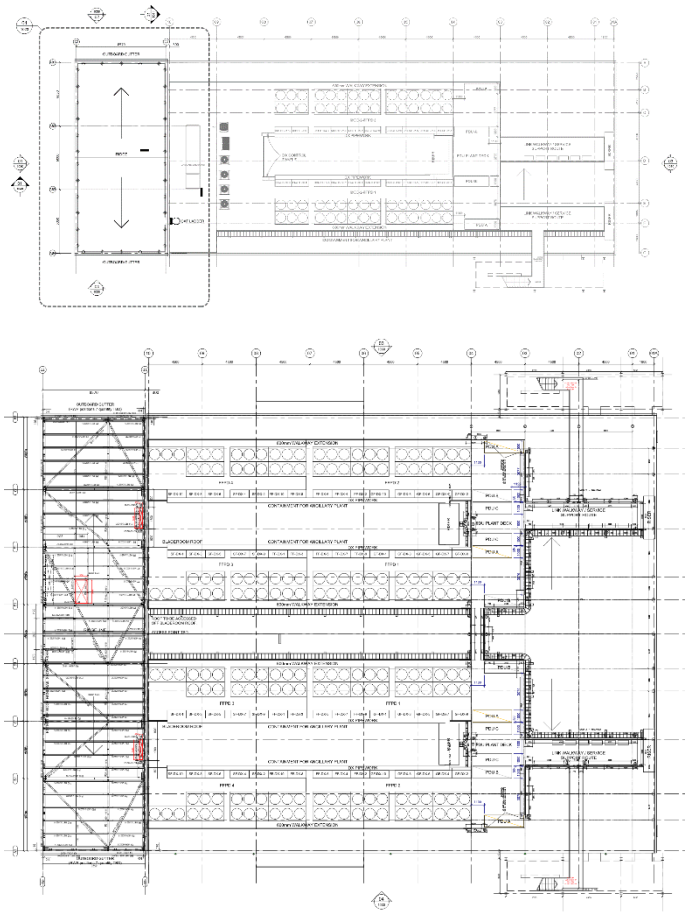


Figure6: P3 Modules 1, 2 and 3 Roof Plans

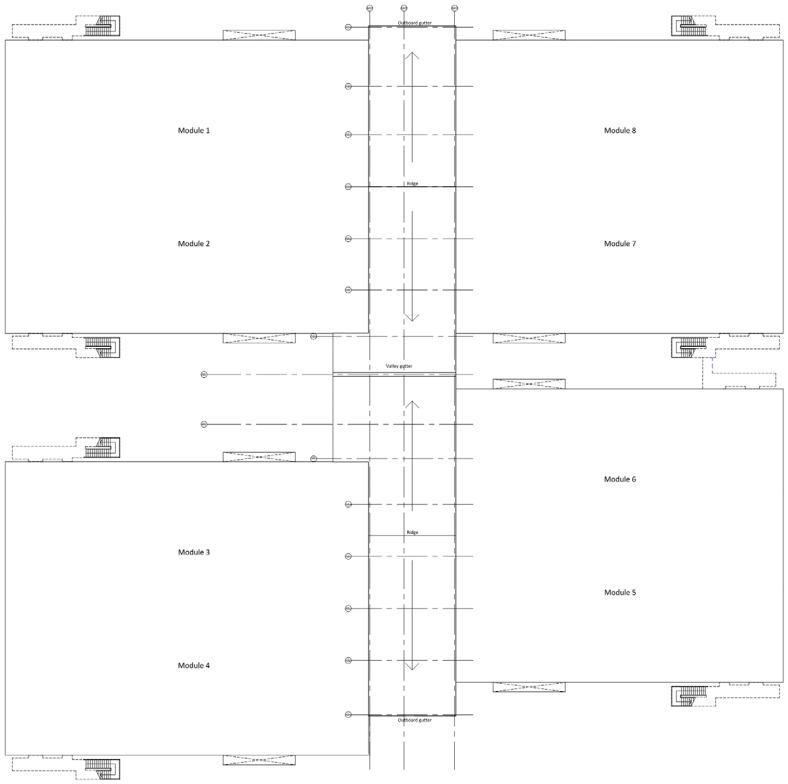


Figure 7: P4 Roof Plan

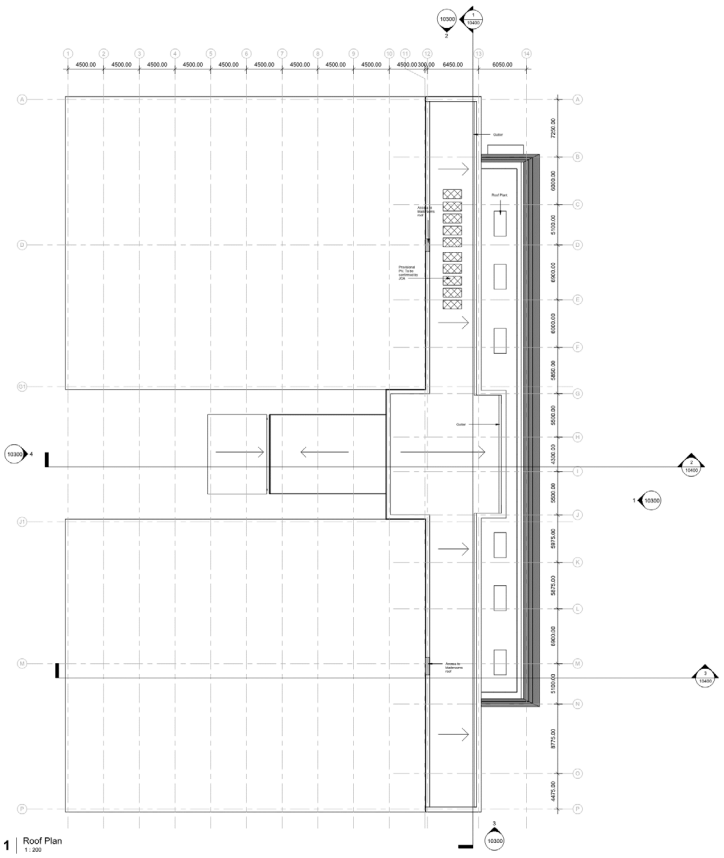


Figure 8: P4 Roof Plan

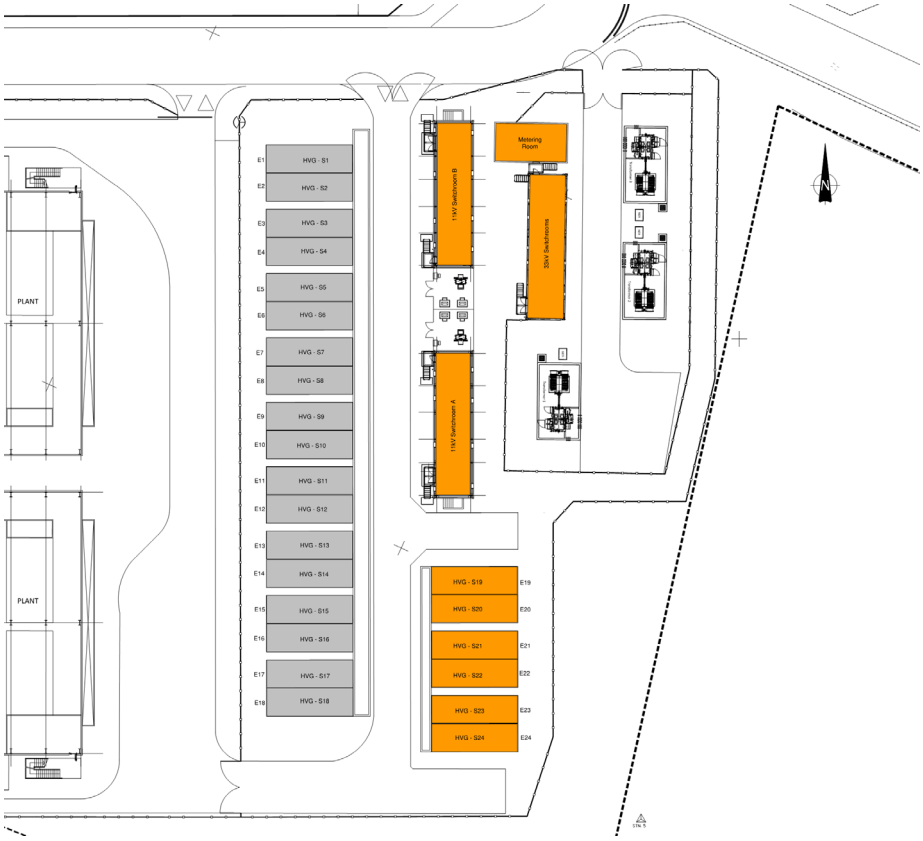


Figure 9: HV Generators Farm Facility Plan (in yellow and grey)

3.2 Site Operation

Under 'Normal Operation' conditions, the data suites located within the buildings are serviced by internal plant rooms, with associated ventilation inlet and outlet louvers at the sides of the buildings.

For SQ17 building, a series of external plant and ventilation louvres operate in a 24/7 basis, associated with the ventilation system of SQ17 modules. There are 3 sets of three chillers each serving the three modules in the building. Additionally, a KST room and its ventilation inlets and outlets were found to be a relevant noise source to be included in the normal operation of the site. The extension modules include the operation of external chillers, dry coolers and condensers.

During the site visit at P1 and P2, certain noise sources were found relevant and included in the normal operation regime for the site. In reference to P1, ventilation louvres for the Switch Room associated with the Energy Centre, were found in operation and deemed to part of the normal operation of the site. Along with this, four ventilation fans associated with the Energy Centre were found to be a dominant noise source and therefore have been included in the noise assessment. In reference to P2, the AHU located on the roof to the east of the building above the ancillary areas, was found to be a dominant noise source which is understood to operate 24/7. This has been included in the noise model and assessment of the normal operation of the site.

For P5, external plant associated with the ancillary bulling has been included under normal operation.

Most external plant items associated with the Data Centres are for the provision of 'Emergency Backup' power generation and emergency data suite cooling, to allow the Data Centre to continue operating and prevent the loss of any data in the event of mains power failure or primary (internal) cooling system failure, or during hot external ambient temperatures.

The air-cooled condensing units (ACCU) associated with emergency cooling system are installed at roof level on buildings P1, P2, P3, P4 and P5. The large backup electricity generators associated with main power failure for all buildings are installed at ground level, within individual high performance acoustically attenuated enclosures and with silenced exhausts.

Based on the information provided by the applicant it is not possible to anticipate the duration and frequency of use of the emergency backup external plant, as this is dependent on main power failure for generator operations or extreme environmental conditions/emergency operations for the ACCUs.

Different emergency situations with different durations are being assessed as required by the applicant, including:

- a mains power failure affecting all the buildings simultaneously;
- a fire in the data centre (which normally would not impact all buildings, or modules in a building simultaneously);
- external ambient conditions with temperatures above 27° C, which may impact all buildings simultaneously, but will not occur at night between 23:00hrs and 07:00 hrs;
- a mains power failure affecting all the buildings simultaneously during external ambient conditions with temperatures above 27° C, which will not occur at night between 23:00hrs and 07:00 hrs;

Nevertheless, emergency events are unlikely and when happen tend to be rectified quickly, due to the enormous impact on the activity within the area affected.

Maintenance tests are undertaken every month, every three months and once a year for each power generator and all energy centres. The duration of the tests is of 15 minutes and it's generally done generator by generator.

3.3 Nearest Noise-Sensitive Receptors (NNSRs)

The nearest and most affected noise-sensitive receptors are properties off Westwells Rd to the east at approximately 60 metres. There is one isolated property approximately 200 metres to the south in the woodland area, and Wadswick Green retirement development also to the south at approximately 270m. Other residential dwellings along Bradford Road to the south-west are at approximately 300m from the site. The NNSRs to the site are identified below.

© MLM Consulting Engineers Limited

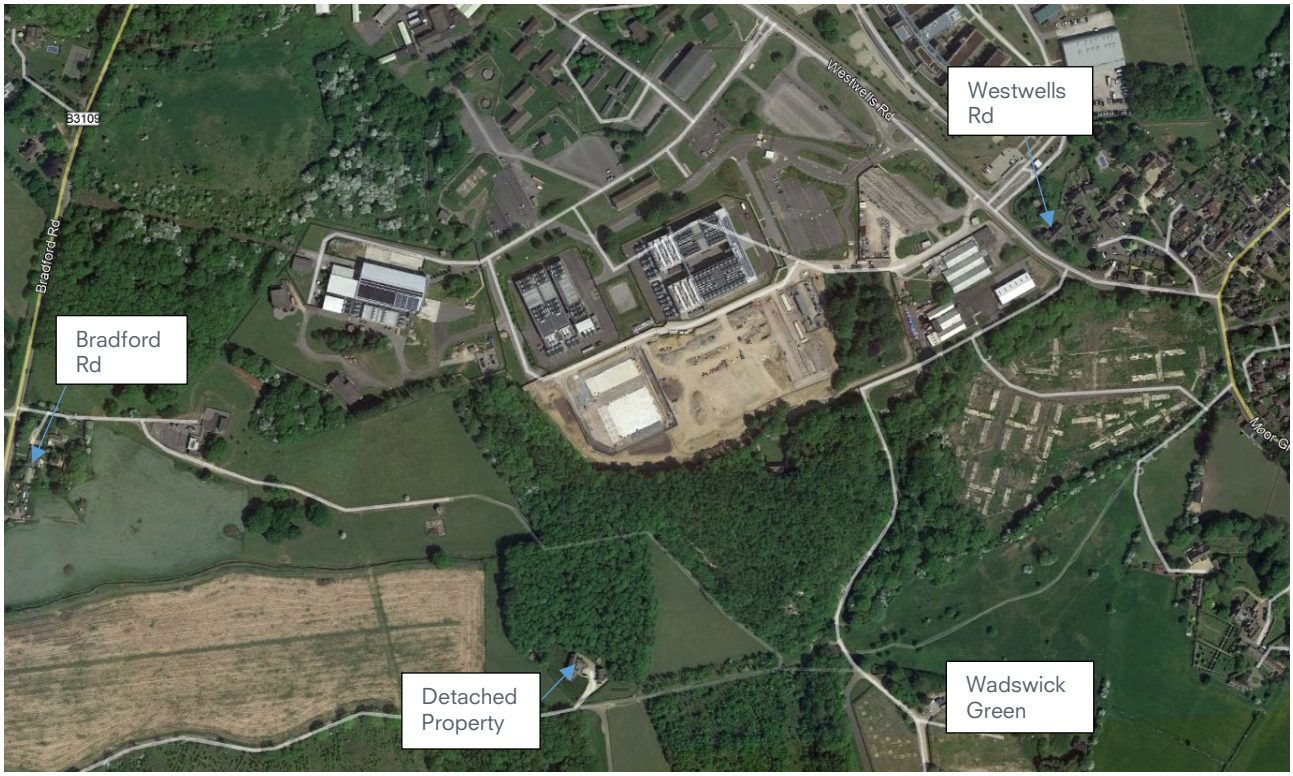


Figure 3: Nearest Noise-Sensitive Receptors (NNSRs)

4 Existing Conditions

The prevailing sound conditions at the location of the development site were determined by a detailed environmental noise survey, undertaken between Friday 17 and Thursday 23 May 2019 at three monitoring positions. The exercise was undertaken in support of a previous assessment for the full site (MLM report reference 102789-MLM-ZZ-XX-RP-YA-0001 dated 1 August 2019), and is considered valid for the current assessment of the full site.

A new residential development is under construction, off Westwells Road, to the north east of the site. Attended measurements were undertaken at a fourth location, representative of the future residential dwellings, to evaluate and inform of differences with the environmental climate at MP2, in case these future receptors need to be considered.

All sound measurements were undertaken by a suitable qualified acoustician, certified as competent in environmental sound monitoring, and in accordance with the principles of BS 7445[4].

All acoustic measurement equipment used during the sound survey conformed to Type 1 specification of BS 61672[5]. A full inventory of this equipment is shown in Table 2 below.

Table 2: Inventory of Sound Measurement Equipment

Item	Make & Model	Serial Number	Calibration Certificate Number	Date of Expiration of Calibration
Sound Level Meter	RION NL-52	00620901		
Preamplifier	RION NH-25	76417		
Microphone	RION UC-59	13342	TCRT18/1581	4 July 2020
Sound Level Meter	RION NL-52	00620957		
Preamplifier	RION NH-25	20998		
Microphone	RION UC-59	03875	TCRT19/1015	7 January 2021
Sound Level Meter	RION NL-52	00620900		
Preamplifier	RION NH-25	31972		
Microphone	RION UC-59	03797	UCRT19/1471	14 April 2021
Sound Level Meter	B&K 2250	3006737		
Preamplifier	B&K ZC 0032	16513		
Microphone	B&K 4189	2556374	TCRT/19/1016	7 January 2021
Calibrator	B&K 4231	2615249	TCRT19/1008	03 January 2020

The sound measurement equipment used during the survey was calibrated at the start and end of the measurement period. The calibrator used had itself been calibrated by an accredited calibration laboratory within the twelve months preceding the measurements. No significant drift in calibration was found to have occurred on the sound level meter. Calibration certificates of the above equipment are available upon request.

[4] British Standard 7445: 2003: Description and measurement of environmental noise. BSI

[5] British Standard 61672: 2013: Electroacoustics. Sound level meters. Part 1 Specifications. BSI.

The sample period was selected following close monitoring of local weather conditions. Weather conditions were generally suitable for the noise measurement exercise, it being dry with only light winds. The periods excluded from the Assessment due to unsuitable weather are 16:00 to 23:00 on Friday 17 May.

It must be noted that construction works on site (for P4 and P3) were found to be noticeable at the receptors locations, and therefore periods from 07:00 to 18:00 Monday to Friday and 07:00 to 14:00 on Saturday have been discarded for the assessment.

All microphones were fitted with a protective windshield and the appropriate correction applied on the Sound Level Meter.

$L_{Aeq,T}$, $L_{A90,T}$ and $L_{AF,max}$ acoustic parameters were register over sequential 15-minute periods. Measurements were carried at the following monitoring positions, as described below and shown in Figure 4 overleaf.

Since the survey was largely unattended it is not possible to comment on the specific nature of the sound climate for the entire duration of the survey, however sound sources were noted during time on site.

- MP1 – Largely unattended measurement of the sound climate representative of the nearest noise-sensitive receptor to the south of the site. The microphone was located under free-field conditions, at a height of 1.5 metres above local ground. During equipment setup the sound climate at this position was dominated by construction noise. Birdsong and very faint road traffic were audible. During equipment retrieval at night, the sound climate was dominated by plant noise and distant road traffic noise. Based on observations on site, the plant noise was steady and identified as ventilation noise, and therefore it is attributed to the Data Centre.
- MP2– Largely unattended measurement of the sound climate representative of the nearest noise-sensitive receptor to the east of the site. The microphone was located under free-field conditions, at a height of 1.4 metres above local ground. The sound climate at this location was dominated by local traffic noise from Westwells Road, and birdsongs; and to a lesser extent construction noise and occasional aircrafts. During equipment retrieval at night, the sound climate at this position was dominated by steady plant noise. Nearby road traffic was intermittent and occasionally dominant when vehicles where in proximity. Additionally, residential activity (i.e. people talking) was audible but not itself a source of dominant noise.
- MP3– Largely unattended measurement of the sound climate representative of the nearest noise-sensitive receptor to the west of the site. The microphone was located under free-field conditions, at a height of 1.5 metres above local ground. The sound climate at this location was dominated by local road traffic from Bradford Road. To a lesser extent, vehicle movements to the south-east and a tonal low-frequency hum possibly from the adjacent MOD site were noticeable. Although construction noise was not identified, the periods with potential construction activity has been discarded to avoid extraneous sound sources, not representative of the noise climate at this location. During equipment retrieval at night, the sound climate at this position was dominated by the aforementioned tonal low-frequency hum and to a lesser extent plant noise which may be attributed to the Data Centre.
- MP4 – Attended short-term measurement position, situated in a small woodland adjacent to Westwells Road and MOD, Corsham. The microphone was installed under free-filed conditions at a height of 1.30m above ground level. This location is considered representative of the future nearest noise-sensitive receptors to the north of site. - The sound climate at this location at night was dominated by steady plant noise. Road traffic was audible and occasionally dominant depending on the proximity. Additionally, air traffic was audible and dominant when directly overhead. This location is deemed to be comparable in terms of noise climate to MP2.

The monitoring positions in relation to the site and the closest NSRs are shown in Figure 4 below.

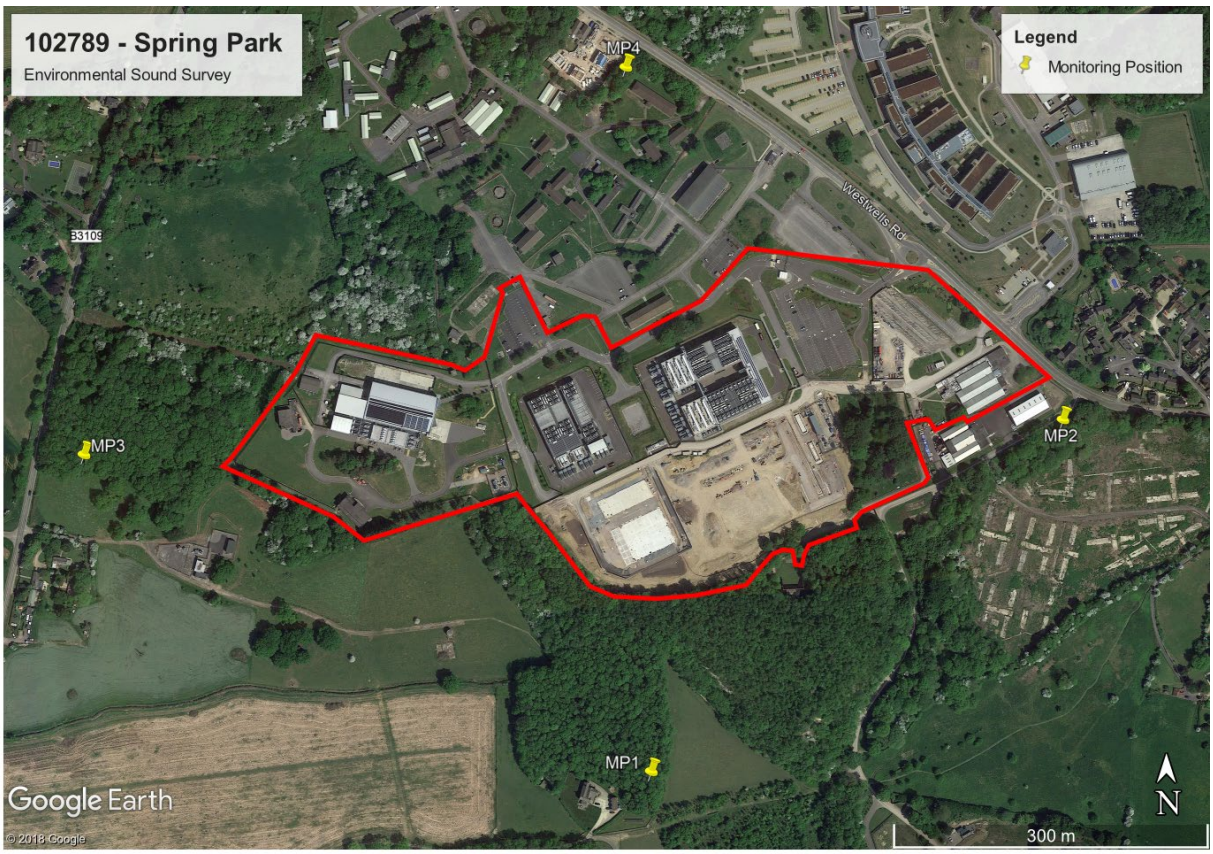


Figure 4: Monitoring positions and approximate site boundary for Spring Park Ark Data Centre

The Wadwicks Green receptors to the south of the site (which is already developed) are in proximity to monitoring position MP1. From our observations on site, it could be concluded that MP1 is representative of typical sound conditions at Wadswick Green development.

It has been observed that MP2 is representative of typical sound conditions at the receptors to the north, off Westwells Road Green. At the moment it is not deemed necessary to consider these receptors, but in case it is required in the future, the sound conditions are comparable to MP2.

4.1 Sound Survey Results

The results of the sound monitoring, in terms of the typical $L_{A90,one\ hour}$ daytime (07:00-23:00) and $L_{A90,15\ minutes}$ night-time (23:00-07:00) are summarised in Table 3 below. In addition to the typical background sound levels, average ambient sound levels and typical maximum sound levels are presented to add context. Values have been rounded to the nearest whole number.

Periods from 07:00 to 18:00 Monday to Friday and 07:00 to 14:00 on Saturday have been discarded for the assessment due to construction activity on site.

Full-tabulated and charted results of the sound measurements are presented in Appendix B of this Report. The statistical analysis for obtaining the typical background sound levels used in this Assessment can also be found in Appendix B.

© MLM Consulting Engineers Limited

Table 3: Measured Broadband Sound Levels (dB)				
Position	Period	$L_{A90,T}$	$L_{Aeq,T}$	L_{Amax}
MP1	Daytime (18:00-23:00)	33-35	52	76
	Night-time (23:00-07:00)	28-29	47	73
MP2	Daytime (18:00-23:00)	34	47	70
	Night-time (23:00-07:00)	24	47	71
MP3	Daytime (18:00-23:00)	43	56	74
	Night-time (23:00-07:00)	28-29	52	71

Table 4: Measured Broadband Sound Levels (dB) - STMP				
Position	Period	$L_{A90,T}$	$L_{Aeq,T}$	L_{Amax}
MP4	23/05/19 23:25	29	37	48
	23/05/19 23:30	31	36	53
	23/05/19 23:35	29	35	51
	23/05/19 23:40	29	32	39
	23/05/19 23:45	29	32	49

5 Sound Predictions and Assessment

In order to assess the impact of sound from the full site, it has been necessary to predict the likely specific sound level from the sources of sound associated with the development at the nearest noise-sensitive receptors. Predictions have been carried out in the noise-modelling suite Cadna/A, in accordance with the ISO 9613 prediction methodology.

In addition to the input data described below, the model considers the effects of topography, ground absorption, atmospheric absorption and acoustic reflections, as well as applying a light downwind correction to consider a typical worst-case downwind situation. In terms of ground absorption, the intervening ground between the sources and receivers has been modelled as acoustically hard, except where ground is covered by grass, trees or other vegetation, as advised on ISO 9613-2.

5.1 Operational Scenarios

As advised by the applicant different operational scenarios have been assessed for the operation of the full site, as presented below:

- a) Normal Operation: P1, P2, P3, P4 and P5 data suites located within the buildings are serviced by internal plant rooms, with associated ventilation inlet and outlet louvers at the sides of the buildings. SQ17 building normal operation includes a series of external plant and ventilation louvres associated with the ventilation system of SQ17 modules along with the KST room and its ventilation. In addition to the above, P1 normal operation will include Energy Centre and Switch Room ventilation. P2 will include ancillary AHU. P5 ancillary external plant is included in the normal operation scenario.
- b) Generator Emergency Operation: In the extremely unlikely event of a total mains supply failure, all the generators running at 80% load along with the plant normally operating. This emergency running will be for a 48-hour period.
- c) Cooling System Emergency Operation: In the extremely unlikely event of a fire affecting all facilities at once. This emergency running will be for a 48-hour period.
- d) Summer Cooling System Operation: In hot external ambient conditions, the DX units will operate along with the normal operation plant for short periods of time during the daytime hours.
- e) Generator Emergency Operation during hot weather: In the extremely unlikely event of a total mains supply failure when hot external ambient condition, all the generators running at 80% load along with all the DX units and normal operation plant . This scenario is extremely unlikely and will only happen during the daytime periods, as during the night-time the temperature will be lower. This emergency running will be for a maximum 48-hour period.
- f) Generator Maintenance Operation: Different maintenance tests are undertaken every month, every three months and once a year for each generator and all energy centres. The duration of the tests is of 15 minutes and it's generally done generator by generator. As a worst case, the simultaneous operation of all the generators during 15 min has been considered for each building.

5.2 Sound Data Assumptions

Ventilation louvres are associated with 'normal operation' of the data centre, while Backup Power Generators and ACCU units are associated with 'backup operations' in the event of mains power or an emergency cooling event (fire or high external ambient temperature conditions).

A series of new detailed source noise measurements were undertaken by MLM at P1, P2 and SQ17 Data Centre buildings during daytime on 21 and 30 May 2019, and 4 and 5 June 2019. Source measurements were undertaken on site during normal operation of the existing buildings, and also during back-up power generators regular maintenance tests. Detailed source noise measurements were undertaken at Generators

at HV Farm on the 30 May 2019. Additionally, measurements were undertaken during the IST test undertaken for Module 3 in P3 on the 20 May 2019.

Certain differences were found during the measurements undertaken during the different visits in relation to the sound emission levels considered in the previous assessments for environmental planning applications.

A summary of the derived sound emission levels of the acoustic sources based on the measurements and noise model validations for SQ17, P1, P2, P3 and P4 is presented below.

Data provided by the plant design engineers and plant manufacturers have also been used for the assessment of the extension of SQ17 and the new building P5.

5.2.1 P1, P2, P3, P4, existing SQ17, and HV Farm

The sound power data for the ventilation inlets and outlets for P1, P2, and P3 are based on model validation following the measurements at the different buildings during the sites visits. Levels for P4 have been assumed based on the levels for P3, following the advice of the design engineers.

Table 5: Normal Operation Plant - Sound Power Levels, dB

Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
Inlet Ventilation Louvres P1	69	71	64	68	70	61	48	38	72
Outlet Ventilation Louvres P1	76	78	72	69	67	62	58	51	72
Inlet Ventilation Louvres P2	64	66	59	63	65	56	43	33	67
Outlet Ventilation Louvres P2	72	74	69	65	63	58	54	47	68
Inlet Ventilation Louvres P3	85	87	80	84	86	77	64	54	88
Outlet Ventilation Louvres P3	86	88	83	79	77	72	68	61	82

In relation to the other normal operation noise sources considered in P1 and P2, the sound power levels have been derived based on sound pressure levels measured on site and a model validation.

In reference to P1, four ventilation louvres for the Switch Room associated with the Energy Centre have been considered in the noise model as part as the normal operation, based on observations on site and information from the plant engineers. Four ventilation fans associated with the Energy Centre were found to be a dominant noise source and therefore have been included in the noise assessment, with a total sound power level as per the table above.

In reference to P2, the sound power levels for the AHU located on the roof to the east of the building above the ancillary areas have been derived based on sound pressure levels measured on site and a model validation.

The sound power levels for the Chillers at SQ17 have been derived based on sound pressure levels measurements of the plant undertaken during the site visit. There are three sets of three chillers each serving the three modules in the SQ17 building.

The sound power levels for the KST room breakout and its ventilation inlets and outlets at SQ17 have been derived based on sound pressure levels measurements undertaken within the room during the site visit and model validation following the measurements.

Table 6: Additional Normal Operation Plant SQ17, P1 and P2 - Sound Power Levels, dB

Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
Ventilation Louvres P1 Energy Centre Switch Room	81	79	76	70	69	66	63	56	75
Energy Centre Ventilation Fans P1	75	93	85	84	84	81	71	59	88
AHU Ancillary Building Roof P2	74	74	81	81	83	92	77	78	94
Module 1 Chillers SQ17	87	87	89	86	84	79	77	70	89
Module 2&3 Chillers SQ17	97	92	86	86	86	80	75	70	89
KST Outlet Ventilation Louvre SQ17	75	85	84	80	69	71	72	61	81
KST Inlet Ventilation Louvre SQ17	84	94	94	92	84	82	75	70	92
KST Room Internal Noise Levels Breakout	71	86	86	80	81	76	52	40	85

The sound power data for the power generators at P1, P2, SQ17 and HV Farm have been derived based on sound pressure level measurements of the plant undertaken during the maintenance test carried out at the different dates above. The sound power data are based on model validation following the measurements at the different buildings.

For the generators at SQ17, which are within buildings rather than individual enclosures, the model has assumed inlet ventilation levels to be two dB below the outlet ventilation levels measured, due to the lack of specific data and based on the original data for P1 generators.

The sound power data for the cooling units at P1 and P2 is based on model validation following the measurements at P1. The original sound power data for the cooling units at P3 were calculated based on the air optimiser datasheet provided based on 66 dBA at 3 metres and considering the dimensions of the unit. The current sound power data for the cooling units at P3 are based on the original data and a model validation following the measurements undertaken during the IST test for Module 3. The sound power data for the cooling units at P4 have been modelled based on the results for the P3 test.

Table 7: Emergency Backup Operation Plant - Sound Power Levels, dB

Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
Cooling Units at P1 & P2	85	84	83	79	75	73	70	62	82
Cooling Units at P3 & P4	90	80	77	76	76	69	68	63	79
Backup Generator Exhaust – P1	93	91	90	85	85	77	69	64	88
Backup Generator Outlet - P1	90	89	90	75	73	67	65	63	83
Backup Generator Inlet – P1	83	82	78	76	77	69	63	56	79
Backup Generator Breakout - P1	79	76	74	76	79	71	62	62	81
Backup Generator Exhaust – P2	93	91	90	85	85	77	69	64	88
Backup Generator Outlet - P2	92	91	92	77	75	70	67	65	85
Backup Generator Inlet - P2	84	82	79	77	78	70	64	57	80

© MLM Consulting Engineers Limited

Table 7: Emergency Backup Operation Plant - Sound Power Levels, dB									
Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
Backup Generator Breakout - P2	81	78	76	78	81	73	64	64	83
Backup Generator Exhaust – SQ17 Type 1	92	90	89	84	84	76	68	63	87
Backup Generator Outlet - SQ17 Type 1	95	94	95	80	78	72	70	68	88
Backup Generator Inlet - SQ17 Type 1	93	92	93	78	76	70	68	66	86
Backup Generator Exhaust – SQ17 Type 2	97	95	94	89	89	81	73	68	92
Backup Generator Outlet - SQ17 Type 2	101	100	101	86	84	78	76	74	94
Backup Generator Inlet - SQ17 Type 2	99	98	99	84	82	76	74	72	92
Backup Generator Exhaust - HV Gen Farm	100	98	97	92	92	84	76	71	95
Backup Generator Outlet - HV Gen Farm	95	94	95	80	78	73	70	68	88
Backup Generator Inlet - HV Gen Farm	82	80	77	75	76	68	62	55	78
Backup Generator Breakout -	87	84	82	84	87	79	70	71	89

Table 7: Emergency Backup Operation Plant - Sound Power Levels, dB									
Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
HV Gen Farm									

The levels above present differences from the levels assumed in the previous environmental permit application noise assessment and the following mitigations/reduction in levels have been assumed in order to reduce the impact of the normal operations at the closest residential receptors to the site:

- Maximum sound power level for Inlet Ventilation louvres of 67 dBA at P3 and P4;
- Maximum sound power level for Outlet Ventilation louvres of 72 dBA at P3 and P4;
- Reduction of 12 dB to the noise emission levels for the AHU at P2 Roof associated with the Ancillary Building;
- Attenuation of 3 dB for the ventilation louvres at P1 Energy Centre Switch Room;
- Attenuation of 15 dB for Module 1 Chillers at SQ17 building;
- Attenuation of 18 dB for Module 2&3 Chillers at SQ17 building;
- Attenuation of 14 dB for each KST Room Outlet Louvres at SQ17 building;
- Attenuation of 20 dB for each KST Room Inlet Louvres at SQ17 building;
- Attenuation of 15 dB for the KST Room Breakout at SQ17 building.

The total number of cooling units considered in the model are 36 on the roof of P1, 72 on the roof of P2, 80 on the roof of P3 and 240 on the roof of P4.

The total number of generators considered in the model are five at SQ17, nine at P1, 12 at P2 and 24 at HV Generators Farm serving P3, P4 and P5.

5.2.2 P5

Noise emission are based on data provided by the design engineers of the development and supported by the source noise measurements undertaken by MLM at P3 during the IST test for Module 3 on the 20 May 2019.

The sound power data for the ventilation inlets for P5 are based on the sound pressure data provided by the plant designers and supported by the measurements during the site visit at the comparable development P3.

Table 8: Normal Operation Plant - Sound Power Levels, dB									
Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
Inlet Ventilation Louvres P5	93	83	92	89	83	77	71	68	89

The sound emission levels for the ventilation outlets for P5 are based on the sound pressure data provided by the plant designers for the area before the outlet louvres and weather louvres attenuation. The noise model levels are in line with the measurements during the site visit at the comparable development P3.

Table 9: Normal Operation Plant – Outlet Ventilation Internal Sound Levels, dB									
Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
Outlet Internal reverberant levels	85	75	84	78	72	67	60	57	80

The sound power data for the cooling units at P5 is calculated based on the manufacturer datasheet provided based on 66 dBA at 3 metres.

Table 10: Emergency Operation Plant - Sound Power Levels, dB									
Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
Cooling Units at P5	72	72	76	81	84	78	77	70	87

The total number of cooling units considered in the model are 120 on the roof of P5.

The plant designers have provided noise data for the external plant to be installed on the roof of the ancillary block which are presented below.

The external plant will comprise the following:

- 3 No AHUs (AHU01, AHU02 and AHU03)
- 3 No AHUs CONDENSER UNITS
- 16 No MMR CONDENSER UNITS
- 4 No CRAC CONDENSER UNITS
- 2 No VRV Condenser Units
- 1 No Landlord VRV Condenser Unit

Table 11: Normal Operation Plant - Ancillary Block External Plant Noise Emission Data from Manufacturer										
Plant Item	Model		Octave Band Data Provided (dB) - PWL							LWA
			63	125	250	500	1k	2k	4k	8k	dBA
AHU01	Barkell	Supply Inlet	72	67	78	75	67	60	54	46	74
		Return Outlet	76	71	86	79	76	76	74	69	83
		Breakout	64	62	59	41	38	39	34	34	52
AHU02	Barkell	Supply Inlet	71	66	77	74	66	59	50	45	73
		Return Outlet	75	70	85	78	75	75	73	68	82

Table 11: Normal Operation Plant - Ancillary Block External Plant Noise Emission Data from Manufacturer										
Plant Item	Model		Octave Band Data Provided (dB) - PWL							LWA
			63	125	250	500	1k	2k	4k	8k	dBA
		Breakout	63	61	58	40	37	38	33	33	51
AHU03	Barkell	Supply Inlet	62	63	69	66	60	53	45	38	66
		Breakout	59	58	45	34	35	37	31	29	45
AHU Condensers	Airedale BluCube		80	84	80	85	85	75	69	62	87
MMR Condensers	STULZ		94	87	85	77	74	68	59	50	81
CRAC Condensers	STULZ		94	84	78	74	72	66	56	44	77
VRV Units	Daikin REYQ30U		81	79	75	73	68	66	67	59	75
VRV Landlord Unit	Daikin REYQ14U		73	74	71	71	64	60	60	58	71

The sound power data for the AHUs breakout and the VRV units have been derived based on sound pressure level at certain distance provided by the manufacturers.

The following mitigations/reduction in levels have been assumed in order to reduce the impact of the normal operations at the closest residential receptors to the site. The mitigations are driven by compliance with night-time operation limit and Planning Condition 10 for P5.

- Reduction of 33 dBA for Data Halls Inlet Ventilation noise levels; 37dB for the Inlets of the southern module.
- Reduction of 12 dBA for outlet noise levels and use of acoustic louvres with minimum sound reduction of 25 dB R_w, reduction of 17 dBA for outlet noise levels of the southern module.
- Reduction of 17dBA for AHU01 and AHU02.
- Reduction of 20dBA for each AHUs Condenser Unit.
- Reduction of 17dBA for each MMR Condenser Unit located to the south and reduction of 15dBA for each MMR Condenser Unit located to the north.
- Reduction of 15dBA for each CRAC Condenser Unit.
- Reduction of 8dBA for each VRV Condenser Unit.
- Reduction of 5dBA for the Landlord VRV Condenser Unit.
- 4.5 metres high solid barrier at the roof boundary.

The barriers assumed should be solid, continuous, sealed at all interfaces and have a surface density of at least 10 kg/m^2, or provide a minimum sound attenuation of 20 dB.

5.2.3 SQ17 Extension: Module 4&5

Noise emissions are based on data provided by the design engineers of the development.

The plant designers have provided noise data for the external plant which are presented below.

The external plant will comprise the following:

- 4 No Battery Room Condenser Units
- 4 No AHUs Condenser Units – Only 2 units running at a time
- 3 No Chillers – Only 2 units running at a time
- 2 No Dry Coolers

Table 12: External Plant Noise Emission Data from Manufacturer

Plant Item	Model	Octave Band Data Provided (dB) - PWL								LWA
		63	125	250	500	1k	2k	4k	8k	dBA
Battery Room Condensers	Daikin RZASG100MV1	76	73	72	69	61	56	53	48	70
AHU Condensers	Mitsubishi PUHZ-ZRP71VHA	73	71	72	63	62	58	53	46	68
Chillers	Daikin EWAT540B-XLA2+VFDFAN	89	94	93	90	90	87	85	79	95
Dry Coolers	Gunter GFD 080.3C/2x3-ND1D/4P.E	96	82	80	82	83	79	74	70	87

The total number of generators associated with SQ17 modules 4 and 5 are three.

The sound power data for the generators have been derived based on sound pressure level of 75 dBA at 1metre distance and the dimensions provided by the manufacturers. Based on spectrum data available for other generator units, the total following sound power data have been used for each generator.

Table 13: SQ17 Modules 4 and 5 Generators - Sound Power Levels, dB

Freq. (Hz)	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	(dBA)
Backup Generator	105	104	105	90	88	82.5	90	78	98

5.3 Assessment of the Normal Operation

The potential impact of sound from the normal operation of the full Data Centre site has been assessed in accordance with BS 4142:2014, based on a comparison between the predicted $L_{Ar,Tr}$ rating sound levels from the ventilation inlet and outlet louvers, and the rest of the sources included in the normal operation regime for P1, P2, P5 and SQ17, with the typical measured $L_{A90,T}$ background sound levels at the nearest noise-sensitive receptors in the vicinity. Sound predictions have been carried out in the noise-modelling suite Cadna/A, in accordance with the ISO 9613 prediction methodology.

For the purpose of this Assessment it is assumed that all the internal plant for the ventilation of the data suites will operate simultaneously and continuously, except for the pressure relief dampers that are assumed to only operate when the gas suppression system is activated, which is in case of fire, and therefore not considered as part of the normal site operation.

BS4142:2014 advises that when the noise contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific noise level to obtain the $L_{Ar,Tr}$ 'rating noise level'. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary. It also advises that the Assessment of the significance of sound needs to consider the context in which the sound will occur. Based on the character of the proposed ventilation plant no penalties are considered necessary for intermittency, tonality or impulsivity of the sound arising from the development.

The prevailing background sound levels used within the Assessment were measured over a 5-days period and in accordance with the principles of BS7445:2003. All acoustic measurement equipment used during the sound survey conformed to Type 1 Specification of British Standard 61672. This reduces the significance of the uncertainty in the measurements. The sound predictions were carried out using the noise-modelling suite Cadna/A, in accordance with the ISO 9613 prediction methodology. They are based on source emission levels measured at the existing plant, and a conservative approach have been followed.

The above approach effectively removes the significance of uncertainty, which has consequently, resulted in no uncertainty budgets being included within the Assessment. Considering the context; the sound from the plant is not expected to alter the character of the prevailing acoustic environment.

Table 14 below presents the predicted sound rating levels at the most exposed NSRs, and compares them against the prevailing background sound levels during the daytime and night-time respectively. Receptors have been modelled at 4 metres high to represent a worst-case upper floor. Values have been rounded to the nearest whole number.

Table 14: Assessment of the Impacts on Residential Dwellings during Normal Operations

Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	27	33-35	-6/-8	Low Adverse Impact
	Night	27	28-29	-1/-2	Low Adverse Impact
Wadwicks Green (south)	Day	28	33-35	-5/-7	Low Adverse Impact
	Night	28	28-29	+0/-1	Low Adverse Impact
Westwells Road (east)	Day	23	34	-11	No Adverse Impact
	Night	23	24	-1	Low Adverse Impact
Bradford Road (west)	Day	27	43	-16	No Adverse Impact
	Night	27	28-29	-1/-2	Low Adverse Impact

During the daytime periods, when background sound is higher, the sound from the 'normal operation' of the proposed full Data Centre will be between 5 dB below and 16 dB below the typical background at the nearest and most potentially exposed NSRs, which is an indication of Low to No Adverse Impact.

During the night-time periods, when background sound drops to very low levels, the sound from the 'normal operation' of the proposed full Data Centre will be between 0 and 2 dB below the typical background at the nearest and most potentially exposed NSRs, which is an indication of Low Adverse Impact, considering the context.

Although this is above the requirements in Planning Conditions of a rating level 5 dB below background for the operation of P3 and P4, and P5, it must be noted that the planning conditions refer to partial operation of the site, and not for the full site operation.

It must be noted that BS4142:2014 states that '*when making Assessments and arriving at decision it is essential to place the sound in context*', following on to say that '*where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night*'. Both background sound levels (28 and 24 dBA) and rating levels (28, 27 and 23 dBA) are definitely low at these Assessment locations, with absolute levels low enough to ensure good internal noise conditions within the dwelling during the night-time period ('i.e: Indoor Ambient Noise Levels within the dwelling in the order of 13, 12 and 8 dBA when considering a partially open window for ventilation, following the 15 dB reduction from outside to inside as stated in BS8233 and WHO Guidelines).

Based on the above, this BS4142:2014 Assessment concludes that the 'normal operation' of the plant, assuming the mitigation measures in section above, will not produce an adverse noise effect onto the nearest NSRs.

A sound map showing the sound breakout contours at 1.5 metres above ground is presented in Appendix C, which graphically articulates the propagation of sound from the plant into the surrounding area.

5.4 Assessment of Not Normal Operational Scenarios

The potential impact of sound during the Emergency and Maintenance operational scenarios as presented in Section 5.1 has been assessed in accordance with BS4142:2014. It must be noted that certain scenarios include extremely unlikely events, such as a main power failure and fire in the data halls. To put this into context, according to the applicant, in the last ten years of operation at Spring Park there has only been one mains power failure which impacted one building (not all) during a thunderstorm.

In addition, due to the emergency character of the plant included in this not normal operation scenarios which is expected to operate very occasionally, an Assessment based on BS8233:2014/World Health Organization guidelines has been carried out to add context.

5.4.1 Generator Emergency Operation – Scenario b

In the extremely unlikely event of a total mains supply failure, all the generators will be running at 80% load along with the plant normally operating. This emergency running it's understood to be for a 48-hour period.

BS4142 Assessment

For the purpose of this Assessment and as a worst-case scenario, it is assumed that all plant (normal operation plant and emergency power generators) on all buildings will operate simultaneously and continuously for 48 hours, which in reality is an extremely unlikely scenario.

Based on our experience the good acoustic design of these plant and associated sound mitigation elements are capable of reducing intermittency, tonality or impulsivity of the plant, which are not expected to be noticeable at receptors locations. Accordingly, no additional penalties have been added to the predicted specific sound level to obtain the rating sound level.

Table 15 below presents the predicted sound rating levels at the most exposed Noise-Sensitive Receptors (NSRs) during generators emergency backup operations and compares them against the prevailing background sound levels during the daytime and night-time respectively. Receptors have been modelled at 4 metres high to represent a worst-case upper floor. Values have been rounded to the nearest whole number.

Table 15: Assessment of the Impacts on Residential Dwellings during Generators Emergency Backup Operations – Scenario b					
Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	40	33-35	+7/+5	Low to Significant Adverse Impact
	Night	40	28-29	+12/+11	Significant Adverse Impact
Wadwicks Green (south)	Day	42	33-35	+9/+7	Significant Adverse Impact
	Night	42	28-29	+14/+13	Significant Adverse Impact
Westwells Road (east)	Day	42	34	+8	Significant Adverse Impact
	Night	42	24	+18	Significant Adverse Impact
Bradford Road (west)	Day	44	43	+1	Low Adverse Impact
	Night	44	28-29	+16/+15	Significant Adverse Impact

During the daytime periods, the sound from all the emergency generators of the development will be between 1 and 9 dB above the typical background at the nearest and most potentially exposed residential receptors, which is an indication of Low Impact to Significant Adverse Impact, depending on the context.

During the night-time periods, when background sound drops to very low levels, the sound from all the emergency generators of the proposed development will be between 11 and 18 dB above the typical background at the nearest and most potentially exposed residential receptors, which is an indication of Significant Adverse Impact, depending the context.

A sound map, showing the sound breakout contours at 1.5 metres above ground is presented in Appendix C, which graphically articulates the propagation of sound from the generators emergency plant into the surrounding area.

As advised by the applicant, the emergency generators are for the provision of power generation, to allow the Data Centre to continue operating and prevent the loss of any data in the event of mains power failure. These events are extremely unlikely to occur and if they did, would be for period of 48 hours given the operational nature of the data centres.

Giving consideration to the extremely infrequent and short duration of this scenario, it is considered appropriate to also assess its impact in accordance with BS8233:2014/World Health Organization guidelines.

BS8233:2014 / World Health Organisation Assessment

Based on the guideline values presented on these guidance, the noise emission from the proposed emergency plant should be controlled to ensure that the $L_{Aeq,T}$ value does not exceed 50 dB externally during the day, or 30 dB internally during the night, at the nearest noise-sensitive receptors.

For the calculation of the indoor noise levels, as a worst-case scenario the Assessment considers that background ventilation on existing NSRs is provided via partially open windows, which will provide a noise reduction from outside to inside of approximately 15 dB, according to BS8233:2014 and WHO Guidelines.

The predicted noise levels and subsequent assessment at each receptor is presented in Table 16 and Table 17 below. It must be noted that daytime levels at external amenity areas has been predicted at 1.5m above ground at the curtilage of the properties, while external night-time levels have been predicted as incident façade levels at first floor. Values have been rounded to the nearest whole number.

Table 16: Assessment of External Amenity Areas during daytime – Generators Emergency Backup Operations – Scenario b

Location	Predicted External Noise Level $L_{Aeq,T}$ (dB)	External Noise Target $L_{Aeq,T}$ dB	Excess of External Noise Target
Detached Property (south)	38	50	-12
Wadwicks Green (south)	37		-13
Westwells Road (east)	44		-6
Bradford Road (west)	44		-6

Table 17: Assessment of Indoor Ambient Noise Levels at Residential Dwellings – Generators Emergency Backup Operations – Scenario b

Location	Predicted Façade Incident Noise Level $L_{Aeq,T}$ (dB)	Predicted Indoor Noise Level, $L_{Aeq,T}$ dB	Indoor Ambient Noise Target $L_{Aeq,T}$ dB	Excess of Indoor Ambient Noise Target (30 dBA)
Detached Property (south)	40	25	30	-5
Wadwicks Green (south)	42	27		-3
Westwells Road (east)	42	27		-3
Bradford Road (west)	44	29		-1

It can be observed in Table 16 above that external noise target to protect outdoor amenity spaces is comfortably achieved at all NSRs.

It can also be observed in Table 17 that Indoor Ambient Noise Levels (IANL) target is achieved at all NSRs.

Based on the emergency character of this plant and the very occasional and short use expected, this assessment concludes that the 'Generators Emergency Backup Operations' of the plant will not produce a significant adverse noise effect at the nearest NSRs.

5.4.2 Cooling Systems Emergency Operation - Scenario c

In the extremely unlikely event of a fire affecting all the facilities at once, the DX and ACCU external units will be running at full load along with the plant normally operating. This emergency running it's understood to be for a 48-hour period. Assuming a fire will affect all building, or modules in a building simultaneously is an extreme scenario.

BS4142 Assessment

For the purpose of this Assessment and as a worst-case scenario, it is assumed that all plant (normal operation plant and emergency cooling plant) on all buildings will operate simultaneously and continuously for 48 hours, which in reality is an extremely unlikely scenario.

Based on our experience the good acoustic design of these plant and associated sound mitigation elements are capable of reducing intermittency, tonality or impulsivity of the plant, which are not expected to be noticeable at receptors locations. Accordingly, no additional penalties has been added to the predicted specific sound level to obtain the rating sound level.

Table 18 below presents the predicted sound rating levels at the most exposed Noise-Sensitive Receptors (NSRs) during the cooling systems emergency operations and compares them against the prevailing background sound levels during the daytime and night-time respectively. Receptors have been modelled at 4 metres high to represent a worst-case upper floor. Values have been rounded to the nearest whole number.

Table 18: Assessment of the Impacts on Residential Dwellings during Cooling System Emergency Operations – Scenario c

Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	42	33-35	+9/+7	Significant Adverse Impact
	Night	42	28-29	+14/+13	Significant Adverse Impact
Wadwicks Green (south)	Day	45	33-35	+12/+10	Significant Adverse Impact
	Night	45	28-29	+17/+16	Significant Adverse Impact
Westwells Road (east)	Day	51	34	+17	Significant Adverse Impact
	Night	51	24	+27	Significant Adverse Impact
Bradford Road (west)	Day	38	43	-5	Low Adverse Impact
	Night	38	28-29	+10/+9	Significant Adverse Impact

During the daytime periods, the sound from all the emergency cooling system plant of the development will be between 5 dB below and 17 dB above the typical background at the nearest and most potentially exposed residential receptors, which is an indication of Low Impact to Significant Adverse Impact, depending on the context.

During the night-time periods, when background sound drops to very low levels, the sound from all the emergency cooling system plant of the proposed development will be between 9 and 27 dB above the typical background at the nearest and most potentially exposed residential receptors, which is an indication of Significant Adverse Impact, depending the context.

A sound map, showing the sound breakout contours at 1.5 metres above ground is presented in Appendix C, which graphically articulates the propagation of sound from the cooling system emergency plant into the surrounding area.

As advised by the applicant, this scenario would happen in the event of a fire affecting all the facilities, which is extremely unlikely to occur and if it did, would be for period of no longer than 48 hours.

Considering the extremely unlikely and short duration of this scenario, it is considered appropriate to also assess its impact in accordance with BS8233:2014/World Health Organization guidelines.

BS8233:2014 / World Health Organisation Assessment

Based on the guideline values presented on these guidance, the noise emission from the proposed emergency plant should be controlled to ensure that the $L_{Aeq,T}$ value does not exceed 50 dB externally during the day, or 30 dB internally during the night, at the nearest noise-sensitive receptors.

For the calculation of the indoor noise levels, as a worst-case scenario the Assessment considers that background ventilation on existing NSRs is provided via partially open windows, which will provide a noise reduction from outside to inside of approximately 15 dB, according to BS8233:2014 and WHO Guidelines.

The predicted noise levels and subsequent assessment at each receptor is presented in Table 19 and Table 20 below. It must be noted that daytime levels at external amenity areas has been predicted at 1.5m above ground at the curtilage of the properties, while external night-time levels have been predicted as incident façade levels at first floor. Values have been rounded to the nearest whole number.

Table 19: Assessment of External Amenity Areas during daytime – Cooling System Emergency Operations – Scenario c

Location	Predicted External Noise Level $L_{Aeq,T}$ (dB)	External Noise Target $L_{Aeq,T}$ dB	Excess of External Noise Target
Detached Property (south)	41	50	-9
Wadwicks Green (south)	42		-8
Westwells Road (east)	51		+1
Bradford Road (west)	37		-13

Table 20: Assessment of Indoor Ambient Noise Levels at Residential Dwellings – Cooling System Emergency Operations – Scenario c

Location	Predicted Façade Incident Noise Level $L_{Aeq,T}$ (dB)	Predicted Indoor Noise Level, $L_{Aeq,T}$ dB	Indoor Ambient Noise Target $L_{Aeq,T}$ dB	Excess of Indoor Ambient Noise Target (30 dBA)
Detached Property (south)	42	27	30	-3
Wadwicks Green (south)	45	30		+0
Westwells Road (east)	51	36		+6
Bradford Road (west)	38	23		-7

It can be observed in Table 19 above that external noise target to protect outdoor amenity spaces is comfortably achieved at all NSRs, except for Westwells Road receptors where it is marginally exceeded.

It can also be observed in Table 20 that Indoor Ambient Noise Levels (IANL) target is achieved at all NSRs, except for Westwells Road receptors.

It must be noted that BS8233:2014 recognises that with a relaxation of 5 dB upon the above targets still reasonable noise conditions can be expected. Therefore, the internal ambient noise levels at night will marginally exceed reasonable conditions.

Based on the emergency character of this scenario operation in case of a fire at all the facilities and short use expected (48 hours), this assessment concludes that the 'Cooling System Emergency Operations' of the plant will not produce a significant adverse noise effect at the nearest NSRs.

5.4.3 Summer Cooling Systems Operation - Scenario d

In hot external ambient conditions with temperatures above 27°C, the DX and ACCU units will operate along with the normal operation plant for short periods of time during the daytime hours, when these temperatures are more likely in hot summer days.

BS4142 Assessment

For the purpose of this Assessment and as a worst-case scenario, it is assumed that all plant (normal operation plant and emergency cooling plant) on all buildings will operate simultaneously and continuously during the daytime, which in reality is an unlikely scenario, as this will happen for shorter periods of time.

As mentioned above, no additional penalties have been added to the predicted specific sound level to obtain the rating sound level.

Table 21 below presents the predicted sound rating levels at the most exposed Noise-Sensitive Receptors (NSRs) during hot external ambient conditions operations and compares them against the prevailing background sound levels during the daytime. Receptors have been modelled at 4 metres high to represent a worst-case upper floor. Values have been rounded to the nearest whole number.

Table 21: Assessment of the Impacts on Residential Dwellings during Summer Hot Weather Days Operations – Scenario d

Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	42	33-35	+9/+7	Significant Adverse Impact
Wadwicks Green (south)	Day	45	33-35	+12/+10	Significant Adverse Impact
Westwells Road (east)	Day	51	34	+17	Significant Adverse Impact
Bradford Road (west)	Day	38	43	-5	Low Adverse Impact

During the daytime periods, the sound from all the emergency cooling system plant of the development will be between 5 dB below and 17 dB above the typical background at the nearest and most potentially exposed residential receptors, which is an indication of Low Impact to Significant Adverse Impact, depending on the context.

As advised by the applicant, this scenario would happen in hot summer days when the external temperature is above 27°C, which is unlikely to occur during the whole day and for several days in the year.

Considering the unlikely and short duration of this scenario, it is considered appropriate to also assess its impact in accordance with BS8233:2014/World Health Organization guidelines.

BS8233:2014 / World Health Organisation Assessment

Based on the guideline values presented on these guidance, the noise emission from the proposed emergency plant should be controlled to ensure that the $L_{Aeq,T}$ value does not exceed 50 dB externally during the day, or 35 dB internally, at the nearest noise-sensitive receptors.

For the calculation of the indoor noise levels, as a worst-case scenario the Assessment considers that background ventilation on existing NSRs is provided via partially open windows, which will provide a noise reduction from outside to inside of approximately 15 dB, according to BS8233:2014 and WHO Guidelines.

The predicted noise levels and subsequent assessment at each receptor is presented in Table 19 in section above and Table 22 below. It must be noted that daytime levels at external amenity areas has been predicted at 1.5m above ground at the curtilage of the properties, while external daytime levels at façades have been predicted at first floor. Values have been rounded to the nearest whole number.

Table 22: Assessment of Indoor Ambient Noise Levels at Residential Dwellings – Summer Hot Weather Days Operations – Scenario d

Location	Predicted Façade Incident Noise Level $L_{Aeq,T}$ (dB)	Predicted Indoor Noise Level, $L_{Aeq,T}$ dB	Indoor Ambient Noise Target $L_{Aeq,T}$ dB	Excess of Indoor Ambient Noise Target (35 dBA)
Detached Property (south)	42	27	35	-8
Wadwicks Green (south)	45	30		-5
Westwells Road (east)	51	36		+1
Bradford Road (west)	38	23		-12

It can be observed in Table 19 in section above (same emergency cooling plant as for this scenario d) that external noise target to protect outdoor amenity spaces is comfortably achieved at all NSRs, except for Westwells Road receptors where it is marginally exceeded.

It can also be observed in Table 22 that Indoor Ambient Noise Levels (IANL) target is achieved at all NSRs, except for Westwells Road receptors where is marginally exceeded. It must be noted that BS8233:2014 recognises that with a relaxation of 5 dB upon the above targets still reasonable noise conditions can be expected.

Based on the sporadic character of this scenario operation, this assessment concludes that the 'Summer Hot Weather Cooling Operations' of the plant will not produce a significant adverse noise effect at the nearest NSRs.

5.4.4 Generators Emergency during Hot Weather Operation - Scenario e

In the extremely unlikely event of a total mains supply failure when hot external ambient conditions, all the generators running at 80% load along with all the DX and ACCU units. This scenario is extremely unlikely and will only happen during the daytime periods, as during the night the temperatures are lower. This emergency running will be for a maximum 48-hour period.

BS4142 Assessment

For the purpose of this Assessment and as a worst-case scenario, it is assumed that all plant (normal operation plant, emergency power generators and emergency cooling plant) on all buildings will operate simultaneously and continuously during the daytime, which in reality is an unlikely scenario.

As mentioned above, no additional penalties have been added to the predicted specific sound level to obtain the rating sound level.

Table 23 below presents the predicted sound rating levels at the most exposed Noise-Sensitive Receptors (NSRs) during hot external ambient conditions operations and a main power supply failure and compares them against the prevailing background sound levels during the daytime. Receptors have been modelled at 4 metres high to represent a worst-case upper floor. Values have been rounded to the nearest whole number.

Table 23: Assessment of the Impacts on Residential Dwellings during Generators Emergency during Hot Weather Operation - Scenario e

Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	44	33-35	+11/+9	Significant Adverse Impact
Wadwicks Green (south)	Day	46	33-35	+13/+11	Significant Adverse Impact
Westwells Road (east)	Day	52	34	+18	Significant Adverse Impact
Bradford Road (west)	Day	45	43	+2	Low Adverse Impact

During the daytime periods, the sound from all the emergency generators and cooling system plant of the development will be between 2 dB and 18 dB above the typical background at the nearest and most potentially exposed residential receptors, which is an indication of Low Impact to Significant Adverse Impact, depending on the context.

A sound map, showing the sound breakout contours at 1.5 metres above ground is presented in Appendix C, which graphically articulates the propagation of sound from the emergency plant into the surrounding area.

As advised by the applicant, this scenario would happen in the event of mains power failure during hot summer days when the external temperature is above 27°C, which is unlikely to occur during the whole day and for several days in the year. Also, these events are extremely unlikely to occur and if they did, would be for period of 2days given the operational nature of the data centres.

Considering the extremely unlikely and short duration of this scenario, it is considered appropriate to also assess its impact in accordance with BS8233:2014/World Health Organization guidelines.

BS8233:2014 / World Health Organisation Assessment

Based on the guideline values presented on these guidance, the noise emission from the proposed emergency plant should be controlled to ensure that the $L_{Aeq,T}$ value does not exceed 50 dB externally during the day, or 35 dB internally, at the nearest noise-sensitive receptors.

For the calculation of the indoor noise levels, as a worst-case scenario the Assessment considers that background ventilation on existing NSRs is provided via partially open windows, which will provide a noise reduction from outside to inside of approximately 15 dB, according to BS8233:2014 and WHO Guidelines.

The predicted noise levels and subsequent assessment at each receptor is presented in Table 24 and Table 25 below. It must be noted that daytime levels at external amenity areas has been predicted at 1.5m above ground at the curtilage of the properties, while external daytime levels at façades have been predicted at first floor. Values have been rounded to the nearest whole number.

Table 24: Assessment of External Amenity Areas during daytime – Generators Emergency during Hot Weather Operation - Scenario e			
Location	Predicted External Noise Level $L_{Aeq,T}$ (dB)	External Noise Target $L_{Aeq,T}$ dB	Excess of External Noise Target
Detached Property (south)	43	50	-7
Wadwicks Green (south)	44		-6
Westwells Road (east)	52		+2
Bradford Road (west)	45		-5

Table 25: Assessment of Indoor Ambient Noise Levels at Residential Dwellings – Generators Emergency during Hot Weather Operation - Scenario e				
Location	Predicted Façade Incident Noise Level $L_{Aeq,T}$ (dB)	Predicted Indoor Noise Level, $L_{Aeq,T}$ dB	Indoor Ambient Noise Target $L_{Aeq,T}$ dB	Excess of Indoor Ambient Noise Target (30 dBA)
Detached Property (south)	44	29	35	-6
Wadwicks Green (south)	46	31		-4
Westwells Road (east)	52	37		+2
Bradford Road (west)	45	30		-5

It can be observed in Table 24 above that external noise target to protect outdoor amenity spaces is comfortably achieved at all NSRs, except for Westwells Road receptors where it is marginally exceeded.

It can also be observed in Table 25 that Indoor Ambient Noise Levels (IANL) target is achieved at all NSRs, except for Westwells Road receptors where is marginally exceeded. It must be noted that BS8233:2014 recognises that with a relaxation of 5 dB upon the above targets still reasonable noise conditions can be expected.

Based on the emergency character of this scenario operation in the event of mains power failure during hot summer days when the external temperature is above 27°C and short use expected (48 hours), this assessment concludes that the 'Generators Emergency during hot weather Operations' of the plant will not produce a significant adverse noise effect at the nearest NSRs.

5.4.5 Generators Maintenance Operation - Scenario f

Different maintenance tests are undertaken every month, every three months and once a year for each generator and all energy centres. The duration of the tests is of 15 minutes and it's generally done generator by generator. As a worst case, the simultaneous operation of all the generators along with normal operation plant during 15 min has been considered for each building individually.

BS4142 Assessment

For the purpose of this Assessment and as a worst-case scenario, it is assumed that all plant (normal operation plant and emergency power generators) on each building will operate simultaneously and continuously during 15 minutes during the daytime. The HV Farm maintenance tests have been assessed operating all the engines at the same time which represent a worst case, as the actual tests take place in batches.

As mentioned above, no additional penalties have been added to the predicted specific sound level to obtain the rating sound level.

Tables below presents the predicted sound rating levels at the most exposed Noise-Sensitive Receptors (NSRs) during generators maintenances tests for each building and compares them against the prevailing background sound levels during the daytime. Receptors have been modelled at 4 metres high to represent a worst-case upper floor. Values have been rounded to the nearest whole number.

Table 26: Assessment of the Impacts on Residential Dwellings during P1 Generators Maintenance Tests - Scenario f

Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	27	33-35	-6/-8	Low Adverse Impact
Wadwicks Green (south)	Day	28	33-35	-5/-7	Low Adverse Impact
Westwells Road (east)	Day	23	34	-11	No Adverse Impact
Bradford Road (west)	Day	27	43	-16	No Adverse Impact

Table 27: Assessment of the Impacts on Residential Dwellings during P2 Generators Maintenance Tests - Scenario f

Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	27	33-35	-6/-8	Low Adverse Impact
Wadwicks Green (south)	Day	28	33-35	-5/-7	Low Adverse Impact
Westwells Road (east)	Day	23	34	-11	No Adverse Impact
Bradford Road (west)	Day	33	43	-10	No Adverse Impact

Table 28: Assessment of the Impacts on Residential Dwellings during SQ17 Generators Maintenance Tests - Scenario f

Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	37	33-35	+4/+2	Low Adverse Impact

Table 28: Assessment of the Impacts on Residential Dwellings during SQ17 Generators Maintenance Tests - Scenario f					
Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Wadwicks Green (south)	Day	38	33-35	+5/+3	Low Adverse Impact
Westwells Road (east)	Day	24	34	-10	No Adverse Impact
Bradford Road (west)	Day	42	43	-1	Low Adverse Impact

Table 29: Assessment of the Impacts on Residential Dwellings during HV Farm Generators Maintenance Tests - Scenario f					
Location	Period	Predicted Rating Sound Level $L_{Ar,Tr}$ (dB)	Typical Background Sound Level $L_{A90,T}$ (dB)	Excess of $L_{Ar,Tr}$ above $L_{A90,T}$ (dB)	Significance of Sound (Depending on the context)
Detached Property (south)	Day	27	33-35	-6/-8	Low Adverse Impact
Wadwicks Green (south)	Day	28	33-35	-5/-7	Low Adverse Impact
Westwells Road (east)	Day	27	34	-7	Low Adverse Impact
Bradford Road (west)	Day	27	43	-16	No Adverse Impact

The sound from all the emergency generators maintenance tests of the development will be between 5 dB above and 16 dB below the typical background at the nearest and most potentially exposed residential receptors, which is an indication of Low to No Adverse Impact, depending on the context.

Generally, the sound from the site generators maintenance tests is well below the typical background levels at the receptor's location. Only the receptors to the south of the site will be affected by levels above background during the maintenance tests for SQ17 generators. Putting this into context, it must be noted that the typical background levels were measured during the evening, and that it is expected that the background levels during the mornings and afternoons (times when the maintenance test will happen) will be higher. Also, the above assessment considers all the SQ17 generators operating simultaneously, when the tests are usually undertaken generator by generator or in small groups.

Takin into consideration all the above and the fact that this will occur on a monthly basis, the maintenance tests is considered to have no adverse impact at the nearest residential receptors.

6 Conclusion

MLM Consulting Engineers has been commissioned by Ark Estates Spring Park Limited to undertake a noise assessment, in order to assess the impact of noise associated with full Data Centre site operations at Spring Park, Corsham, to support an Environmental Permit application for the extension of the current consented site.

The current assessment is intended to evaluate the operation of the full site including the addition of P5 and the extension of SQ17 in support of an Environmental Permit application.

This Report assesses the acoustic acceptability of the full Data Centre site, following the baseline sound survey previously carried out at the nearest noise-sensitive receptors and a comprehensive noise modelling exercise. The assumptions of the noise model are detailed in the Assessment text and are based on source noise measurements carried out at existing and operating Data Centre P1, P2, Module P3, SQ17, data provided by the applicant, and necessary sound reductions.

Six scenarios have been assessed. The 'Normal Operation' scenario assesses acoustic impact of plant which will normally be running, such us the internal plant rooms with associated ventilation inlet and outlet louvers at the buildings' facades and the external roof plant associated with P5 ancillary block and SQ17 extension. Additional noise sources found to be significant during the site visits at P1, P2 and SQ17 have also be incorporated for the 'Normal Operation' scenario.

Different 'Emergency Backup' and not normal scenarios assess the acoustic impact of the different situations, including the extremely unlikely event of roof-mounted air-cooled condensing units associated with emergency cooling system operation and backup electricity generators operation associated with main power failure occurring simultaneously.

The outcomes of the Assessment show that incorporating the noise reductions set out in the text the 'Normal Operations' are expected to have No Impact or a Low Adverse Noise Impact at the nearest and most exposed noise-sensitive receptors, when assessed in accordance with BS4142:2014.

The 'Emergency Generators Backup Operations' have shown to have a Low to Significant Adverse noise impact when assessed in accordance with BS4142:2014. However, considering the emergency, short duration and very occasional occurrence of this scenario, it is considered appropriate to extend the Assessment to comply with BS8233:2014/WHO Guidelines.

This Assessment has found that in the worst-case scenario of all emergency power generators from all buildings operating at the same time, the BS8233:2014/WHO Guidelines at external amenity areas and the Indoor Ambient Noise Levels targets are achieved at all nearby properties. This scenario operation will not produce a significant adverse noise effect at the nearest NSRs

The 'Cooling System Emergency Operations' have shown to have a Low to Significant Adverse noise impact when assessed in accordance with BS4142:2014. However, considering the emergency, short duration and extremely rare occurrence of this scenario, it is considered appropriate to extend the Assessment to comply with BS8233:2014/WHO Guidelines.

This Assessment has found that in the worst-case scenario of all emergency cooling system plant from all buildings operating at the same time, the BS8233:2014/WHO Guidelines at external amenity areas are achieved at most nearby properties and marginally exceeded at Westwells Road. The Indoor Ambient Noise Levels targets are achieved at most nearby properties and reasonable conditions marginally exceeded at Westwells Road. This scenario operation will not produce a significant adverse noise effect at the nearest NSRs considering the extremely rare occurrence.

The 'Summer Cooling System Operations' have shown to have a Low to Significant Adverse noise impact when assessed in accordance with BS4142:2014. However, considering the short duration of this scenario, it is considered appropriate to extend the Assessment to comply with BS8233:2014/WHO Guidelines.

This Assessment has found that in the worst case scenario of all cooling system plant from all buildings operating at the same time, the BS8233:2014/WHO Guidelines at external amenity areas and Indoor Ambient Noise Levels are achieved at most nearby properties and marginally exceeded at Westwells Road, but it would be within the +5 dB relaxation at which 'reasonable' acoustic conditions can be expected. This scenario operation will not produce a significant adverse noise effect at the nearest NSRs considering the context.

The 'Emergency Generators during Hot Weather Backup Operations' have shown to have a Low to Significant Adverse noise impact when assessed in accordance with BS4142:2014. However, considering the emergency, short duration and very rare occurrence of this scenario, it is considered appropriate to extend the Assessment to comply with BS8233:2014/WHO Guidelines.

This Assessment has found that in the worst case scenario of all cooling system plant from all buildings and all emergency power generators operating at the same time, the BS8233:2014/WHO Guidelines at external amenity areas and Indoor Ambient Noise Levels are achieved at most nearby properties and marginally exceeded at Westwells Road, but it would be within the +5 dB relaxation at which 'reasonable' acoustic conditions can be expected. This scenario operation will not produce a significant adverse noise effect at the nearest NSRs.

The 'Emergency Generators Maintenance Tests Operations' have shown to have a Low to No Adverse noise impact when assessed in accordance with BS4142:2014.

© MLM Consulting Engineers Limited

Appendix A - Glossary of Acoustic Terminology

Wording	Description
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa (20x10-6 Pascal's) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which considers the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. Lmax is sometimes used for the Assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L10 can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

In order to assist the understanding of acoustic terminology and the relative change in sound, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 db. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1: Typical Sound Levels Found In The Environment	
Sound Level	$L_{A90,T}$
0 dB(A)	Threshold of hearing
20 to 30 dB(A)	Quiet bedroom at night
30 to 40 dB(A)	Living room during the day
40 to 50 dB(A)	Typical office
50 to 60 dB(A)	Inside a car
60 to 70 B(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140 dB(A)	Threshold of Pain

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale is commonly identified by the notation dB (A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB (A) in the noise level from a single source.

A change of 3 dB (A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB (A) is just perceptible). Therefore, a 2 dB (A) increase would not be normally be perceptible. A 10 dB (A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}.

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the sound measurement should be specified. For example, BS 4142 specifies background sound measurement periods of 1 hour during the day and 15 minutes during the night. The sound levels are commonly symbolised as L_{A90}, 1hour dB and L_{A90}, 15mins dB. The sound measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms

Appendix B - Full Sound Measurements Results

© MLM Consulting Engineers Limited

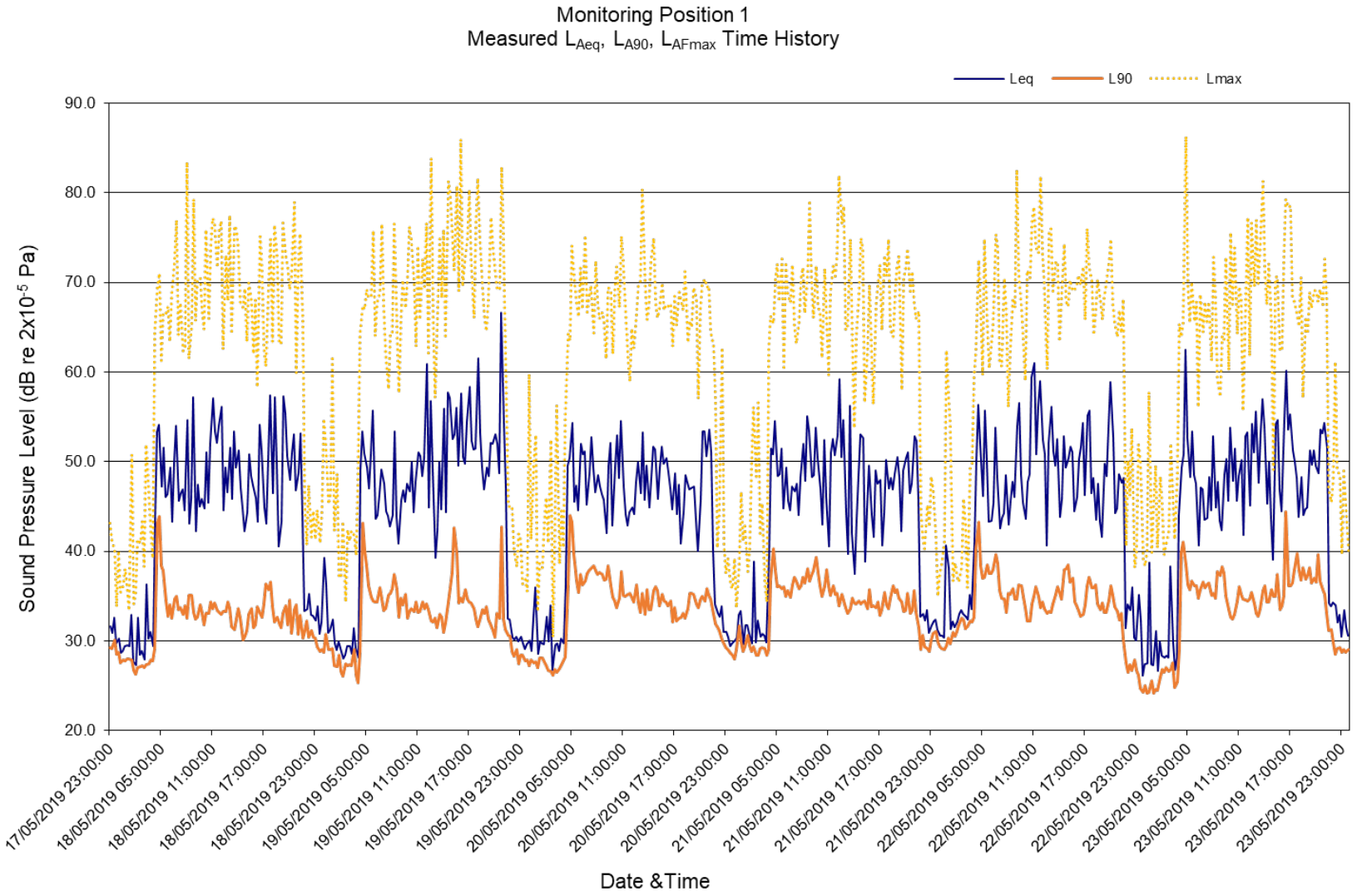


Figure B1: Time History of L_{Aeq}, L_{A90},L_{Amax}, (dB) Noise Levels at Monitoring Position 1

© MLM Consulting Engineers Limited

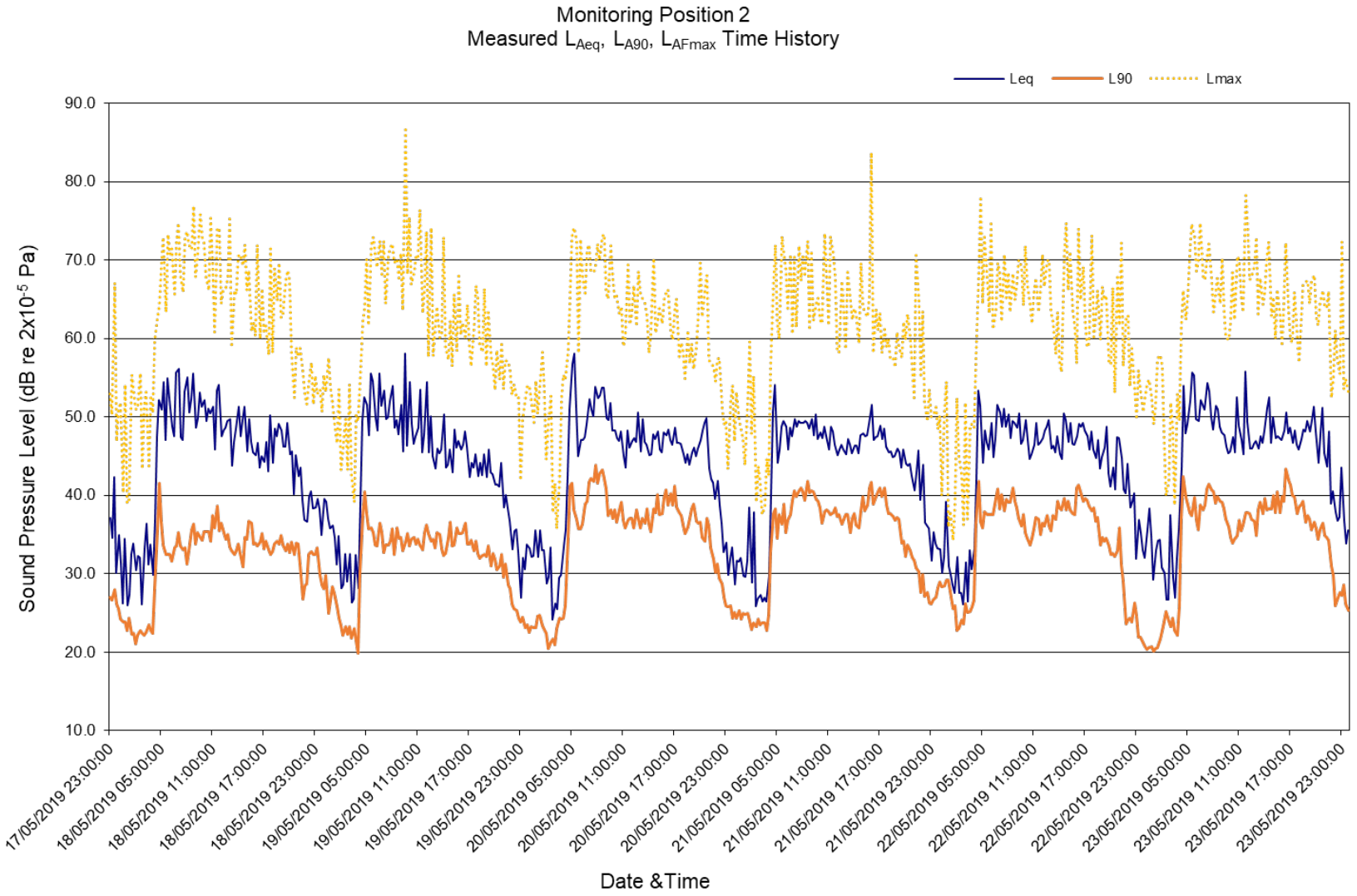


Figure B2: Time History of L_{Aeq}, L_{A90},L_{Amax}, (dB) Noise Levels at Monitoring Position 2

© MLM Consulting Engineers Limited

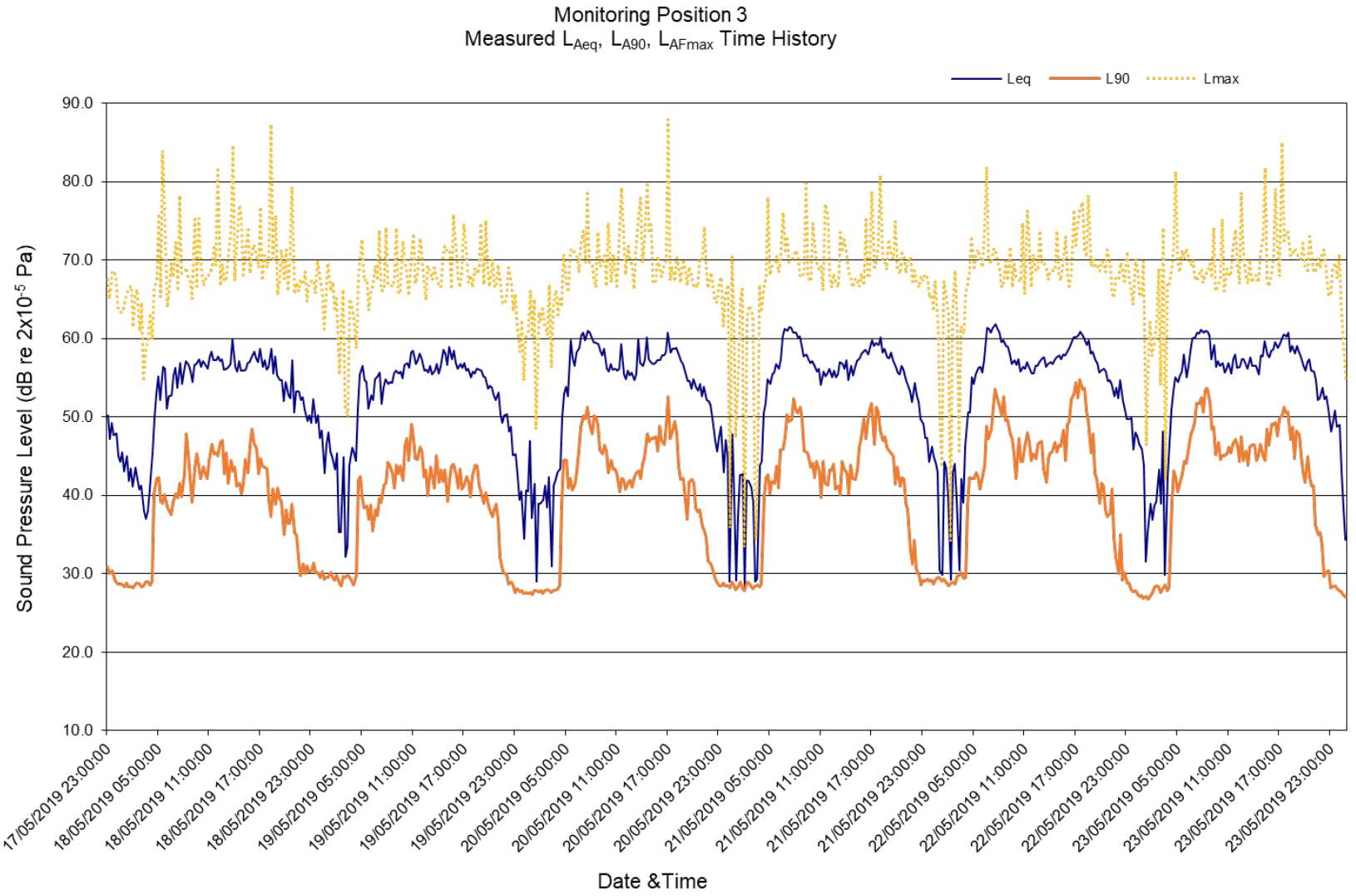


Figure B3: Time History of L_{Aeq}, L_{A90},L_{Amax}, (dB) Noise Levels at Monitoring Position 3

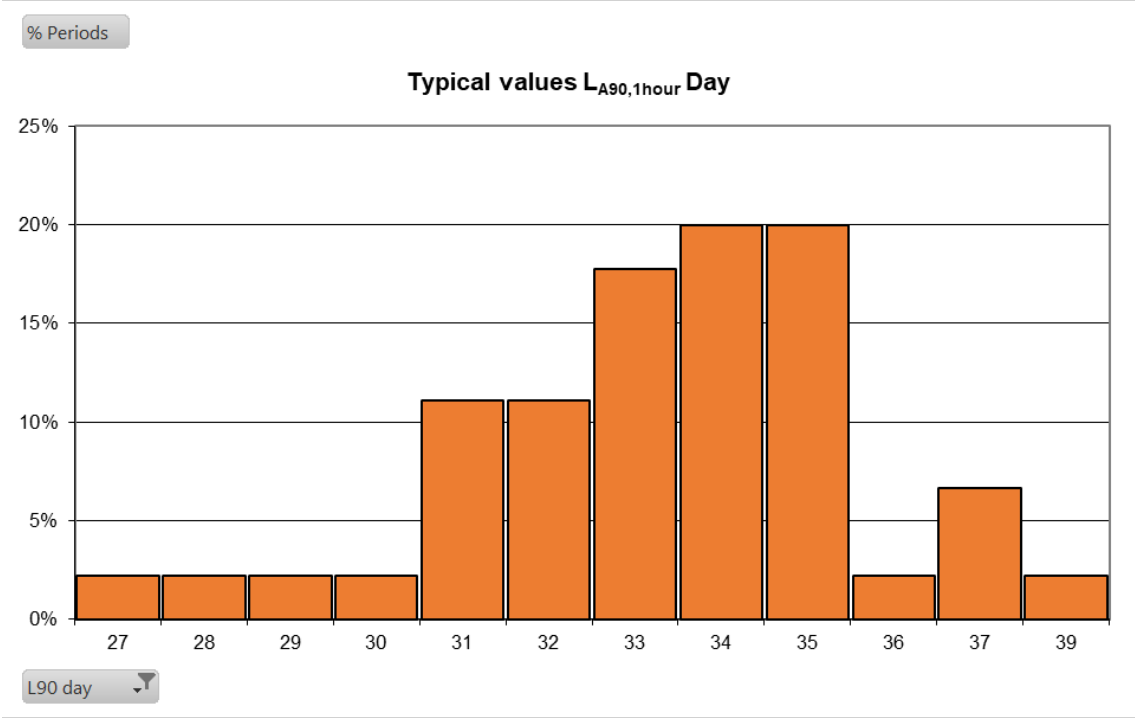


Figure B4: Statistical Analysis $L_{A90,\ 1\ hour}$ Daytime – Position 1

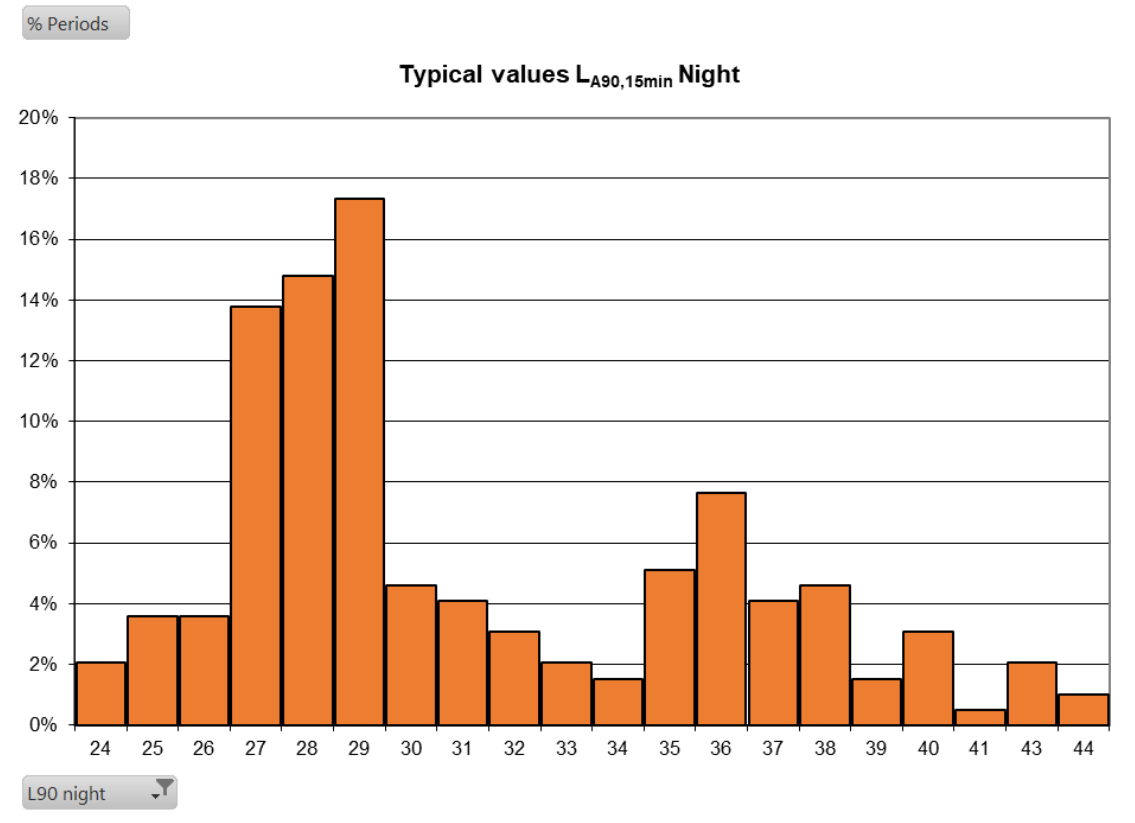


Figure B5: Statistical Analysis $L_{A90,\ 15\ min}$ Night Time – Position 1

© MLM Consulting Engineers Limited

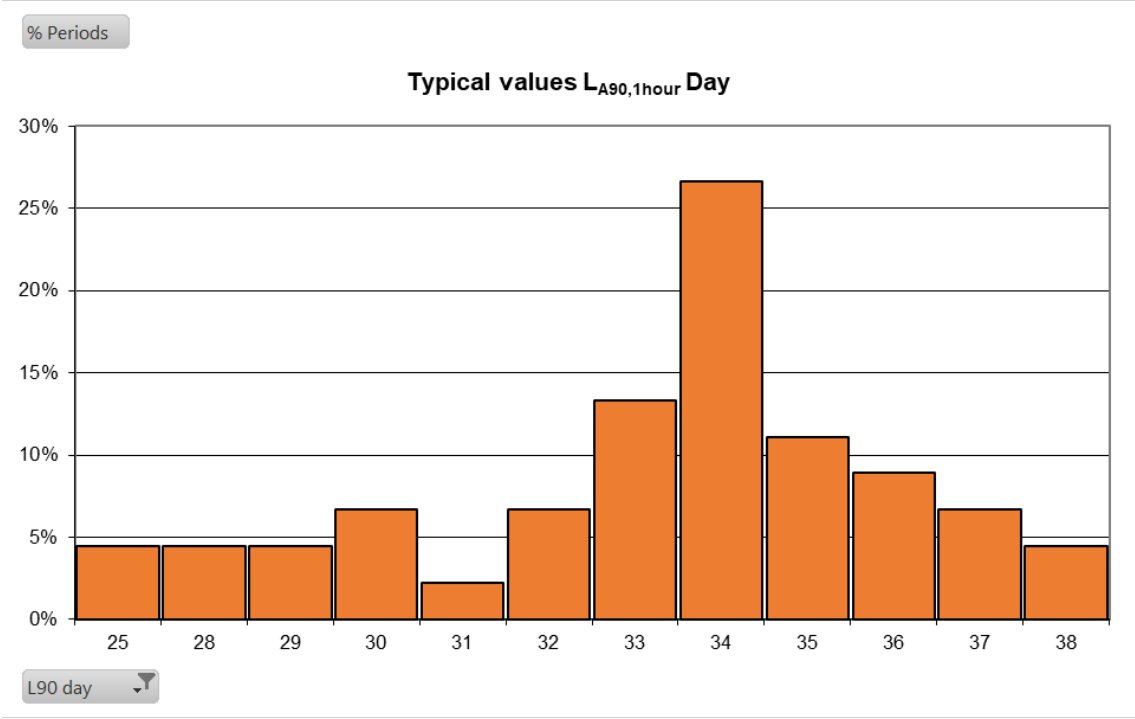


Figure B6: Statistical Analysis $L_{A90,\ 1\ hour}$ Daytime – Position 2

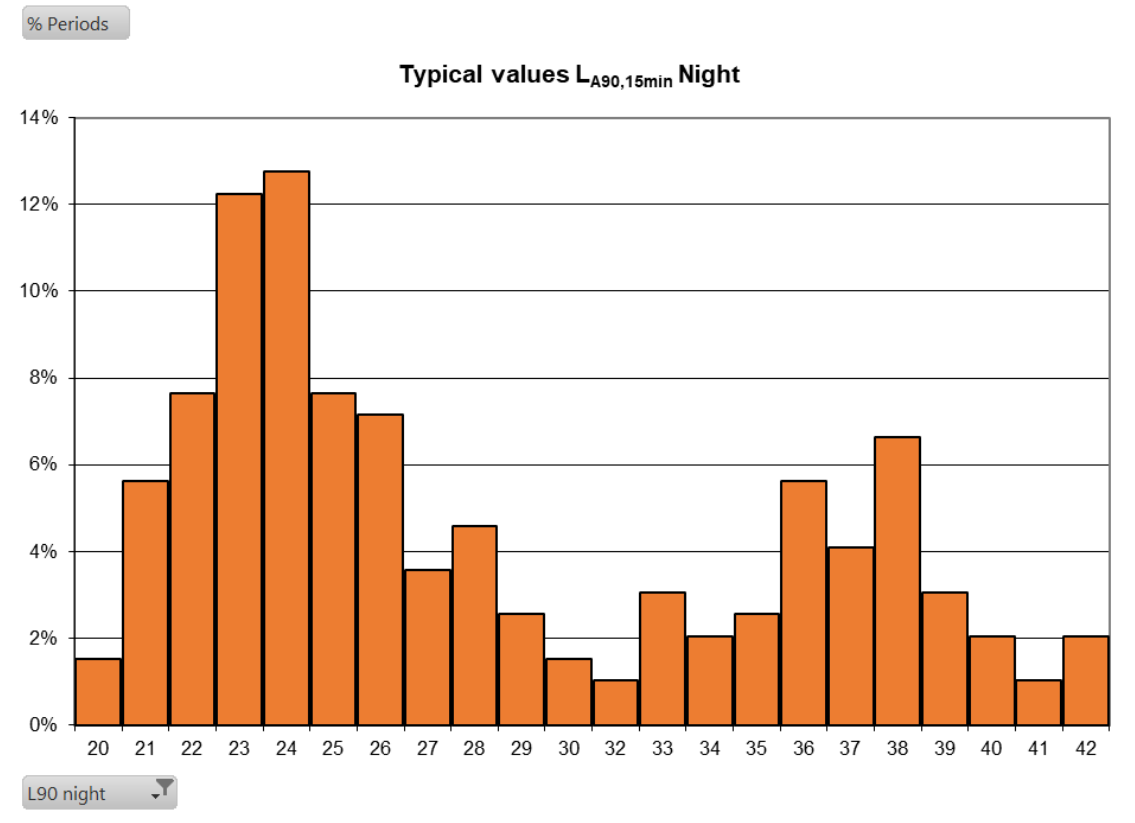


Figure B7: Statistical Analysis $L_{A90,\ 15\ min}$ Night Time – Position 2

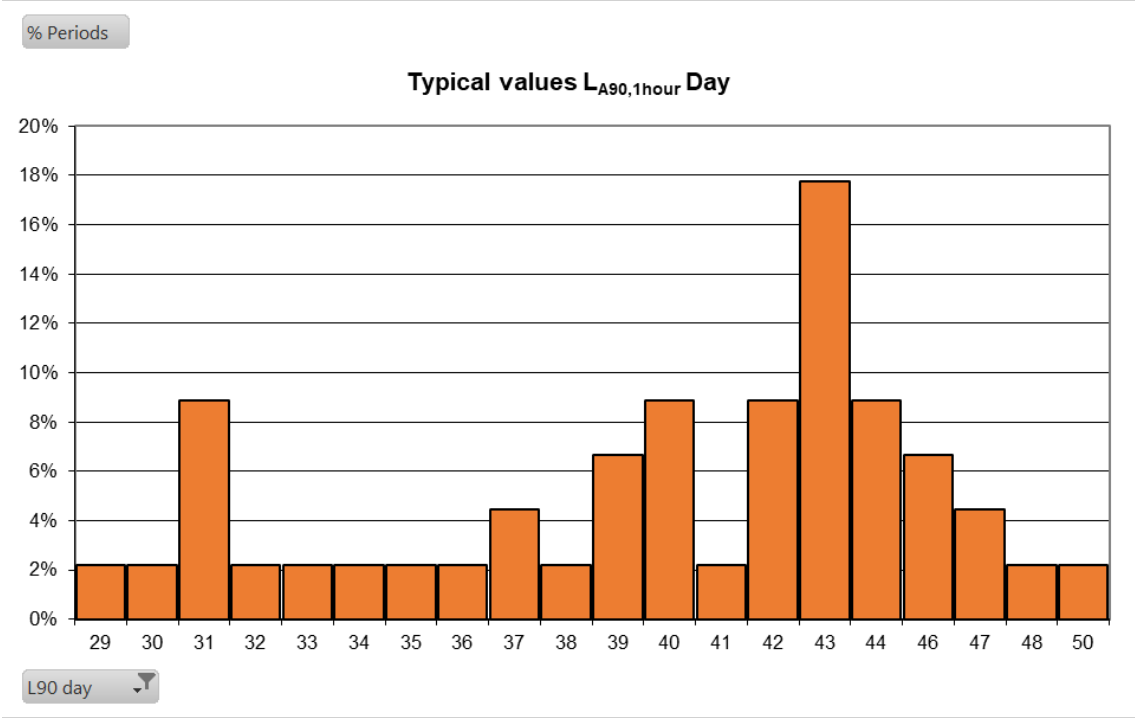


Figure B8: Statistical Analysis $L_{A90,\ 1\ hour}$ Daytime – Position 3

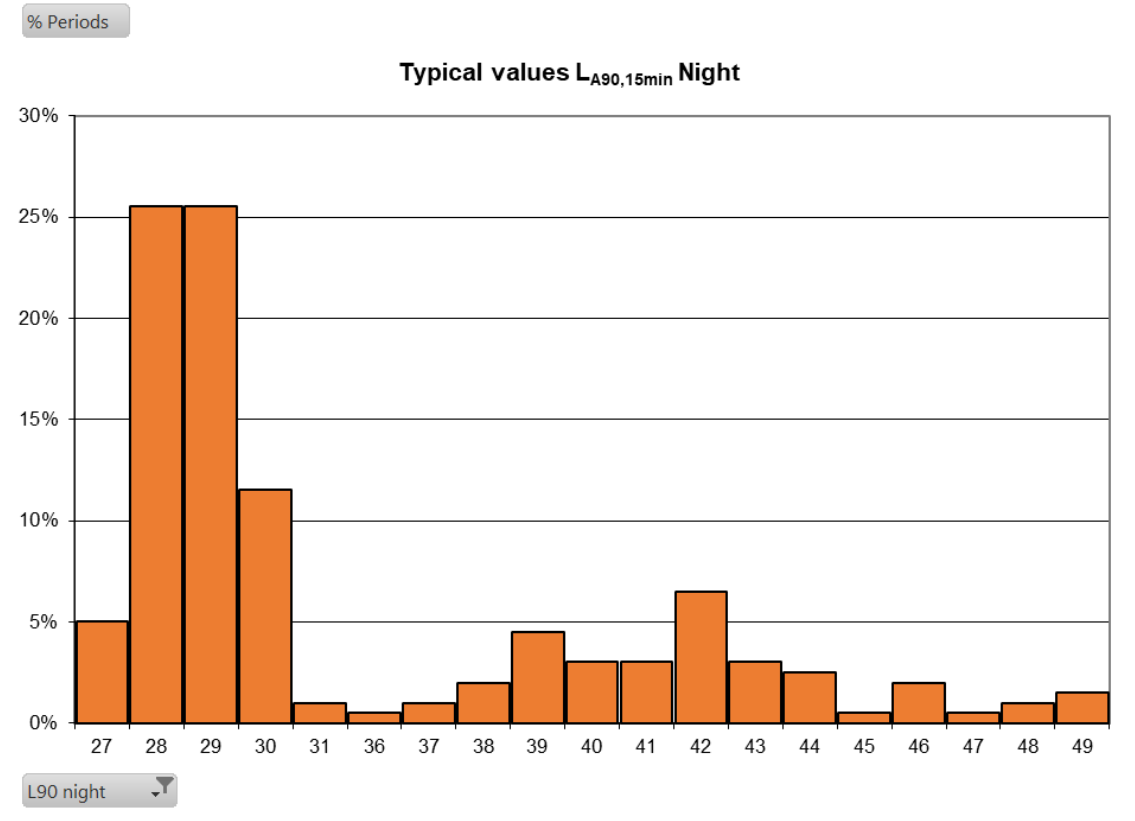
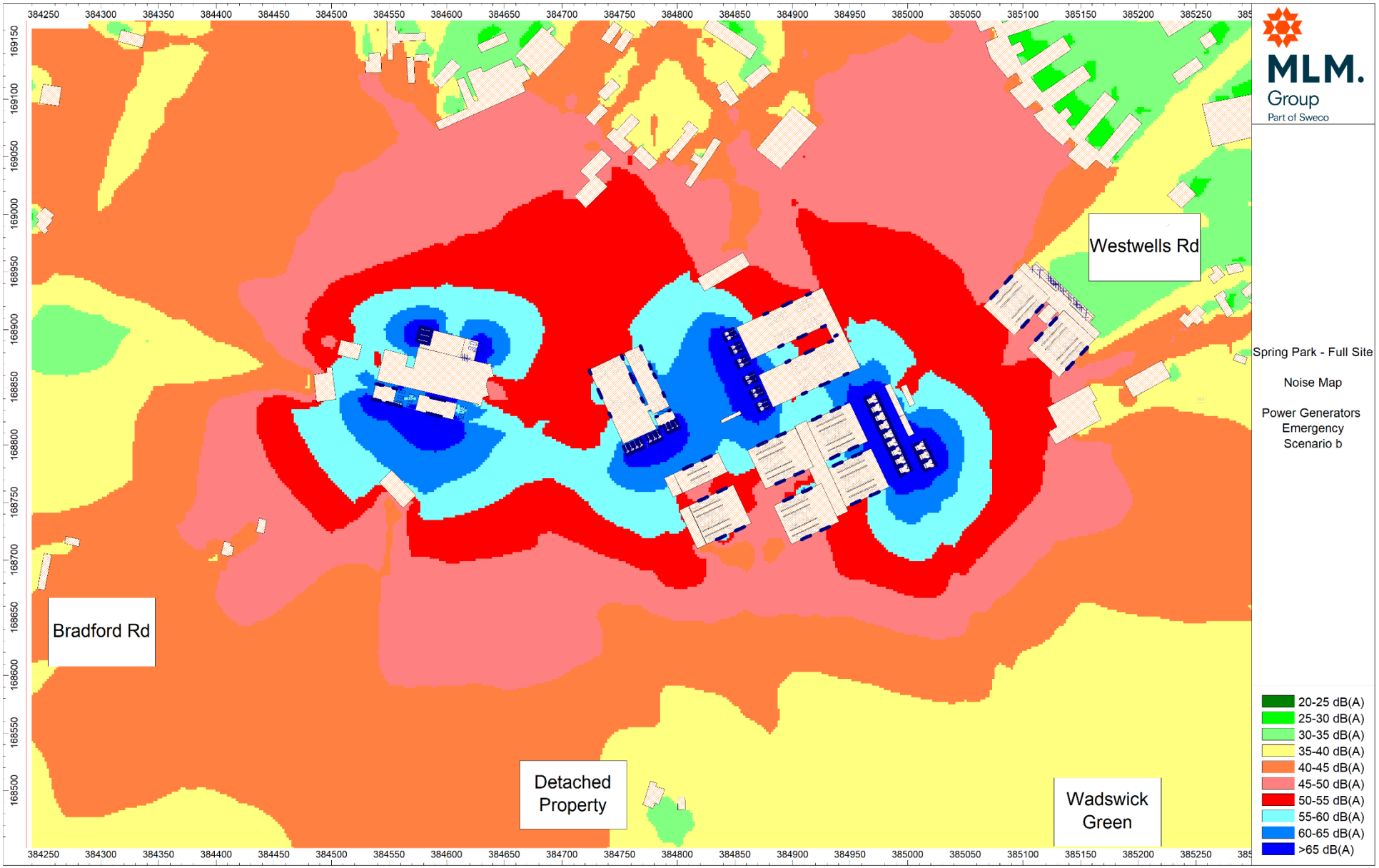


Figure B9: Statistical Analysis $L_{A90,\ 15\ min}$ Night Time – Position 3

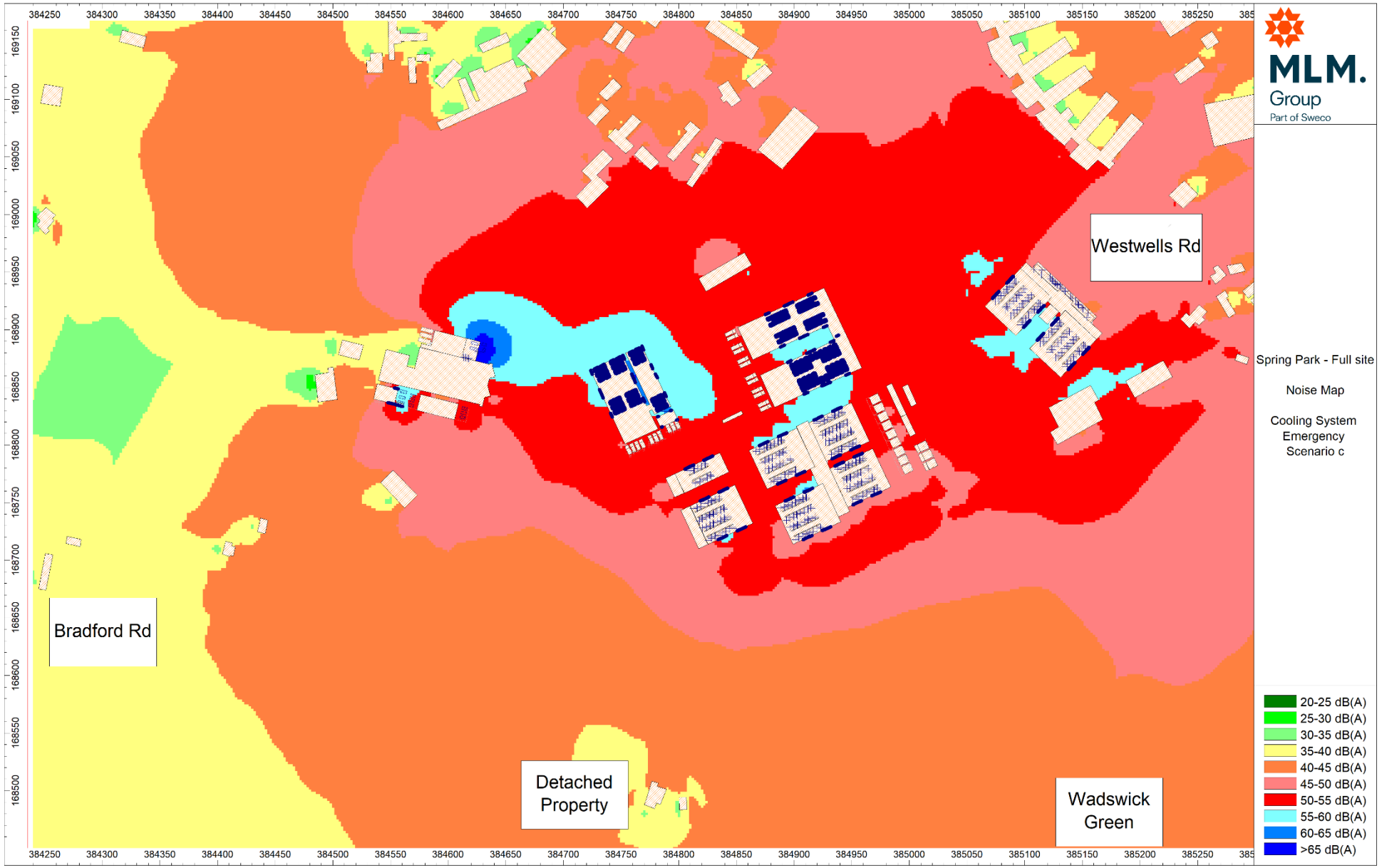
Appendix C - Noise Maps

© MLM Consulting Engineers Limited

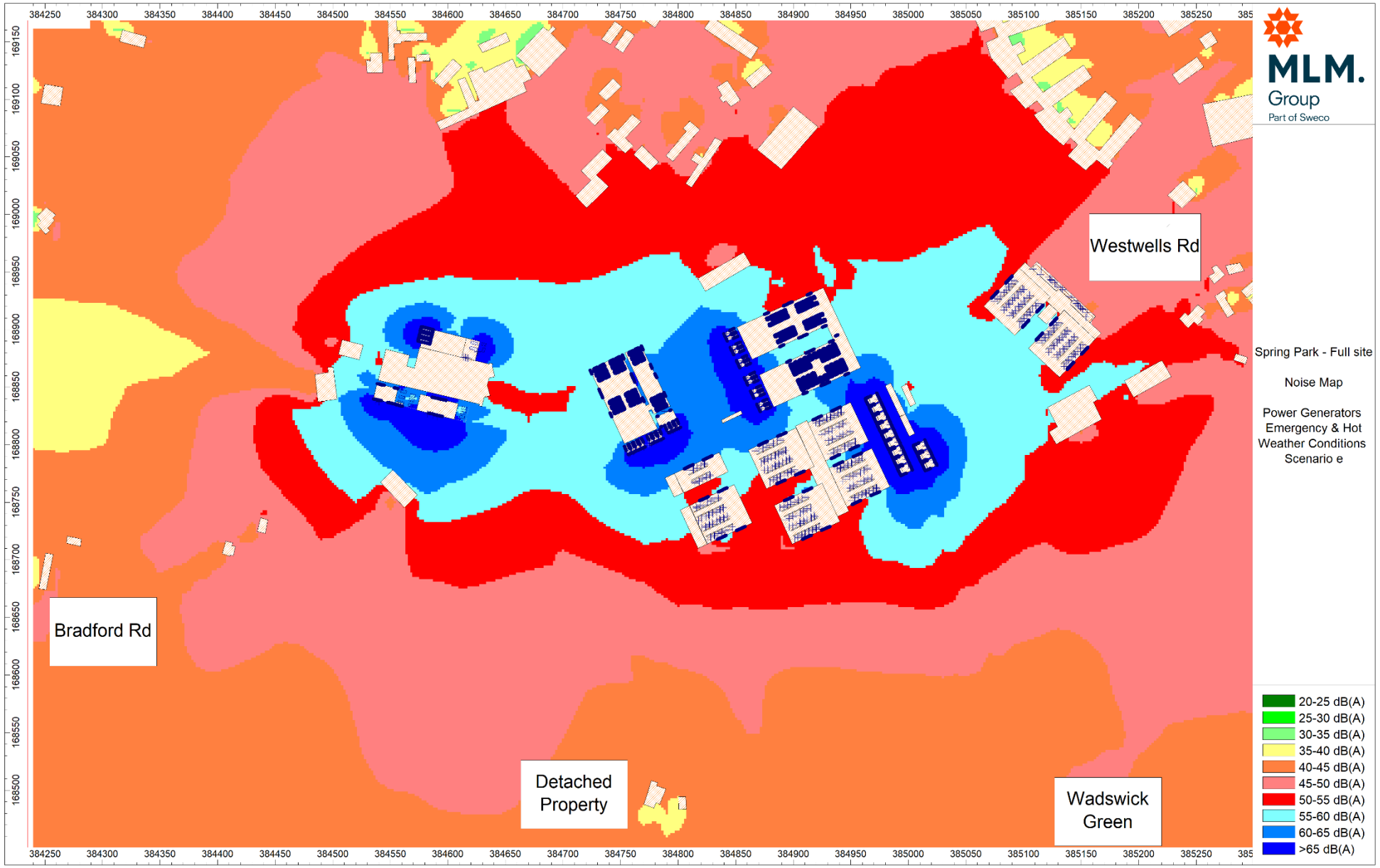
© MLM Consulting Engineers Limited



© MLM Consulting Engineers Limited



© MLM Consulting Engineers Limited



T +44 117 244 5510
A Temple 1852
Lower Approach Road
Temple Meads, Bristol, BS1 6QS

www.mlmgroup.com