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Development Technical
Consultants

ACOUSTIC AIR



J.J. Churchill, Station Road, Market Bosworth
Acoustics Assessment
March 2023

Report Ref: 23380-ENV-0401

J.J. Churchill, Station Road, Market Bosworth

Acoustics Assessment

March 2023

REPORT REF: 23380-ENV-0401

CLIENT: J.J. Churchill Limited

ENGINEER: Mewies Engineering Consultants Limited
The Old Chapel
Station Road
Hugglescote
Leicestershire
LE67 2GB

Tel: 01530 264 753
Email group@m-ec.co.uk

REGISTRATION OF AMENDMENTS

Date	Rev	Comment	Prepared By	Checked By	Approved By
March 2023	-	First issue	Elliot Williams BSc (Hons) Graduate Acoustics Consultant	Adam Walker BSc (Hons) MIOA MInstSCVE Senior Acoustics Consultant	Alexander Bennett BSc (Hons) MCIHT MTPS Director

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CONTENTS

1.0	INTRODUCTION	4
2.0	SITE DESCRIPTION	5
3.0	STANDARDS AND GUIDANCE	6
4.0	ENVIRONMENTAL SOUND SURVEY	8
5.0	ACOUSTIC MODELLING SETUP AND RECEPTOR IDENTIFICATION	12
6.0	ASSESSMENT	16
7.0	CONCLUSIONS	19

APPENDICES

A.	PROPOSED SITE LAYOUT
B.	ACOUSTIC GLOSSARY
C.	UNATTENDED SURVEY DATA
D.	NOISE BREAKOUT CALCULATIONS
E.	SOUND LEVEL CONTOURS

1.0 INTRODUCTION

- 1.1 Mewies Engineering Consultants Limited (M-EC), has been commissioned by J.J. Churchill Limited (hereafter referred to as 'the Client') to undertake an Acoustics Assessment for a proposed commercial development at J.J. Churchill, Station Road, Market Bosworth (hereafter referred to as 'the Site').

Assessment Scope

- 1.2 This assessment seeks to establish the potential impact new sources of sound, of a commercial and/or industrial nature, will have on existing and proposed residential dwellings adjacent to the Site.
- 1.3 The following scope of works has been undertaken:
- An Environmental Sound Survey has been undertaken to determine both prevailing and background sound levels and internal sound levels produced in the current buildings occupied by the Client.
 - An acoustic model has been developed using Datakustik CadnaA®, a proprietary modelling/mapping software, adopting the calculation algorithms from ISO 9613-2¹;
 - The model has been used to predict sound levels from the Site using a combination of in-house library data, site specific sound levels and calculations in accordance with the NAC Guide², to inform source sound levels;
 - The model has been used to assess the potential risk of adverse effects upon health and wellbeing for residents at the nearest existing and, approved but under construction, residential receptors, initially in the absence of any mitigation measures in accordance with BS 4142³;
 - Should mitigation measures be required, they will be presented within this report to demonstrate a reduction in sound levels at the nearest residential receptors.

Disclaimer

- 1.4 M-EC has completed this report for the benefit of the individuals referred to in Paragraph 1.1 and any relevant statutory authority which may require reference in relation to approvals for the proposed development. Other third parties should not use or rely upon the contents of this report unless explicit written approval has been gained from M-EC.
- 1.5 M-EC accepts no responsibility or liability for:
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 - The issue of this document to any third party with whom approval for use has not been agreed.

¹ ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation'

² A Guide to Measurement and Prediction of the Equivalent Continuous Sound Level, L_{Eq} , Noise Advisory Council, 1978

³ BS 4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial noise'

2.0 SITE DESCRIPTION

Existing Site

- 2.1 The wider Site is occupied by the Client within the town of Market Bosworth. The Site is bound to the north by Station Road, to the east by existing commercial buildings and farmland; to the south by farmland; and to the west by Market Bosworth Railway Station (Battlefield Line).
- 2.2 The Site has been operational for a number of years with various noise sensitive receptors (NSRs) within vicinity of the Site, it is understood that no significant noise complaints have been made throughout that time indicating that current Site operations don't impact existing residents given that the majority of operations are contained within closed façade buildings.
- 2.3 Additionally, a residential development to the west has recently been approved (ref. 12/00597/FUL dated 10 July 2012) and is currently under construction.
- 2.4 An approximate redline boundary is presented in Figure 2.1.

Figure 2.1: Approximate Redline Boundary



Development Proposals

- 2.5 The development proposals comprise the erection of one commercial unit, for class B8 usage, with associated parking and infrastructure to the south of the existing development.
- 2.6 The proposed development plan is provided in **Appendix A**.

3.0 STANDARDS AND GUIDANCE

General

3.1 An acoustic glossary is provided in **Appendix B** to assist the reader.

Summary of Guidance and Standards

3.2 The following guidance and standards relevant to the assessment presented herein:

- National Planning Policy Framework (NPPF) 2021;
- Noise Policy Statement for England (NPSE) 2010;
- BS 4142:2014 +A1;2019 '*Methods for rating and assessing industrial and commercial sound*'.

3.3 For conciseness, the guidance and standards most appropriate to this assessment are summarised in this section.

BS 4142

3.4 BS 4142 describes methods for rating and assessing industrial and/or commercial sound and includes, but is not limited to, the assessment of:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical equipment;
- Sound from the (un)loading of goods and materials at industrial/commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes such as that from forklift trucks on or around an industrial and/or commercial site.

3.5 The methods described in BS 4142 use outdoor sound levels to assess the likely effects of sound on people who are typically outside residential premises. Although indoor effects can be indicated where the façade composition is known. A summary of the approach set out in BS 4142 is set out below:

- Establish or predict the specific sound level of the source(s) by considering both the ambient (includes the source to be assessed) and residual (excludes the source to be assessed but includes all remaining sources) sound level;
- Measure the representative background sound levels, typically by measuring close to the receptor location;
- Rate the specific sound level to account for any distinguishing characteristics (see below);
- Estimate the impact by subtracting the background sound level from the rating level; and
- Consider the initial estimate of impact, as determined above, in the context of the noise and its environment.

3.6 The specific sound level is rated to account for distinguishing characteristics by using penalties for tonality, impulsivity, intermittency and other sound characteristics. The dominant acoustic characteristic should be applied to avoid large penalties which is in accordance with the Institute of Acoustics response to BS 4142.

- 3.7 An initial estimate of impact of the specific sound is obtained by subtracting the background sound level from the rating level. Typically, the greater the difference, the greater the magnitude of impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
 - A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context;
 - At differences lower than +5 dB a low impact is likely, depending on the context. The lower the rating level is to the measured background sound level, the less likely it is that the specific sound source will have an impact.
- 3.8 The results of the initial assessment should then be considered in light of all pertinent contextual factors.



4.0 ENVIRONMENTAL SOUND SURVEY

Methodology

- 4.1 Existing sound levels at the site have been established by undertaking an Environmental Sound Survey. The survey was undertaken in full accordance with the guidance set out in BS 4142.
- 4.2 Sound Level Meters (SLMs) were installed at three locations as follows:
- Sample Measurement 1 (SM1): within the northern industrial building;
 - Sample Measurement 2 (SM2): within the southern industrial building; and
 - Continuous Measurement 1 (CM1): in the south west corner of the Site location.
- 4.3 The sample measurements were undertaken between 11:00 and 12:00 on Thursday 9th March with the continuous measurement taken between 13:00 on Thursday 9th March and 10:00 on Tuesday 14th March 2023.
- 4.4 SM1 was taken within the northern building to obtain existing sound levels that would be representative of the proposed building's operations. On site observations indicated there were multiple sources of noise within the building, the predominant sources of noise were from manufacturing processes. A central measurement position unobstructed by neighbouring machines was selected to obtain a representative sound level of internal operations.
- 4.5 A similar position, SM2, was also monitored in the southern building. Similar acoustic conditions were observed within the southern building, but the overall noise output was lower due to there being fewer workshop machines.
- 4.6 CM1 was used to get representative sound levels away from existing commercial sound. Observations during setup and collection indicated that noise from the J.J. Churchill buildings and Station Road to the north were inaudible. Construction was being undertaken to the west of the measurement position during collection but was not audible at the measurement location.
- 4.7 The measurement positions are identified in Figure 4.1.

Figure 4.1: Measurement Positions**Equipment**

- 4.8 Measurements were taken using Class 1 integrating/averaging SLMs, housed in environmental protection apparatus. The SLMs were field calibrated before and after the survey using a Class 1 calibrator, with no significant drift in calibration noted.
- 4.9 The SLMs were installed in a free field position at 1.5m height above local ground level. The SLMs were set up to capture the following parameters at a minimum: L_{Aeq} , L_{A90} and L_{AFmax} values.
- 4.10 Full details of the equipment used to undertake the survey are presented in Table 4.1.

Table 4.1: Equipment and Calibration Details

Measurement Position	Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
CM1 & SM1	Sound Level Meter	Type NOR140	1407932	26/02/2025
	Pre-Amplifier	Type 1209	23695	
	Microphone	Type 1225	505583	
	Calibrator	Norsonic 1251	34315	05/03/2024
SM2	Sound Level Meter	Type SVAN 971	34384	04/09/2024
	Pre-Amplifier	Type SV 81	32154	
	Microphone	Type ACO 7052E	54657	
	Calibrator	Norsonic 1255	34315	08/12/2022
All measurement equipment was calibrated by a UKAS accredited laboratory no more than two years prior to the environmental survey, with the exception of the calibrators, which were calibrated no more than one year prior to the survey.				

Meteorological Conditions

- 4.11 During the attended survey and the installation of the continuous measurement position, weather conditions were observed as cold, with light snow, snow settled on the ground and a north easterly wind of 2.1m/s on equipment installation. On equipment collection weather conditions were observed as mild, with wet ground and a north easterly wind of 1.4m/s.
- 4.12 It can therefore be concluded that there were no adverse meteorological conditions that could influence the survey outcome.

Results

Source Levels

- 4.13 A summary of results of the sound level survey are presented in Table 4.2 for the attended measurement positions SM1 (North Building) and SM2 (South Building).

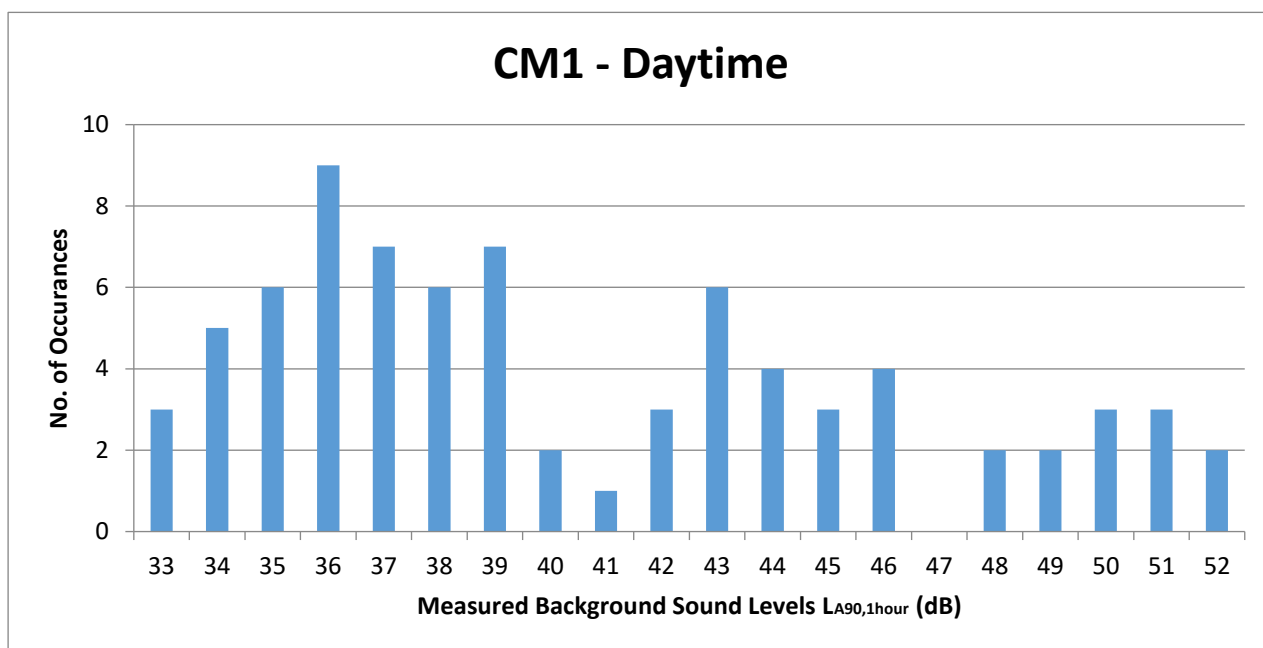
Table 4.2: Summary of Measured Sound Levels,

Measurement Position	Ambient Sound Level dB LAeq, 1hour
North Building	71
South Building	64

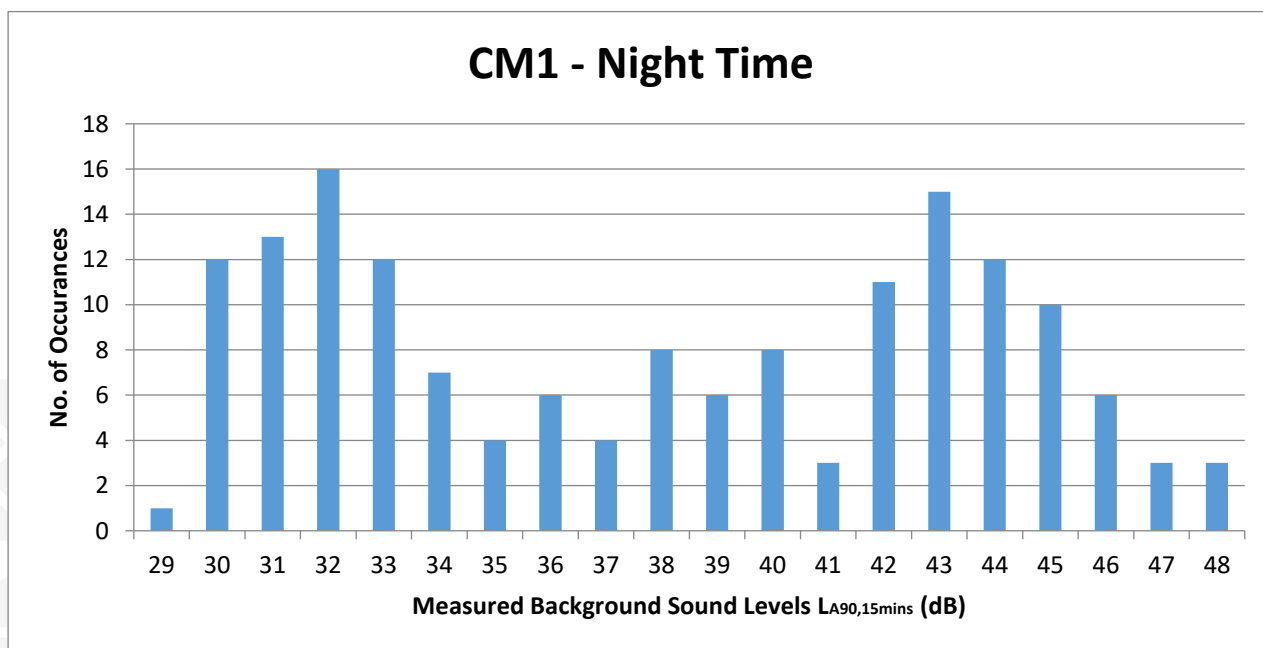
- 4.14 Measured sound levels from the northern building will be used within the acoustic model as they represent a louder, and therefore more robust, scenario for the potential sound levels of future operations within the proposed building.

Background Sound Levels

- 4.15 Unattended background sound levels have been monitored over the full duration of the survey in accordance with BS 4142.
- 4.16 A time history graph showing the unattended survey data is presented in **Appendix C**.
- 4.17 CM1 was used to establish suitable background sound levels during the daytime and the night-time period. Analysis of the survey data indicated that construction noise, and existing commercial sound, did not impact the overall background sound levels for the survey period.
- 4.18 Statistical analysis of the measured data at CM1 is presented in Figure 4.2 and Figure 4.3 for daytime and night-time respectively.

Figure 4.2: Statistical Analysis of Daytime Background Sound Levels $L_{A90, 1hr}$, CM1

4.19 The statistical analysis for daytime indicates that the prevailing background sound level is 36 dB $L_{A90, 1hr}$.

Figure 4.3: Statistical Analysis of Night-time Background Sound Levels $L_{A90, 15mins}$, CM1

4.20 The statistical analysis for night-time indicates that the prevailing background sound level is 32 dB $L_{A90, 15mins}$.

5.0 ACOUSTIC MODELLING SETUP AND RECEPTOR IDENTIFICATION

Overview

- 5.1 An acoustic model of the Site and environs has been generated in Datakustik CadnaA® modelling software. The model has been generated using source data provided by M-ECs in house library data and guidance found within the NAC Guide in order to predict sound levels at the existing, nearby, residential receptors.
- 5.2 CadnaA® considers various inputs, including topography, buildings and road noise sources, and calculates sound levels in accordance with national and international standards; in this case, the relevant UK standards are the procedures set out within ISO 9613-2.
- 5.3 The modelling assumptions and input information for the acoustic model are as follows:
- Digital Terrain Model – Lidar 1m (Environment Agency, downloaded on 17th March 2023.)
 - Open Street Map data (publicly available);
 - Ground absorption for the Site = 0 (hard ground);
 - Building heights estimated following site observations or based upon masterplan;
 - First order reflections included in the modelling;
 - Temperature set to 10°C; and
 - Relative humidity set to 70%.

Source Sound Levels

- 5.4 The Site has been assessed as a whole in terms of overall noise impact in accordance with BS 4142. However, acoustic calculations have been undertaken to determine the potential internal sound levels produced from manufacturing operations within the proposed building and external sound levels produced by deliveries from heavy goods vehicles (HGVs).
- 5.5 With regards to the internal sound levels at the proposed building, the measured sound levels from SM1 have been used to determine the internal reverberant sound pressure level of the proposed building on the assumption that the internal acoustic finishes will be similar to the existing buildings. Using the available architectural drawings and indicative façade compositions, calculations have been undertaken to predict the potential sound energy transmitted through the external façade. This has been applied to the acoustic model in the form of a vertical area source and calibrated such that the predicted sound levels match the calculated values. The calculations are provided in **Appendix D**.
- 5.6 It's been advised that a small working overnight shift works from 18:00 to 06:00 on weekdays. However, despite this reduced capacity, the daytime sound levels measured at SM1 have been used for the night-time model in order to provide a more robust assessment for the night-time scenario.
- 5.7 In terms of the external sound levels, the source data used to inform this assessment has been adopted from M-EC's library of in-house historic measurement data as well as manufacturers specifications used in similar facilities to that of the Site. 1 HGV per hour, based upon traffic data provided by the Client, has been modelled using point and line sources following projected operational movements displayed in the development plan.

- 5.8 It's been advised that HGV's will only be operating during the daytime, so have been excluded from the modelling for the night-time scenario
- 5.9 It should also be noted that parts of the HGV movements are screened by both existing and proposed J.J. Churchill buildings, reducing the potential impact towards the noise sensitive receptors in the west.
- 5.10 The source levels used for each external source are presented in Table 5.1.

Table 5.1: Source Level Data

Activity	Sound Pressure Level (dB) in Octave Band Centre Frequency (Hz)								Time (s)	L _{Aeq} @ 10m
	63	125	250	500	1k	2k	4k	8k		
HGV Arriving & Manoeuvring	71	66	65	66	69	65	58	50	109	72
HGV Engine Idling	75	58	66	60	62	59	52	42	37	66
HGV Pulling Away	71	65	64	65	63	62	56	46	15	68
Air Brakes	-	-	-	-	-	-	-	-	3	80
Unloading Activities	-	-	-	-	-	-	-	-	420	60
'-' denotes octave band data unavailable. 'cont.' denotes continuous sound level assumed to be operating at all times.										

- 5.11 For HGV movements to and from service yards and delivery points, source data has been determined based upon the guidance contained within the NAC Guide.
- 5.12 Section 2.5 of the NAC Guide details a method for calculating the L_{eq} noise level from the combined effect of a number of events (e.g., HGV pass-bys) with their own single event noise exposure level (L_{AX}, also commonly referenced as SEL). The method is as follows:

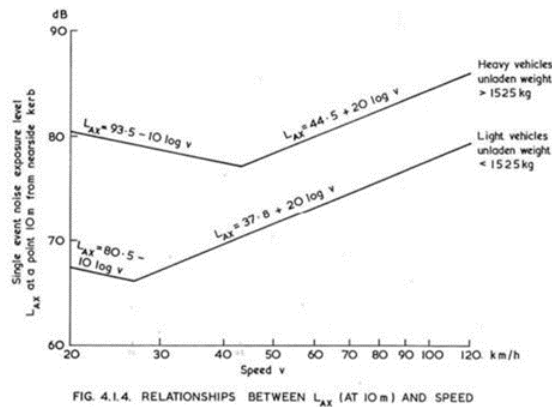
$L_{eq} = L_{AX} + 10\log(N) - 10\log(T)$; whereby:

L_{AX} = single event noise exposure level (SEL);

N = number of events within the time period; and

T = duration of time period in seconds.

- 5.13 In addition, Figure 4.1.4 from the NAC guide presents a method for determining the L_{AX} at a distance of 10m from the nearest kerbside edge, for heavy and light vehicles travelling at different speeds. This figure is duplicated below for reference:

Figure 5.1: NAC Guide Figure 4.1.4

- 5.14 Combining the use of NAC Figure 4.1.4 with the equation adopted from NAC Section 2.5 provides a means of determining the L_{eq} that will arise at 10m as a result of a given number of HGV movements on an access road or defined path. This has been applied assuming an HGV pass-by speed of 20km/hour. Within the acoustic model, the sound power levels of the HGV line source(s) have been calibrated such that the calculated levels are modelled.
- 5.15 With regards to unloading activities, the model has also accounted for forklifts and reverse beeping within the spectral data presented in Table 5.1.
- 5.16 In addition to HGV movements and unloading activities around the site, stationary plant will also be required within the Site. At this stage, fixed plant items are unknown, therefore, indicative plant levels are presented in Section 6.0.

Noise Sensitive Receptors

- 5.17 A review of satellite imagery and proposed developments demonstrates approximately two groups of Noise Sensitive Receptors (NSRs) in the vicinity of the Site, as follows;
- NSR 1 - dwellings located on Heath Road, approximately 230m to the north-east of the proposed building location; and
 - NSR 2 – proposed dwellings on land south of Station Road, approximately 60m to the west of the Site boundary.
- 5.18 The NSRs are presented in Figure 5.2.

Figure 5.2: Noise Sensitive Receptors



6.0 ASSESSMENT

Assessment Methodology

- 6.1 The methodology for the BS 4142 assessment is presented below for the identified commercial/industrial operations within the Site.
- 6.2 The model has been created and includes the following sources:

Internal Sources

- Sound levels identified during the sound survey undertaken within the existing buildings.

External Sources

- 1 HGV Arrival;
 - 1 HGV Manoeuvre;
 - 1 Air Brakes activated;
 - 1 Cab Engine Idling;
 - 50% of the assessment period includes unloading/loading (modelled within docking bays only); and
 - 1 HGV Pulling away.
- 6.3 The above is based upon a single HGV collecting or delivering goods alongside typical operations within the existing facility and is considered to demonstrate what is likely to occur at the proposed building.
- 6.4 Additionally, it is understood that the fixed mechanical services have not been finalised and the Client has requested a limiting sound level be applied with consideration given to the location of such units at this stage and can be considered further in detail during the detailed design process of the Site.

Initial Estimate of Impact

- 6.5 The above sources have been implemented within the acoustic model and the overall potential impact on the nearby NSRs from the Site has been assessed as one.
- 6.6 Acoustic character corrections have not been applied as the Client currently operates within the area and as such, no new distinguishable features will be present as part of the development.
- 6.7 Table 6.1 and Table 6.2 demonstrate the Initial Estimate of Impact, in accordance with BS 4142, for each NSR.

Table 6.1: NSR 1 - Initial Estimate of Impact

Assessment Step	Daytime	Night-time
Modelled Specific Sound Level [A]	26 dB LAeq, 1hr	12 dB LAeq, 15mins
Acoustic Character Correction [B]	-	-
Rating Level [C = A + B]	26 dB LAr, 1hr	12 dB LAr, 15mins
Background Sound Level [D]	36 dB LA90, 1hr	32 dB LA90, 15mins
Rating over Background [E = C – D]	-10 dB	-20 dB
Estimation of Impact ^(a)	Low	Low
^(a) Impact dependent upon context and other pertinent factors.		

Table 6.2: NSR 2 - Initial Estimate of Impact

Assessment Step	Daytime	Night-time
Modelled Specific Sound Level [A]	35 dB LAeq, 1hr	21 dB LAeq, 15mins
Acoustic Character Correction [B]	-	-
Rating Level [C = A + B]	35 dB LAr, 1hr	21 dB LAr, 15mins
Background Sound Level [D]	36 dB LA90, 1hr	32 dB LA90, 15mins
Rating over Background [E = C – D]	-1 dB	-11 dB
Estimation of Impact ^(a)	Low	Low
^(a) Impact dependent upon context and other pertinent factors.		

6.8 For both the daytime and night-time scenarios at NSR 1 and NSR 2, a 'Low' impact is predicted in accordance with BS 4142, as the Rating Levels are predicted to be below the Background Sound Level. Therefore, no mitigation measures or restrictions on the Site are required.

6.9 Full sound level contour maps, for the daytime and night-time operating scenarios above, are presented in **Appendix E**.

Context and Uncertainty

6.10 For the assessment at all NSRs for daytime and night-time, no contextual considerations are required as the Initial Estimate of Impacts shows a 'Low' Impact in accordance with BS 4142.

6.11 However, it is important to give consideration to the contextual factors and uncertainty surrounding the assessment for due diligence, as follows.

6.12 Despite the predicted impact of 'Low' at both NSRs during the night-time, the measurements are at an external location rather than inside of a dwelling, in accordance with the initial assessment procedure of BS 4142.

- 6.13 However, during night-time operations (23:00 – 07:00) residents are unlikely to be outside their properties and instead would likely be inside their bedrooms. Therefore, consideration should be given to the façade composition and break-in via ventilation elements.
- 6.14 Under a worst-case scenario, assuming residents have windows open at night-time to combat overheating, the predicted Rating Level would be reduced by approximately 13 dB⁴.
- 6.15 Whilst internal noise conditions are outside the scope of BS 4142, the estimated values would be below BS 8233⁵ criteria for night-time conditions and would be highly unlikely to have any adverse impact on residents during night-time periods.
- 6.16 Therefore, in summary, it can be concluded that the Site is likely to have an even lower impact at night than originally stated in Table 6.1 and Table 6.2.

Fixed Mechanical Services

- 6.17 At this stage of the design, no mechanical services have been suggested as part of the development and as such, the assessment methodology has been to devise limiting sound levels such that the impact at the nearest residential receptors is negligible.
- 6.18 Therefore, it is recommended that mechanical services do not exceed 32 dB $L_{Aeq, T}$ at the western boundary of the Site meaning sound levels would not exceed background sound levels at the nearest residential receptors. It is also recommended that any fixed mechanical services are located either on the south, or east façade of the proposed building, however, this is not compulsory.
- 6.19 Such requirements can be secured through a typical planning condition as required.

⁴ 13 dB is a typical reduction provided by a partially open window to combat overheating.

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

7.0 CONCLUSIONS

- 7.1 Mewies Engineering Consultants Limited has been commissioned by J.J. Churchill Limited to undertake an Acoustics Assessment for a proposed commercial development at J.J. Churchill, Station Road, Market Bosworth.
- 7.2 Detailed assessments of the Site have been undertaken in accordance with BS 4142.
- 7.3 An Environmental Sound Survey has been undertaken to determine internal sound levels produced in the current buildings occupied by the Client and the prevailing background sound levels at the nearby existing residential receptors.
- 7.4 An acoustic model has been created and through the use of the NAC Guide and historic measured library data, source levels have been defined to demonstrate potential operating scenarios for both daytime and night-time.
- 7.5 Predicted sound levels at all nearby Noise Sensitive Receptors have been presented for operating scenarios during the daytime and night-time assessment periods.
- 7.6 The outcome of the Initial Numerical BS 4142 assessment demonstrates that sound levels from the proposed commercial premises are unlikely to yield an impact, from an acoustics perspective, on the nearest Noise Sensitive Receptors as the Impact is predicted to be 'Low'.
- 7.7 It is therefore considered that the Site is suitable for the proposed development and should be free to operate without restriction.



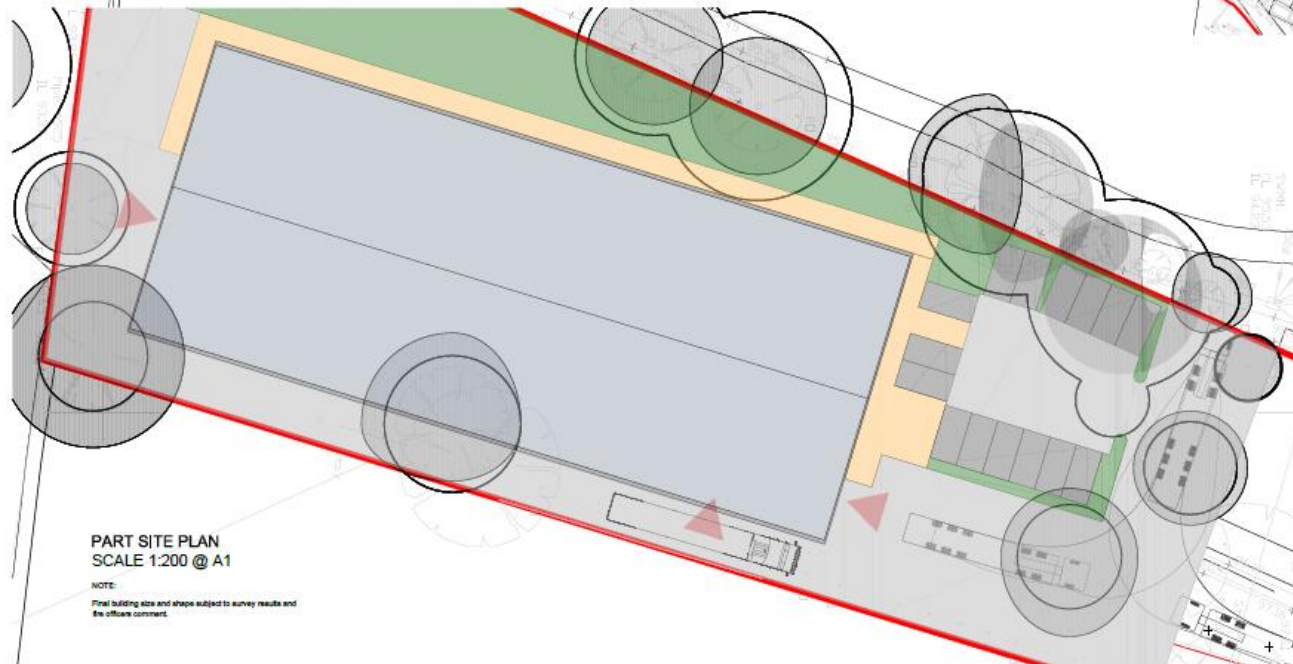
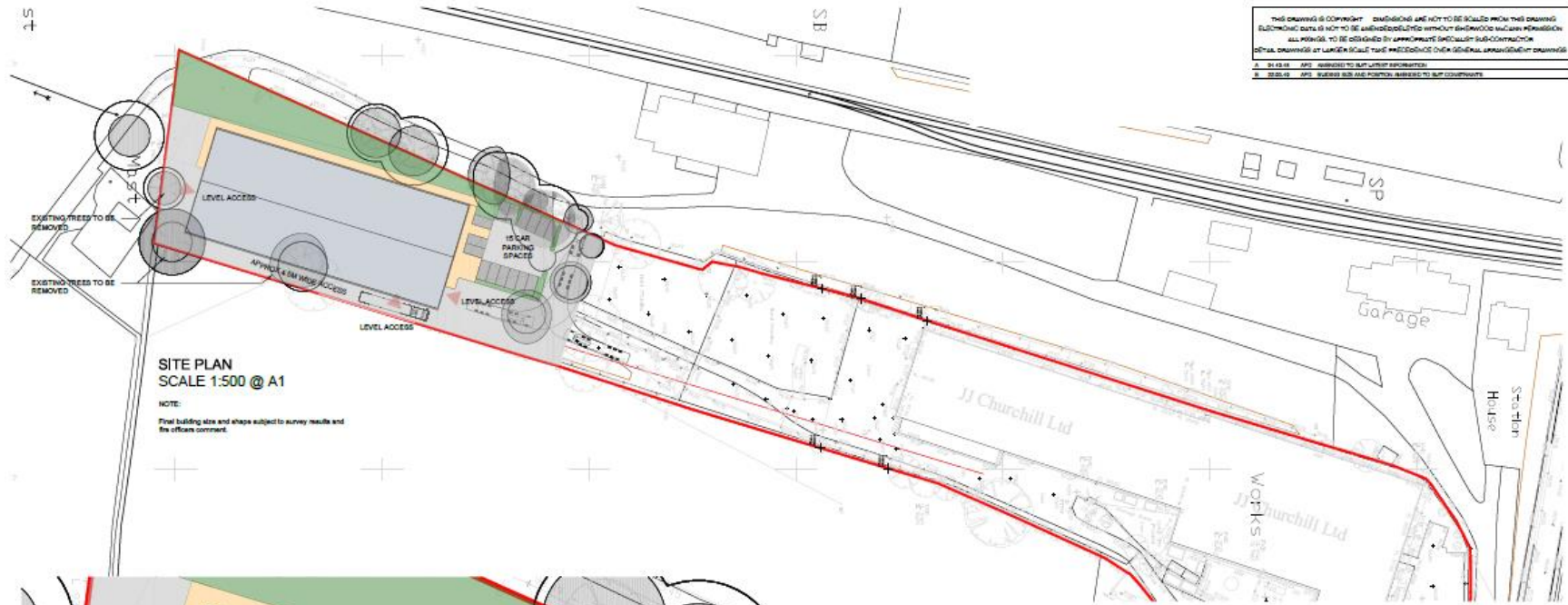
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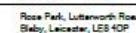
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APPENDICES



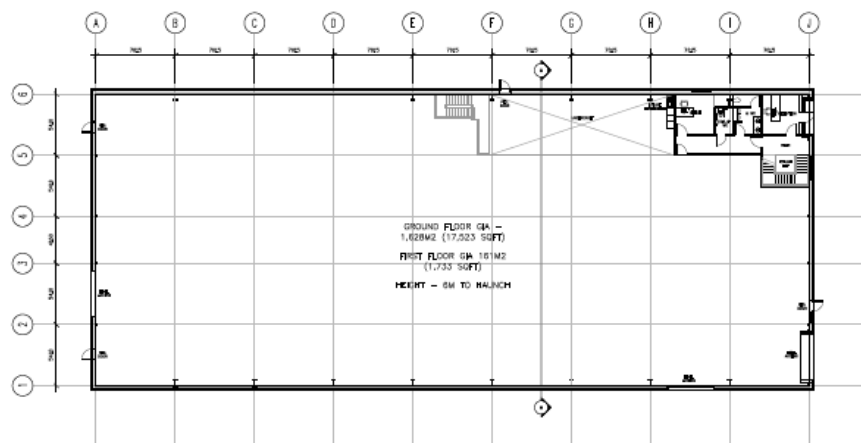
APPENDIX A



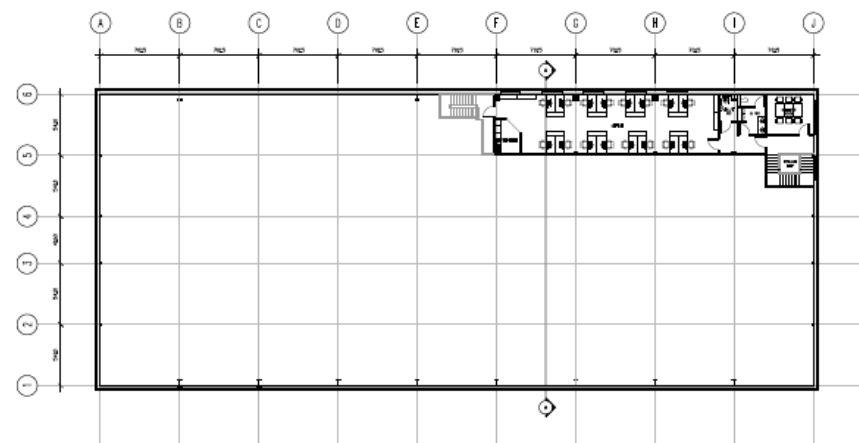
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STATUS	PRELIMINARY		
DRAWING TITLE	SITE PLAN		
DATE	25.07.18	DRAWN BY	APD
SCALE	1:500 AT A1	CHECKED BY	APD
    			
DRAWING NO.	218038-SK02	REVISION	B

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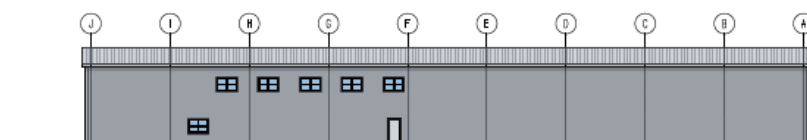
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 B. 27-02-18 EPO - REVISIONS NOT ASSIGNED TO SUB CONTRACTOR



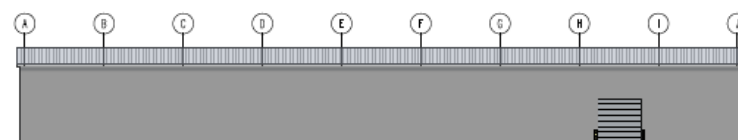
GROUND FLOOR
PROPOSED PLANS
SCALE 1:200 @ A1



FIRST FLOOR



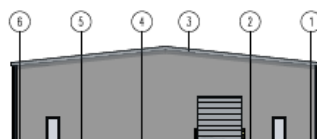
SIDE ELEVATION



SIDE ELEVATION



FRONT ELEVATION



REAR ELEVATION

PROPOSED ELEVATIONS
SCALE 1:200 @ A1

NOTE:
Final building size and shape subject to survey results and fire officers comment.

PROJECT:	JJ CHURCHILL FACTORY STATION ROAD, MARKET BOSWORTH		
STATUS:	PRELIMINARY		
PROPOSED STATUS:	PROPOSED BUILDING		
DATE:	25.09.18	CHANGED BY:	APD
REASON:	AS NOTED AT A1	CHANGED BY:	APD
		Rose Park, Lutterworth Road, Babby, Leicester, LE15 4DP	
		0116 2781200	
		www.jzhmcc.com	
CHANGED BY:	218038-SK03	REVISION:	B



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APPENDICES



APPENDIX B

GLOSSARY OF TECHNICAL TERMS

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurements, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc, according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

Typical sound levels found in the environment

Sound Level	Location
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 dB(A)	Typical high street
70 to 90 dB(A)	Inside a factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft taking off
140 dB(A)	Threshold of pain

Descriptor	Terminology
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10 ⁻⁶ Pascals) 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 s_1 and s_2 is given by $20 \log_{10} (s_1 / s_2)$. 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 takes into account 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.
$L_{AFmax, T}$	A noise level index defined as the maximum noise level during the measurement period. L_{Max} is sometimes used for the assessment of discrete loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. It is typically 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 . L_{90} 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 . L_{10} 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.
Façade	At a distance of 1m in front of a large sound reflecting object such as a building facade.
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Octave Band	A range of frequencies whose upper limit is twice the frequency of the lower limit
One-third Octave Band	A frequency band in which the upper limit is $2^{1/3}$ times the frequency of the lower limit.
Rating Level	The specific sound level, plus any adjustment for characteristic feature of sound in BS 4142.
Specific Sound Level	The A-weighted L_{eq} sound level produced by a sound source during a specified period of time. Commonly known as the sound source under investigation as defined in BS 4142.
Typical Maximum Level	The 90 th percentile maximum event level (L_{AFmax}) measured during a period. Used for assessing night-time maximum levels under typical and overheating conditions.



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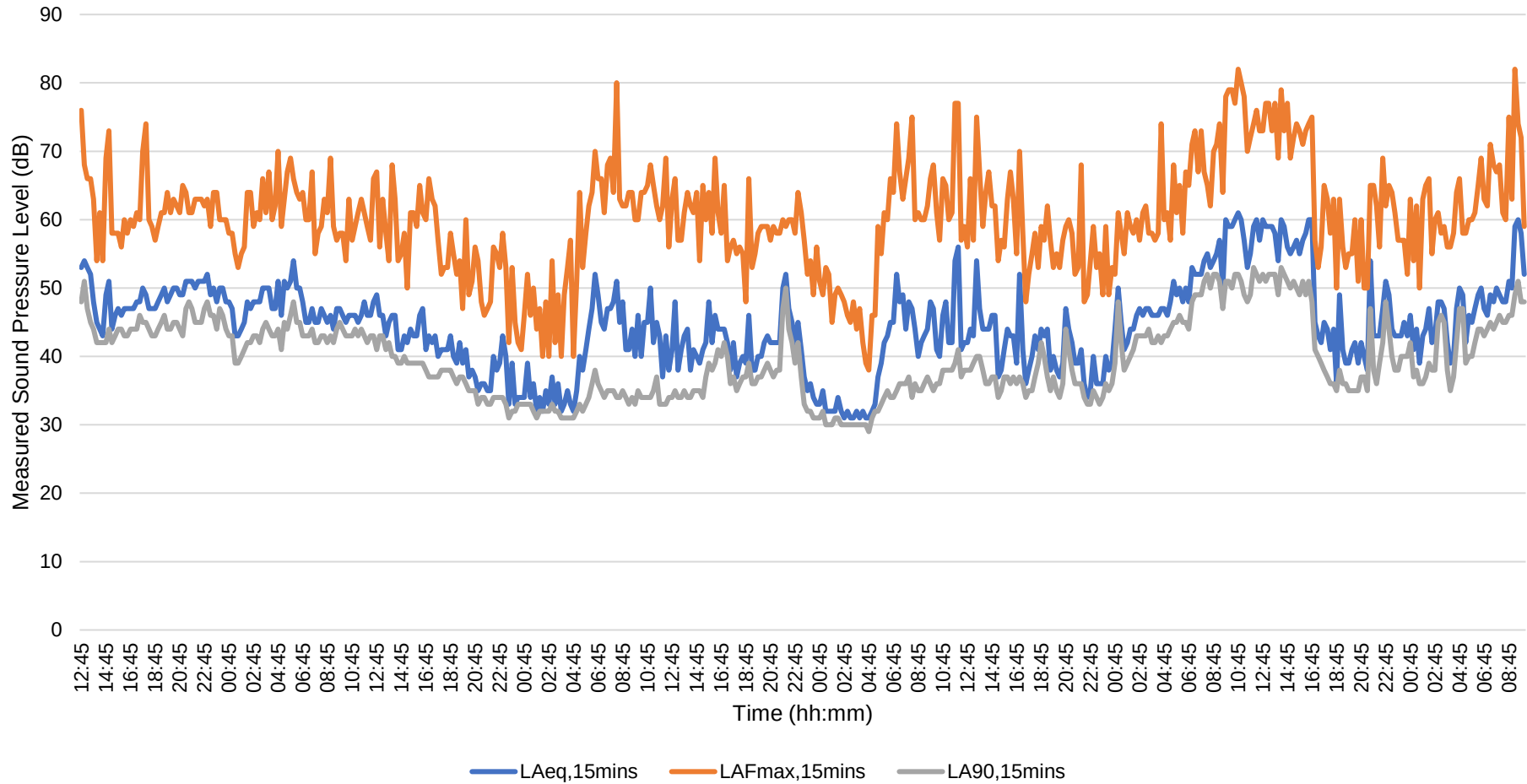
APPENDICES



APPENDIX C

J.J Churchill, Station Road, Market Bosworth - CM1
Environmental Sound Monitoring Survey Results

$L_{Aeq,15mins}$, $L_{AFmax,15mins}$ & $L_{A90,15mins}$ Measured Sound Levels - 9th - 13th March 2023





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APPENDICES



APPENDIX D

East and West Façade Calculations

			Octave Band Centre Frequencies (Hz)							
			63	125	250	500	1000	2000	4000	8000
Measured Internal Sound Pressure Level ($L_{p_{in}}$ dB)			67	65	68	67	66	65	60	57
Calculation of Element Sound Power (Equation (4) BS EN 12345-4)										
	Area (S_i , m ²)	Name	63	125	250	500	1000	2000	4000	8000
Insertion Loss of Opening Element, D_i	428	Metal Cladding - 19/1000 liner, 120mm rock mineral wool 23 Kg/m3, 32/1000 outer	13	20	27	44	54	62	64	65
Diffusivity Term, C_d		Large space, few sources, reflecting surface	-3	-3	-3	-3	-3	-3	-3	-3
Sound Power Level of Element (L_w dB)			77	68	64	46	35	26	19	15
External Proagation										
Distance to receiver	20	m								
Element Width	63	m								
Element Height	7	m								
Directivity (Q) of Surroundings	Flush									
			63	125	250	500	1000	2000	4000	8000
Sound Power Level of Element (L_w dB)			77	68	64	46	35	26	19	15
Distance Attenuation (Rathe)			-36	-36	-36	-36	-36	-36	-36	-36
Directivity			3	3	3	3	3	3	3	3
Sound Pressure Level at Receptor Position, L_p = 25 dB			44	35	31	13	2	-7	-14	-18

North and South Façade Calculations

			Octave Band Centre Frequencies (Hz)							
			63	125	250	500	1000	2000	4000	8000
Measured Internal Sound Pressure Level ($L_{p_{in}}$ dB)			67	65	68	67	66	65	60	57
Calculation of Element Sound Power (Equation (4) BS EN 12345-4)										
	Area (S_i , m ²)	Name	63	125	250	500	1000	2000	4000	8000
Insertion Loss of Opening Element, D_i	177	Metal Cladding - 19/1000 liner, 120mm rock mineral wool 23 Kg/m3, 32/1000 outer	13	20	27	44	54	62	64	65
Diffusivity Term, C_d		Large space, few sources, reflecting surface	-3	-3	-3	-3	-3	-3	-3	-3
Sound Power Level of Element (L_w dB)			73	64	60	42	31	22	15	11
External Proagation										
Distance to receiver	20	m								
Element Width	26	m								
Element Height	7	m								
Directivity (Q) of Surroundings	Flush									
			63	125	250	500	1000	2000	4000	8000
Sound Power Level of Element (L_w dB)			73	64	60	42	31	22	15	11
Distance Attenuation (Rathe)			-36	-36	-36	-36	-36	-36	-36	-36
Directivity			3	3	3	3	3	3	3	3
Sound Pressure Level at Receptor Position, L_p = 22 dB			41	32	28	10	-1	-10	-17	-21



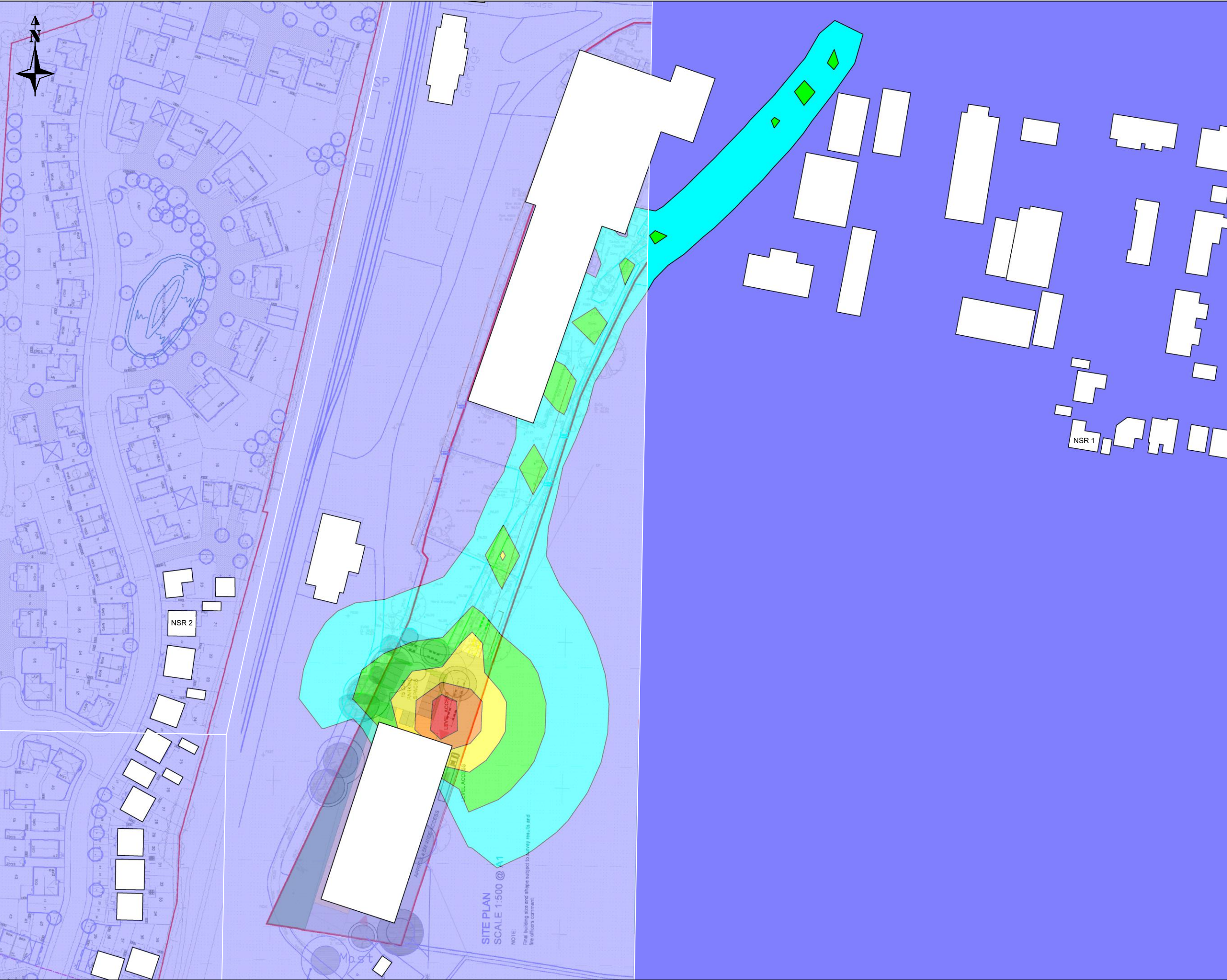
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APPENDICES



APPENDIX E

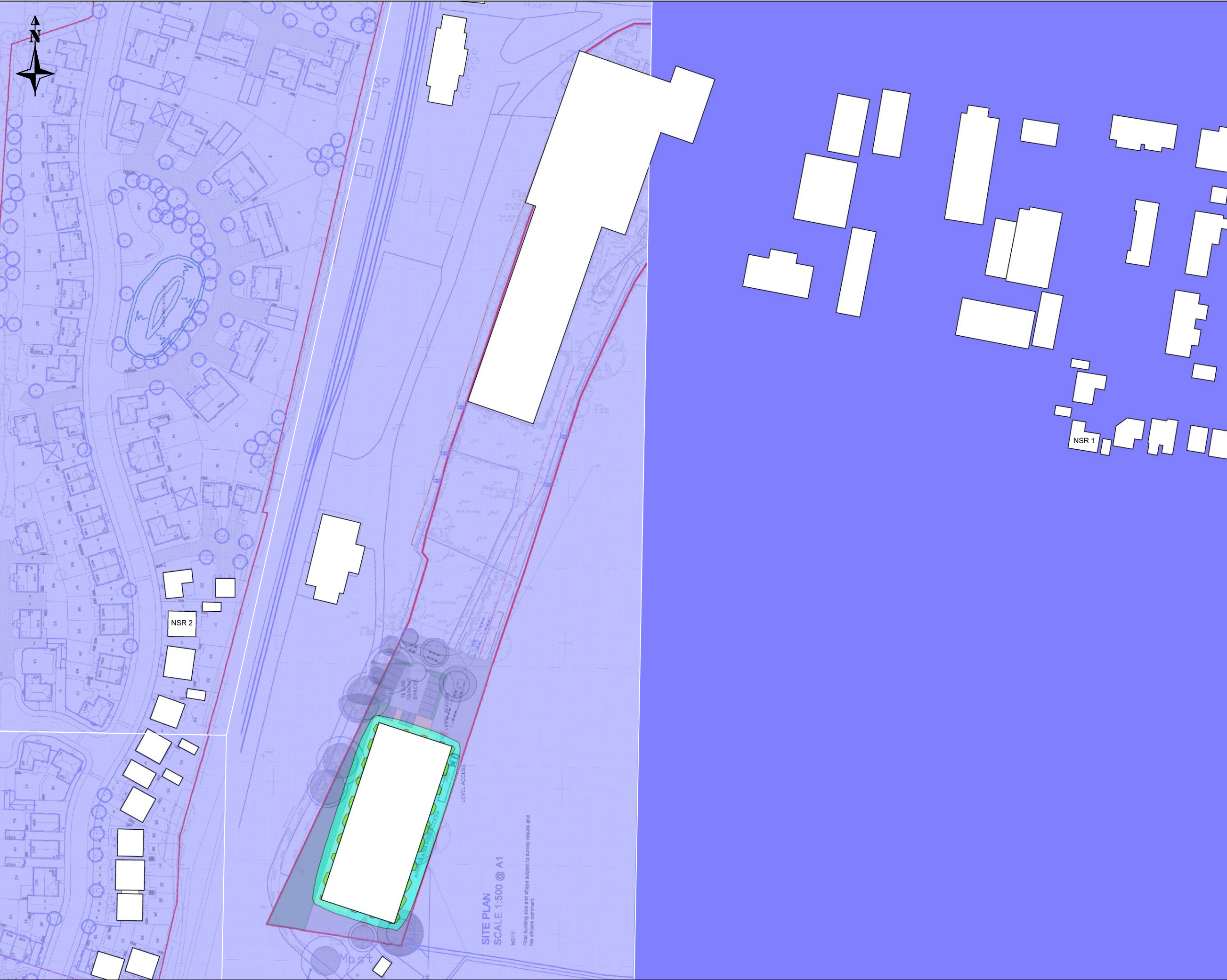


NOTES:
1. DO NOT SCALE THIS DRAWING.

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	30–35dB(A)
	35–40dB(A)
	40–45dB(A)
	45–50dB(A)
	>50dB(A)

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CLIENT: J.J. CHURCHILL LIMITED					
DRAWING NUMBER: 23380_04_120_01					
REVISION: -	SHEET SIZE: A3		SCALE: NTS		
STATUS: FOR INFORMATION					
			Telephone: 01530 264 753 Email: group@m-ec.co.uk Website: www.m-ec.co.uk ORDNANCE SURVEY © CROWN COPYRIGHT 2015. ALL RIGHTS RESERVED. LICENCE NUMBER 100055865.		

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	45–50dB(A)
	>50dB(A)

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CLIENT: J.J. CHURCHILL LIMITED					
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STATUS: FOR INFORMATION					
			Telephone: 01530 264 753 Email: group@m-ec.co.uk Website: www.m-ec.co.uk ORDNANCE SURVEY © CROWN COPYRIGHT 2015. ALL RIGHTS RESERVED. LICENCE NUMBER 100055865.		

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The Old Chapel
Station Road, Hugglescote
Leicestershire LE67 2GB
T: 01530 264753
E: group@m-ec.co.uk
www.m-ec.co.uk