



Tymerwood Primary Academy

ASHP Noise Impact Assessment

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Client: Reach2 Academy Trust
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REVISION HISTORY

Revision	Date	Revision Details	Author	Checked
R01	15/11/2023	Original issue	Susan Witterick BSc MIOA	Ben Tomlin BSc MIOA
R01A	21/11/2023	Updated to reflect Local Authority requirements.	Susan Witterick BSc MIOA	Ben Tomlin BSc MIOA

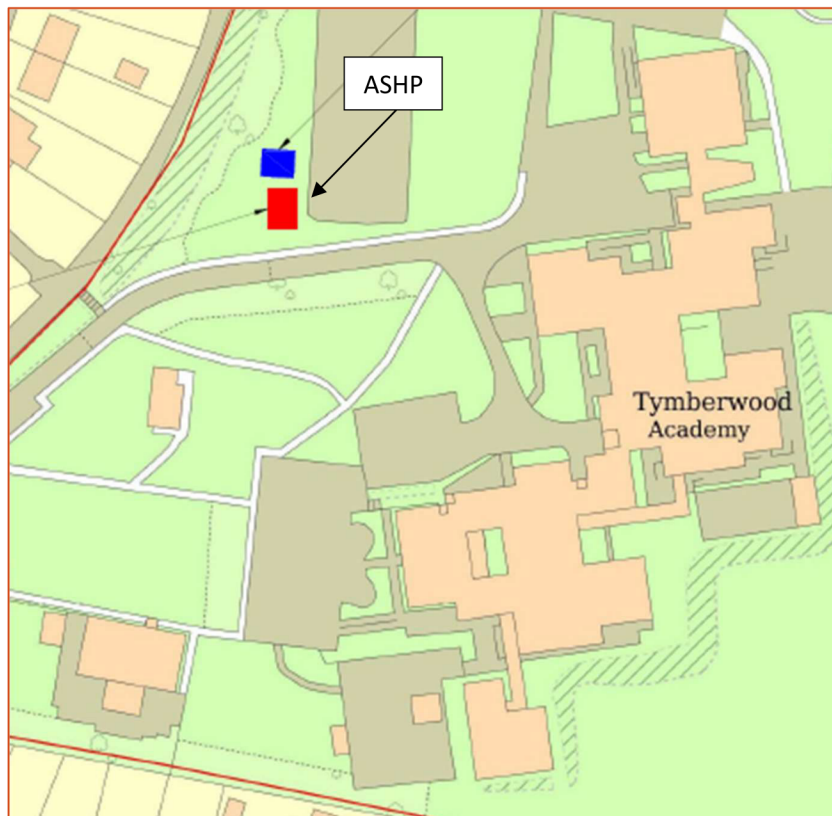
1 INTRODUCTION

- 1.1 dBx Acoustics has been appointed by the Reach2 Academy Trust to carry out a noise survey and noise impact assessment for the proposed installation of two air source heat pumps (ASHP) at the Tymberwood Primary Academy, Cerne Road, Gravesend DA12 4BN.
- 1.2 This report presents the results of a noise survey carried out at the site, and an assessment of the noise impact from the proposed units.
- 1.3 A glossary of acoustic terminology is provided in Appendix A to assist the reader.

2 DESIGN PROPOSAL

- 2.1 Two Trane CXAF-060 air source heat pumps are to be installed within a compound to the north west of the school site. The location is indicated in Figure 1, below.

Figure 1: Proposed ASHP Location



- 2.2 The nearest noise sensitive receptors are the residential properties along Doria Drive, the nearest facades of which are approximately 90m from the proposed plant.

3 ACOUSTIC DESIGN CRITERIA

Local Authority Requirements

- 3.1 The Local Authority is Gravesham Borough Council (GBC).
- 3.2 In an email dated 15th November 2023, Ms Julie Oates, Senior Environmental Health Officer at GBC, advised that;

'...the rating noise from fixed building services/mechanical plant/equipment associated with the development shall be at least 10dB below the existing L_{A90} background level at the nearest noise sensitive receptors (i.e. dwellings) when measured and assessed in accordance with BS4142:2014.'

BS 4142:2014 'Methods for Rating and Assessing Industrial and Commercial Sound'

- 3.3 BS 4142:2014 sets out a procedure for assessing noise impact whereby a Noise Rating Level is determined and compared with the existing local Background Sound Level.
- 3.4 The Rating Level ($dB_{L_{Ar,Tr}}$) is evaluated from the Specific Noise Level by including cumulative corrections to account for factors such as distinguishable tone, impulsivity, intermittency or other readily distinguishable sound characteristics.
- 3.5 The assessment of the impact depends upon the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level. An initial estimate of the impact of the specific sound is made by subtracting the Background Sound Level from the Rating Level, while considering the following points:
- a) Typically, the greater this difference, the greater the magnitude of the impact.
 - b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
 - c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.
 - d) 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.

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

Indoor Ambient Noise Levels within Habitable Rooms

- 3.6 BS 8233 gives guidance for noise levels within residential properties for noise without a specific character. It discusses appropriate criteria for reasonable rest and sleep conditions and provides noise levels which are considered to provide appropriate conditions in accordance with World Health Organisation (WHO) guidelines. The guidance on limits from the standard is reproduced in

Table 1.

Table 1: Indoor Ambient Noise Limits (BS 8233)

Activity	Location	07:00 – 23:00 hrs	23:00 – 07:00 hrs
Resting	Living room	35dBL _{Aeq,16h}	-
Dining	Dining room/area	40dBL _{Aeq,16h}	-
Sleeping (daytime resting)	Bedroom	35dBL _{Aeq,16h}	30dBL _{Aeq,8h}

- 3.7 It should be noted that these levels represent the average noise level over the 16-hour day or 8-hour night period. This potentially means that higher noise levels may be experienced internally over a shorter period of time (e.g. individual passing trams or vehicles). These equivalent noise levels over a period of time are the best representation of the average noise level and are generally the main focus when it comes to evaluating noise exposure.
- 3.8 A relaxation of up to 5dB to provide “reasonable internal conditions” for both day and night-time cases where development is considered necessary or desirable.

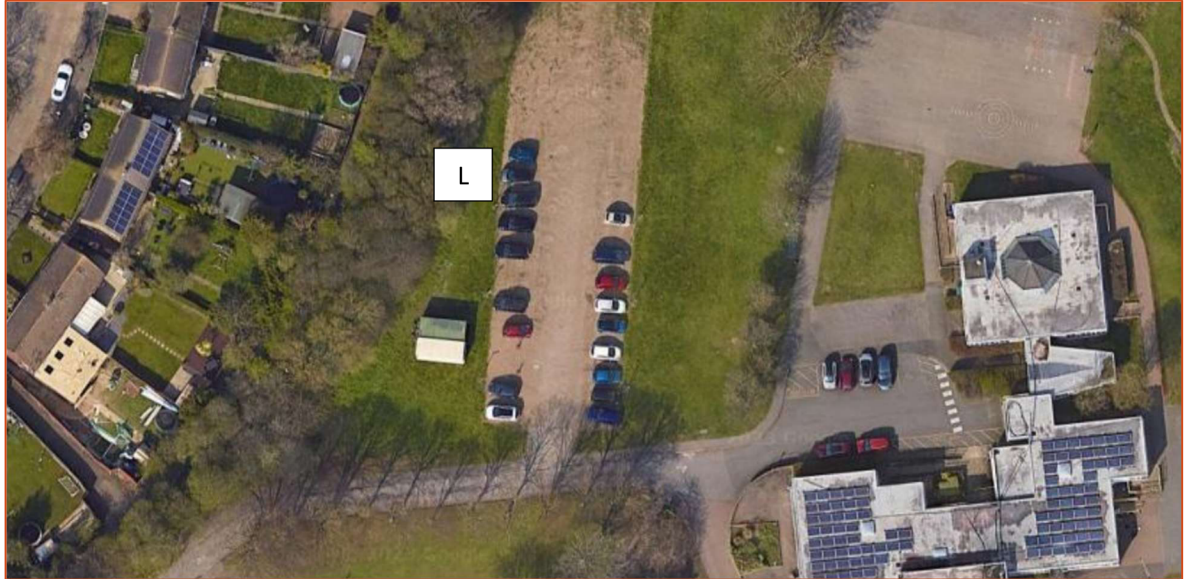
Outdoor Noise Levels in External Amenity Areas

- 3.9 BS 8233: 2014 and the WHO document ‘*Guidelines for Community Noise: 1999*’ present guidance for external noise levels within outdoor amenity areas of residential properties to be no higher than 55dBL_{Aeq,16h}.

4 NOISE SURVEY

- 4.1 An unattended noise survey was carried out between 14:15h on Monday 6th November and 13:15h on Thursday 9th November 2023. Measurements were made continuously throughout this period at the location indicated as 'L' in Figure 2, below.
- 4.2 This monitoring location was selected to be representative of noise levels affecting the nearby residential properties.

Figure 2: Noise Monitoring Location



- 4.3 The key noise source affecting the measurements was road traffic noise from the surrounding road network, with occasional vehicle movements in the school car park.
- 4.4 Measurements were undertaken in accordance with BS 7445-1:2003 *Description and Measurement of Environmental Noise*, with the microphone located approximately 1.5 metres above the local ground level and at least 3.5 metres away from reflective surfaces other than the ground; i.e in free field conditions. Measurements were 15 minutes in duration, and were continuously logged for the duration of the noise survey.

Weather Conditions

- 4.5 Weather conditions during the measurement period were cool with no precipitation.
- 4.6 Wind speeds were within suitable parameters for the measurement of environmental noise (i.e. generally under 5 ms^{-1}). The microphone was protected with a windshield for the duration of the survey.

Equipment

- 4.7 The equipment used during the environmental noise survey is detailed in Table 2, below.

Table 2: Equipment Used for Continuous Noise Survey (Location L)

Kit Reference	Equipment	Manufacturer & Part No.	Serial Number	Calibration Date
Kit 4 - Cirrus	Meter	CR:171C	G300656	24/10/2023
	Pre-Amp	MV:200F	9136F	
	Microphone	MK:224	215619A	
	Calibrator	CR:515	87921	18/01/2023

- 4.8 The sound level meter was calibrated before and after measurements, with no significant drift recorded. An accredited laboratory calibrated the equipment not more than two years prior to the measurements being made, with the exception of the calibrator, which had been calibrated not more than one year prior to the survey.

5 ENVIRONMENTAL NOISE SURVEY RESULTS

- 5.1 The noise levels measured during the environmental noise survey are summarised in Table 2, below. Full measurement data are available on request.

Table 3: Continuous Noise Monitor Results, Location L

Date	Period	Ambient Noise Level, $\text{dBL}_{\text{Aeq,T}}$	Background Noise Level, $\text{dBL}_{\text{A90,T}}$
Monday 6 th November	Daytime (14:15h-23:00h)	51	49
	Night-Time (23:00h-07:00h)	46	44
Tuesday 7 th November	Daytime (07:00h-23:00h)	56	50
	Night-Time (23:00h-07:00h)	49	42
Wednesday 8 th November	Daytime (07:00h-23:00h)	52	50
	Night-Time (23:00h-07:00h)	49	42
Thursday 9 th November	Daytime (07:00h-13:15h)	54	51

- 5.2 Using the statistical analysis methodology described in *BS 4142:2014 'Methods for Rating and Assessing Industrial and Commercial Sound'* (BS4142), the typical daytime and night-time background noise levels to be used for this assessment have been determined to be $50\text{dBL}_{\text{A90,1hr}}$ and $43\text{dBL}_{\text{A90,15mins}}$, respectively.
- 5.3 In accordance with GBC requirements, the daytime and night time rating noise levels should therefore not exceed $40\text{dBL}_{\text{Ar,Tr}}$ and $33\text{dBL}_{\text{Ar,Tr}}$ respectively.

6 PLANT NOISE IMPACT ASSESSMENT

- 6.1 Two Trane CXAF-060 air source heat pumps will be installed within a compound to the north west of the school site. The location is indicated in Figure 1, above.
- 6.2 The manufacturer's noise data for these units is presented in Figure 3, below.

Figure 3: Manufacturer's Noise Data

Acoustic data								
Outdoor sound power level					92 dBA			(4)
Outdoor sound pressure level					60 dBA			(3)
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Sound power spectrum (Lwa)	97 dB	93 dB	89 dB	86 dB	84 dB	78 dB	73 dB	

- 6.3 Calculations have been undertaken to predict the specific sound level arising at the noise sensitive receptors from the operation of these units. It has been assumed that the AHSP compound will be an open palisade fence construction.
- 6.4 The units will operate in a 'lead and lag' mode, where one unit is running, with the other on standby. There is a possibility during the peak of winter that both units would run simultaneously for a short period of time to get the school up to temperature.
- 6.5 It is understood that the units would not normally operate overnight (23:00h-07:00h), but that occasional overnight operation may be required for frost protection. This would be a brief period of operation (a few minutes) for a single unit.
- 6.6 It is also possible that the units may operate prior to 07:00h if required to warm the building e.g. for breakfast clubs.
- 6.7 With no mitigation, the predicted specific sound level is 48dB_{L_{Aeq,T}} when assessed at the façade of the housing on Doria Drive, for both units operating simultaneously which represents a worst-case scenario for daytime operation.
- 6.8 This calculation is based on noise levels received at first floor windows which do not benefit from acoustic screening from the close boarded timber garden fences.
- 6.9 This is 2dB lower than the typical daytime background noise level measured during the survey.
- 6.10 With one unit in operation (e.g. for frost protection), the specific sound level is predicted to be 45dB_{L_{Aeq,T}}.
- 6.11 On this basis, it can be seen that additional mitigation will be required to meet the requirements of the Local Authority.
- 6.12 The calculations have therefore been updated to assess the mitigation provided by an enclosure formed from an acoustic louvred panel, to allow airflow to the units. For the purposes of this assessment, the following sound reduction index(SRI) has been assumed, based on a typical 300mm deep single bank acoustic louvre.

Table 4: Louvre Sound Reduction Index, dB

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
300mm single bank louvre	6	6	7	12	19	19	17	16

- 6.13 The results of the acoustic model indicate that, with a louvre extending to a height of 0.5m above the top of the ASHP units, the specific noise level at the housing would be reduced to $33\text{dBL}_{\text{Aeq,T}}$ with two units running simultaneously, and $30\text{dBL}_{\text{Aeq,T}}$ with a single unit running (e.g. for overnight frost protection). These therefore meet GBC's criteria at all times, with either one or both units running simultaneously.
- 6.14 The assessment has been carried out to the first-floor window of the residential property to represent a worst-case for noise impact.
- 6.15 On this basis, the BS4142 assessment is presented for both the daytime and night time scenarios in Table 4, below.

Table 5: BS4142 Assessment

Item	Daytime (Two units)	Night Time (One Unit)	Relevant Clause	Comments
Measured background sound level	$50\text{dBL}_{\text{A90,1hr}}$	$43\text{dBL}_{\text{A90,15min}}$	8.3	The typical background sound level measured during each period.
Specific sound level	$33\text{dBL}_{\text{Aeq,1hr}}$	$30\text{dBL}_{\text{Aeq,15min}}$	7.3.3	A prediction made using the methodology outlined above, includes all sources, screening and distance corrections.
Assessment made during the daytime and night time period so reference period is 1 hour and 15 minutes respectively			7.2	-
Acoustic feature correction	3dB	3dB	9.2	Potential for acoustically distinct characteristics
Rating Level	$36\text{dBL}_{\text{Ar,Tr}}$	$33\text{dBL}_{\text{Ar,Tr}}$	9.2	The predicted Rating Level during the day and night-time periods
Excess of Rating Level over background sound level	-14dB	-10dB	11	-
Assessment indicates low likelihood of adverse impact during the daytime, potential for adverse impact at night dependent on context (see discussion)			11	Predicted Rating Level does not exceed the lowest measured background level during the daytime period. This is an indication of the development having a low impact.
Uncertainty of the assessment	Minor		10	Background sound level based on repeatable measurements. The predicted Rating Level is based on established prediction methodologies.

External Amenity

- 6.16 BS 8233: 2014 and the World Health Organisation (WHO) document 'Guidelines for Community Noise: 1999' present guidance for external noise levels within outdoor amenity areas of residential properties to be within $55\text{dB}_{\text{L}_{\text{Aeq},16\text{h}}}$.
- 6.17 The predicted noise level within the residential gardens arising from ASHP operation (two units simultaneously) is $40\text{dB}_{\text{L}_{\text{Aeq},\text{T}}}$. The existing daytime ambient noise level within the garden areas is $50\text{dB}_{\text{L}_{\text{Aeq},\text{T}}}$ and as such no adverse effect on external amenity is anticipated, even with a worst case scenario of both ASHPs operating simultaneously.
- 6.18 It should also be considered that the ASHP would not be expected to operate when the residential gardens are most likely to be in use, during the summer months and weekends when the school is unoccupied.

7 CONCLUSION

- 7.1 dBx Acoustics Ltd has been appointed by Reach2 Academy Trust to undertake a noise survey and noise impact assessment for the proposed installation of ASHP units at the Tymberwood Primary Academy, Cerne Road, Gravesend DA12 4BN.
- 7.2 An attended noise survey has been undertaken at the site at a location representative of the nearby noise sensitive receptors.
- 7.3 Based upon the manufacturers data for the plant intended for the development, an assessment of operational plant noise levels at the nearest sensitive receptors has been undertaken.
- 7.4 To meet the Local Authority's requirements for a BS4142 rating level 10dB lower than the background noise level, an acoustic louvre screen is proposed. Recommended performance criteria for this louvre are presented within the report.
- 7.5 Noise levels arising within the residential gardens due to operation of the ASHP have been assessed. No adverse impact on external amenity is anticipated.
- 7.6 Taking the above into account, noise should not be a limiting factor in any planning application.

APPENDIX A – GLOSSARY OF ACOUSTIC TERMINOLOGY

Decibel, dB	A unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. For sound pressure level (L_p) the reference quantity is 2×10^{-5} N/m ² . The sound pressure level existing when microphone measured pressure is 2×10^{-5} N/m ² is 0 dB, the threshold of hearing.
L	Instantaneous value of Sound Pressure Level (L_p) or Sound Power Level (L_w).
Frequency	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
A-weighting	Arithmetic corrections applied to values of L_p according to frequency. When logarithmically summed for all frequencies, the resulting single "A weighted value" becomes comparable with other such values from which a comparative loudness judgement can be made, then, without knowledge of frequency content of the source.
$L_{eq,T}$	Equivalent continuous level of sound pressure which, if it actually existed for the integration time period T of the measurement, would possess the same energy as the constantly varying values of L_p actually measured.
$L_{Aeq,T}$	Equivalent continuous level of A weighted sound pressure which, if it actually existed for the integration time period, T, of the measurement would possess the same energy as the constantly varying values of L_p actually measured.
$L_{n,T}$	L_p which was exceeded for n% of time, T.
$L_{An,T}$	Level in dBA which was exceeded for n% of time, T.
L_{Fmax}	The instantaneous maximum sound pressure level which occurred during the measurement. F indicates that the fast time-weighting is used.
L_{AFmax}	The instantaneous maximum A weighted sound pressure level which occurred during the measurement. F indicates that the fast time-weighting is used.
$L_{Ar,Tr}$	The rating level: the equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise.
Reverberation Time, T	The time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped. The descriptor T, often includes other nomenclature to describe the type of reverberation time measurement or if the reverberation time is an average taken for specific frequencies. For example, a T_{mf} is the mid-frequency reverberation time.
Absorption Coefficient, α	The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.
Acoustic Class, A - E	Classification of sound absorbers into Sound Absorption Classes A-E, according to BS EN ISO 11654, including frequencies 200-5000 Hz
NRC	A single-number rating system used to compare the sound-absorbing characteristics of building materials. A measurement of the acoustical absorption performance of a material, calculated by averaging its Sound Absorption Coefficients at 250, 500, 1000 and 2000 Hz
STI	Speech Transmission Index , Metric ranging between 0 and 1 representing the transmission quality of speech with respect to intelligibility by a speech transmission channel
R	Sound Reduction Index , the laboratory measured sound insulation properties of a material or building element in octave or third octave bands.
R_w	Weighted Sound Reduction Index , a single number which represents the sound reduction of a material. It is derived by plotting the sound reduction index against a set of reference curves. The curves are shifted until a best-fit is established and the curve which best fits the sound reduction spectrum is used to represent the single figure value.
D_w	Weighted Level Difference , the weighted level difference between a pair of rooms, stated as a single figure.

D_{nT}	Standardised Level Difference, a frequency-dependent measurement of airborne sound insulation, calculated using the following formula: $D_{nT} = L_1 - L_2 + 10\log(T/T_0)$ dB Where: L_1 is the energy-averaged sound pressure level due to the pink noise source measured in the source room using a sweep technique. L_2 is the energy-averaged sound pressure level measured in the receiving room using a sweep technique. T is the mean receiving room reverberation time (derived from T_{30} measured in seconds). T_0 is the reference reverberation time (= 0.5s for dwellings).
$D_{nT,w}$	Weighted Standardised Level Difference, a single-figure value of airborne sound insulation performance, derived according to procedures in BS EN ISO 717-1, based on the D_{nT} values at different frequencies (100-3150 Hz third octave bands).
$D_{n,F,w}$	Weighted, Normalised Flanking Level Difference, the normalised, weighted difference in sound level between a pair of rooms via a flanking element, such as mullion or ceiling detail. The level difference in octave bands is first normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.
D_{ne}	Normalised Element Level Difference. The normalised difference in sound level between a pair of rooms via a small element such as a trickle ventilator. The level difference in octave bands is normalized to a reference amount of absorption.
$D_{n,e,w}$	Weighted, Normalised Element Level Difference. The normalised, weighted difference in sound level between a pair of rooms via a small element such as a trickle ventilator, stated as a single figure. The level difference in octave bands is normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.
C_{tr}	Spectrum Adaptation Term, a correction term applied to the sound insulation single-number values (R_w, D_w, and $D_{nT,w}$) in accordance with BS EN ISO 717-1. Applying the C_{tr} penalises a construction's performance if its low frequency performance is poor in relation its performance at higher frequencies.
Impact Sound	The noise generated by an impact on a structure. This is normally used to describe the noise created by people walking or moving furniture on a floor structure.
L_{nT}	Standardised Impact Sound Pressure Level, a frequency dependent measurement of impact sound insulation, calculated using the following formula: $L_{nT} = L_1 + 10\log(T/T_0)$ dB Where: L_1 is the mean sound pressure level due to the tapping machine measured in the receiving room using a sweep technique. T is the mean receiving room reverberation time (derived from T_{30} measured in seconds). T_0 is the reference reverberation time (0.5s for dwellings)
$L'_{nT,w}$	Weighted Standardised Impact Sound Pressure Level, a single-figure value (@ 500 Hz) of impact sound insulation, performance, derived according to BS EN ISO 717-2, based on the L_{nT} values at different frequencies (100Hz- 3150 Hz third octave bands).
Insertion Loss, IL	The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence.
NR	The Noise Rating level. This is a single figure value derived by plotting a noise spectrum against a set of curves. The curve under which the spectrum fits is the resulting NR level.

This report (including any enclosures and attachments) has been prepared by dBx Acoustics with reasonable skill and care in accordance with generally accepted acoustic principles and the terms agreed between dBx Acoustics and our Client. Any information provided by third parties and referred to herein may not have been checked or verified by dBx Acoustics unless expressly stated otherwise. This document contains confidential information, and no part of this report should be reproduced, distributed or communicated to any third party without express prior written consent from dBx Acoustics. We do not accept any liability if this report is used for an alternative purpose from that for which it is intended, nor to any third party in respect of this report. Where a noise survey has been undertaken, this report is based on the noise climate at the site at the time of the survey and no warranty is given as to the possibility of changes at differing times.

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23092-R01A-SW Tymberwood ASHP Assessment

Final Audit Report

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