ENVIRONOISE

Residential Development, Bendix Street, New Cross, Manchester M4 5FQ

Noise & Vibration Impact Assessment

for GMI Construction, Carvers Warehouse, 77 Dale Street, Manchester M1

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Table of Contents

Executive Summary 4

1 Criteria 5
1.1 Noise 5
1.2 Vibration 5

2 Noise Survey 7
2.1 Survey Details 7
2.2 Instrumentation and Weather Conditions 8
2.3 Summary of Noise Results 8

3 Noise Impact Assessment 9
3.1 Proposed Works 9
3.2 Piling 10
3.3 Groundworks 10

4 Noise Impact Results 11
4.1 Noise Level at Residential Receptor 11
4.2 Recommendations 12

5 Vibration Impact Assessment 13
5.1 Overview 13
5.2 Piling 13
5.3 Groundworks 13
5.4 Other Groundworks 13
5.5 Recommendations 14

Table of Contents (continued)

6 Best Practice Techniques 15
6.1 Noise 15
6.2 Vibration 16

Appendix A: Piling Rig and Compactor Noise & Vibration Data 17
Appendix B: Calculations 19

References 20

Executive Summary

Environoise Consulting Limited has been instructed by GMI Construction to do a noise and vibration impact assessment associated with construction works for a proposed 13-storey residential apartment development on Bendix Street, New Cross, Manchester M4 5FQ.

Predicted Noise Levels

- Predicted construction noise levels exceed the 70dB $L_{Aeq,T}$ target [(as part of the ABC method) in BS 5228-1] at the nearest residential receptors. As per BS 5288-1, noise levels should be acceptable where activities are relatively short-term with regular liaison with nearby residents.

- Short-term noise monitoring at the site boundary of the nearest residential receptor is recommended given the potential for complaint from the nearby residents.

Predicted Vibration Levels

- The vibration levels due of piling at the nearest point to residential receptors (13 metres) will meet the BS 5228-2 recommended criteria of ≤15.0 mm/s to avoid cosmetic damage to residential buildings. The impact on humans could cause an impact of ‘low’ amplitude and ‘moderate’ severity for human receptors which means that ‘vibration might be just perceptible in residential environments’.

- Vibration from the relatively small compactor model chosen is expected to be negligible when measured at the residential receptors.

1 Criteria

1.1 Noise

1.1.1 British Standard 5228-1:2009+A1:2014 '*Code of practice for noise and vibration control on construction and open sites. Noise*'[i] provides guidance on the prediction and assessment of noise and vibration from development sites. The 'ABC Method' prescribed in the standard requires the ambient noise level at existing noise sensitive properties, rounded to the nearest 5dB integer and compared to the values shown in Table 1.1 to determine the appropriate threshold category value either A, B or C.

Table 1.1 Threshold of significant effect at nearest receptors.

Assessment category and Threshold value period [L_{Aeq} (dB)]	Threshold value (dB)		
	Category A	Category B	Category C
Daytime (07.00 -19.00hrs) Saturdays (07.00 – 13.00hrs)	65	70	75

Category A: Threshold values to use when the ambient noise levels (when rounded to the nearest 5dB) are less than this value.
Category B: Threshold values to use when the ambient noise levels (when rounded to the nearest 5dB) are the same as Category A values.
Category C: Threshold values to use when the ambient noise levels (when rounded to the nearest 5dB) are higher than Category A values.

1.1.2 It should be noted that the BS 5228 criteria relates to the main long term works i.e. operations that are done on a daily or regular basis. Higher noise levels may be necessary to enable some short-term operations to be undertaken.

1.2 Vibration

1.2.1 BS 5228-2:2009+A1:2014 *'Code of practice for noise and vibration control on construction and open sites. Vibration'*[ii] provides guidance on construction vibration. The effects of vibration on humans within buildings depending on Peak Particle Velocity (PPV) levels are described in Table B1 of BS 5228-2, reproduced as Table 1.2. A semantic scale for the impact on human receptors in residential buildings is also provided together with a significance of effect descriptor considering the high sensitivity of residential receptors.

Table 1.2: Construction vibration levels and magnitude impact criteria.

Vibration Level [PPV (mm/s)]	Effect Description	Magnitude of Impact	Significance Effect Level
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Negligible	Not Significant
0.3	Vibration might be just perceptible in residential environments.	Low	Moderate
1.0	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.	Medium	Major / Moderate
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High	Major

1.2.2 Cosmetic damage (not structural damage) is most likely to occur to properties that are within the first 20 metres (m) of piling activities. Table B.2 of BS 5228-2 gives vibration limits for transient excitation for different types of buildings and are reproduced in Table 1.3. Vibration levels at considered distances can be estimated from existing piling vibration data provided in BS 5228-2.

Table 1.3: Guidance on transient vibration levels for cosmetic damage.

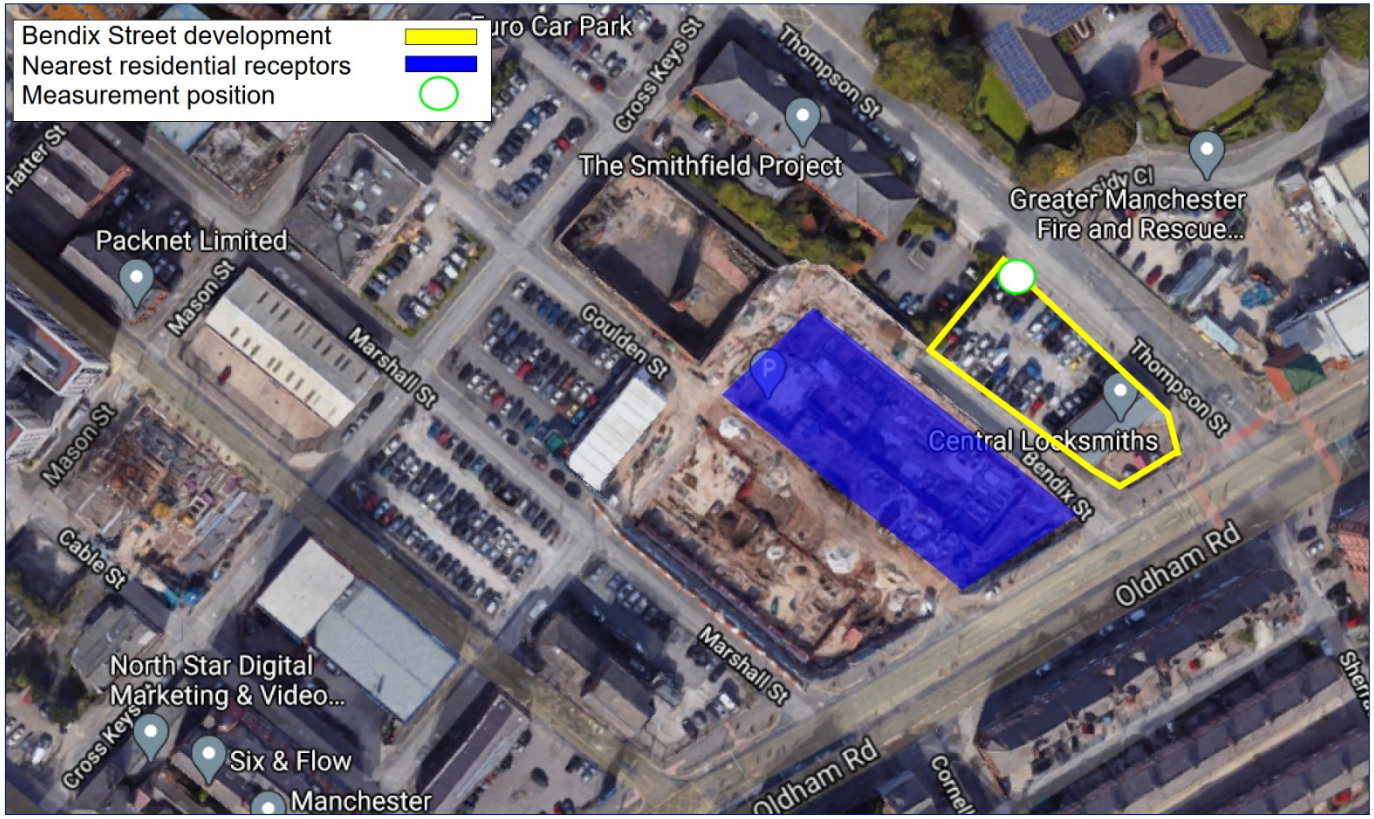
Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse[1]	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures (industrial and heavy commercial buildings)	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures. (residential or light commercial buildings)	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz[2]	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

2 Noise Survey

2.1 Survey Details

2.1.1 Overall A-weighted ambient noise level measurements ($L_{Aeq,1min}$) and associated octave band noise levels ($L_{eq,T}$, L_{90}, $L_{max,fast}$) were taken for 1-minute intervals at a position representative of the nearest existing residential receptors between 07.00hrs and 10.00hrs, Tuesday 13th October 2020.

Figure 2.1: Location of noise measurement positions and receptors.



2.2 Instrumentation and Weather Conditions

2.2.1 The sound level meter was calibrated at the start and end of the noise survey. The recorded drift was 0.1dB and therefore acceptable, instrumentation details are available upon request. Weather conditions including periods of adverse weather which have been discounted from assessment are given in Table 2.1.

Table 2.1: Weather conditions during noise surveys.

Date	Rainfall	Maximum wind speed (m/s)	Observed cloud cover (oktas)	Temperature (°c)
13/08/2020	None	3	6	4 - 6

2.3 Summary of Noise Results

2.3.1 A summary of measured noise levels is provided in Table 2.2.

Table 2.2: Measured noise data summary.

Period	$L_{eq,T}$ at octave band centre frequency (Hz)							$L_{Aeq,T}$ (dB)
	63	125	250	500	1k	2k	4k	
Daytime (07.00 – 10.00 hrs)	69	65	62	61	64	60	51	67

3 Noise Impact Assessment

3.1 Proposed Works

3.1.1 The following construction working hours are proposed:

- Monday to Thursday: 07.30 to 18.00hrs. Breaks: 09.30 – 10.00hrs, 12.30 – 13.00hrs and 14.30 – 14.45hrs.
- Friday 07.30 to 17.00hrs. Breaks: 09.30 – 10.00hrs, 12.30 – 13.00hrs and 14.30 – 14.45hrs.
- Saturday 08.00 to 14.00hrs. Breaks: 09.30 – 10.00hrs, 12.30 – 13.00hrs.

Works Overview

3.1.2 Table 3.1 gives the schedule[1] for high-noise level works and corresponding machinery and noise data.

Table 3.1: Proposed activities and machinery.

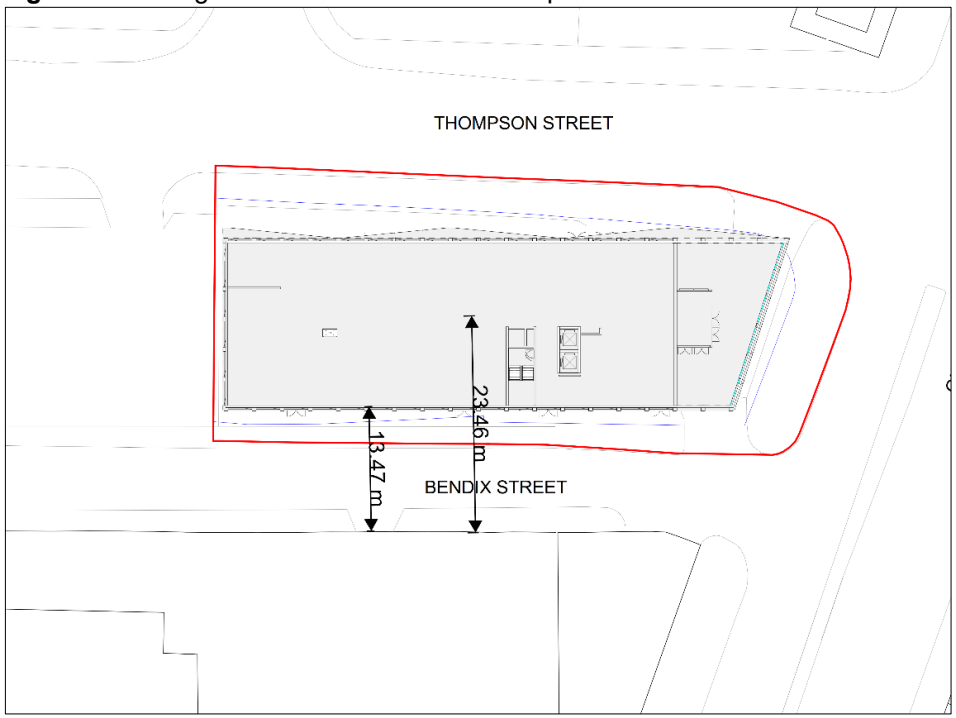
Activity	Date of works	Machinery	Model	Sound level
Piling	04/11/21 – 05/12/21	Piling rig	Soilmec SR-35	110dB L_{wA}
		Concrete pump and 9m^3 concrete agitator drum	Putzmeister PM55	80dB L_{pA} at 10 metres
		Excavator	Hitachi ZX135US-6	99dB L_{wA}
		Compressor	Compair C38	98dB L_{wA}
Groundworks	From 08/11/21. Finish date TBC.	Compactor	Hyundai HYCP9070	91dB L_{wA}
		Generator	Honda GX-160	65dB at 10 metres[2]
		Excavator	Hitachi ZX135US-6	99dB L_{wA}
		Compressor	Compair C38	98dB L_{wA}

[1] As informed by Chris Alessandra, GMI Construction in email to Sam Williams, Environoise Consulting dated Friday 13th August 2021.
[2] Noise data does not state distance the level (65dB) applies to, assumed to be 10-metres which would correspond to a typical generator noise level.

3.2 Piling

3.2.1 CFA piles are to be installed to a depth of 10 to 20 metres and will consist of drilling, drill withdrawal and concreting and finally, steel cage installation. An assumed piling on time of 50% has been considered. The distance from the centre-point of site / central pile to the nearest residential receptor is approximately 23 metres with the nearest point of site / nearest pile approximately 13 metres away from the receptor[3], see Figure 3.1.

Figure 3.1: Piling distances to residential receptor.



3.3 Groundworks

3.3.1 It is assumed that the 'on-time' for the compactor is 30%. The centre-point of site and nearest point to the receptors (as given in Figure 3.1) have been considered within our calculations.

[3] Determined through cross-referencing of 'Site Plan' drawing (Tim Groom Architects drawing ref: 0324-TGA-XX-XX-DR-A-0201, Rev PA) and 'Piling Sequence' drawing (Ridge drawing ref: B8T-RDG-00-FN-DR-8-0002, Rev P2).

4 Noise Impact Results

4.1 Noise Level at Residential Receptor

4.1.1 Table 4.1 shows the predicted overall typical construction noise levels at the nearest receptor for piling and for groundworks (full calculations in Appendix B provide levels for individual machinery). Table 4.2 provides a calculation for the piling and groundworks where activity is at the closest point to residential receptors. Screening mitigation has not been considered as any site boundary hoarding will provide negligible noise mitigation due to the height of the adjacent receptors.

Table 4.1: Typical noise impact to receptors.

Construction Phase	BS 5228 target [$L_{Aeq,T}$ (dB)]	Noise at nearest receptors [$L_{Aeq,T}$ (dB)]	Excess over target (dB)
Piling	70	80	+10
Groundworks	70	71	+1

Table 4.2: Highest calculated noise impact to receptors.

Construction Phase	BS 5228 target [$L_{Aeq,T}$ (dB)]	Noise at nearest receptors [$L_{Aeq,T}$ (dB)]	Excess over target (dB)
Piling	70	85	+15
Groundworks	70	75	+5

Discussion of Results

4.1.2 As shown in Table 4.1, the predicted construction noise levels typically exceed the 70dB $L_{Aeq,T}$ criterion by 10dB during piling and 1dB during groundworks.

4.1.3 As shown in Table 4.2, piling and groundworks may exceed target by 15dB and 5dB when works at the closest point to the receptors along the south-west site boundary; however, this is expected to be for a relatively short period.

4.2 Recommendations

Piling Method

4.2.1 The excess over the BS 5288 noise target during piling is largely due to the high sound power level associated with the use of the auger piling rig. An alternative, quieter method such as press piling, if practicable, would reduce operational noise levels at the receptors.

Resident Liaison

4.2.2 Section 6.3 'Issues associated with noise effects and community reaction' of BS 5228 Part 1 part b (existing ambient noise levels) seems most appropriate where the duration of the works is relatively short, and states:

'Experience of complaints associated with industrial noise sources indicates that the likelihood of complaint increases as the difference between the industrial noise and the existing background noise increases. Some types of open sites, such as quarries and landfill sites, are usually assessed in this manner. For some large infrastructure projects that require an environmental statement to be prepared, construction noise is sometimes assessed by comparing the predicted construction noise (plus ambient noise) with the pre-construction ambient noise. However, it is generally assumed that a greater difference might be tolerated, than for an industrial source, when it is known that the operations are of short or limited duration, and the critical issues are likely to include interference with speech communication and/or sleep disturbance.'

4.2.3 Section C 'Duration of site operations' of the same section also states:

'…Local residents might be willing to accept higher levels of noise if they know that such levels will only last for a short time. it is then important that construction activities are carried out in accordance with the stated schedule and that the community is informed of their likely durations.'

4.2.4 Considering the above, we recommend that a construction schedule is issued to local residents and that open communication is established and retained thereafter.

Noise Monitoring

4.2.5 Short-term monitoring of noise levels should be done at the boundary of the nearest receptors during piling and groundworks to assess the levels of noise against the BS 5228 criteria given the potential for complaint from the receptors.

5 Vibration Impact Assessment

5.1 Overview

5.1.1 In this section, the level of vibration (peak particle velocity [mm/s]) due to compaction and piling works has been predicted at the closest proposed location that the works will be carried out to the nearest receptors.

5.2 Piling

5.2.1 Vibration levels of the Soilmec SR-35 piling rig have not been made available. Therefore, vibration levels have been taken from historic case data[4] given in Appendix D of 5228-2:2009+A1:2014 for auger piling systems which states a peak particle velocity of level of 0.4mm/s at 10 metres.

5.2.2 The vibration levels due of piling at the nearest point to residential receptors (13 metres) will meet the BS 5228-2 recommended criteria of ≤15.0 mm/s to avoid cosmetic damage to residential buildings. The impact on humans could cause an impact of 'low' amplitude and 'moderate' severity for human receptors which means that 'vibration might be just perceptible in residential environments'.

5.2.3 Most piling will occur at a distance further than 13 metres and therefore may not be perceptible to residents.

5.3 Groundworks

5.3.1 Vibration levels for the Hyundai HYCP9070 have not been made available. However, this is a relatively small compactor model which is expected to provide negligible vibration when measured at the residential receptors.

5.4 Other Groundworks

5.4.1 Resultant ground borne vibration levels from other groundwork construction techniques to receptors vary significantly as the level is dependent on ground type relative to both the block under construction and the receptor, construction technique and distance. Therefore, the transmission of ground-borne vibration to receptors during construction cannot be accurately predicted. However, for guidance, Table 5.1 provides estimates of the minimum distances to receivers and equipment that is most likely to be vibration intensive. This allows for a comparison for safe working distances when determining the likely vibration impacts of the construction scenarios as well as 'human response'.

[4] BS 5228 case reference numbers 103 (1983 Romford) and 104 (1985 London W1).

Table 5.1: Recommended safe working distances for vibration intensive plant.

Plant item	Description	Safe working distance (metres)	
		Cosmetic damage*	Human response
Vibratory roller	<50 kN – typically 7 – 13t	15	100
	<50 kN – typically 13 – 18t	20	
	<50 kN – > 18t	25	
Small hydraulic hammer	300kg 18t to 34t excavator	2	7
Medium hydraulic	1600kg 5 to 12t excavator	7	23
Large hydraulic hammer	1600kg 12 to 18t excavator	22	73

*From BS 7385 Part 2 1993 Evaluation and measurement for vibration in buildings Part 2.

5.5 Recommendations

Piling Method

5.5.1 Similar to section 4.2.1 of this report, press piling would be expected to have lower resultant vibration levels, if a practicable method for this site.

Vibration Monitoring

5.5.2 Short-term monitoring of vibration levels should be done at the boundary of the nearest receptors during compaction and piling activity to assess the levels of vibration against the BS 5228 criteria given the difficulties in vibration prediction.

6 Best Practice Techniques

6.1 Noise

6.1.1 The contractor should be committed to following best practice construction techniques to minimise their noise impact on receptors; such measures are likely to include:

- Plant should be shut down when not in use or for long periods of inactivity between uses. Similarly, delivery vehicles should not leave engines running idle whilst stationary.
- Regular maintenance of construction plant.
- All vehicles and mechanical plant should be fitted with effective exhaust silencers and should be maintained in good, efficient working order.
- Stationary plant (e.g. generators, compressors and pumps) should be positioned so as to cause minimum noise disturbance through distance and shielding to receptors. Additionally, localised screens/enclosures should be used to reduce noise from static sources.
- All ancillary pneumatic percussive tools should be fitted with mufflers or silencers as recommended by the respective manufacturers.
- Handled materials should be placed rather than dropped. Care should be taken when unloading vehicles to minimise noise.
- Compressors should be fitted with and sealed acoustic covers and lined with a suitable sound-absorbent material. Attention should be given to selecting the quietest available and appropriate plant.
- Delivery routes to the site should be marked so that the noise impact on local residents is reduced; deliveries should be made during the daytime period only.
- The impact of noise on local residents can be ameliorated by establishing and maintaining a line of communication with affected residents. This should include the informing of them of any periods of construction which are likely to produce atypically high noise levels.
- Works should not generally be undertaken outside of the agreed hours of operation. However, if works outside of normal working hours is required, then the residents should be notified.
- Short-term noise monitoring at the boundary of the nearest receptors during activities of expected high levels of noise should be considered.

6.2 Vibration

6.2.1 The contractor should be committed to following best practice construction techniques to minimise vibration impact to receptors; such measures are likely to include:

- Noise caused by vibrating machinery having rotating parts can be reduced by attention to proper balancing.
- Wherever possible, the use of hydraulic attachments is preferred to pneumatic breakers. Where the use of impact hammers is necessary, their attachment to larger and heavier excavators often can reduce the level of vibration.

  Short-term monitoring of vibration levels at the boundary of the nearest receptors during activities of expected high levels of vibrations should be considered.

Appendix A: Piling Rig and Compactor Noise & Vibration Data

Figure A1: Piling rig noise data.

C-6.3 Sound emission

The noise emission values above have been determined during a standard test cycle and may not be representative for all conditions in accordance with the intended use. Operating conditions such as the soil the machine is operated on or sound reflective surfaces near the operating environment can cause the sound levels to be higher than the values declared in this manual.

Weighted sound pressure level (A) at the operator's station:

LpA = 80 dB (A) (Tier 3) - 75 dB (Tier 5)

(*) Measurement pursuant to EN 16228-1:2014 and EN 16228-4:2014

WARNING

When working with the door and/or glass open or when the sound pressure level is higher than 85 dB(A), special ear protection must be worn. Always respect the regulations of the country where the machine is being used.

Guaranteed sound power level (pursuant to directive 2000/14/EC):

LwA = 108 dB (Tier 3) - 110 dB (Tier 5)

Measurement uncertainty: 1 dB.

The value of the guaranteed sound power level (**LwA**) is indicated in a plate (see *Guaranteed sound power level plate*) installed on the machine.

Guaranteed sound power level plate

Figure A2: Compactor noise data.

8/10/2021 Hyundai HYCP9070 196cc Petrol Plate Compactor / Wacker

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Engine Model TypeFuel Type

Unleaded Petrol

Engine Model TypeGross Weight

86

Noise Rating (dBA)

91

Engine Model TypePlate Size

540 x 420

Starting Method

Recoil Pull

Travel Speed (m/min)

15

Vibration value m/s2

15.0

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Appendix B: Calculations

Table B1: Predicted noise level from nearest pile to receptor.

Nearest pile to receptor	Piling rig	Excavator	Compressor		Concrete pump and 9m3 concrete agitator drum			Combined Noise level [$L_{Aeq,T}$ (dB)]	Distance to Residential receptor (m)	Noise level at Residential receptor (m)
Sound power level	110	99	98	Sound pressure level at 10m	80					
% on time	50	20	50	% on time	20					
Attenuation (dB)	0	0	0	Attenuation (dB)	0					
On-time' corrected sound power level [L_{wA} (dB)]	107	92	95	On-time' corrected sound pressure level at 10m [$L_{Aeq,T}$ (dB)]	73					
				On-time' corrected sound pressure level at receptor (13m) [$L_{Aeq,T}$ (dB)]	71			107	13	**85**

Table B2: Predicted noise level from central pile to receptor.

Central pile to receptor	Piling rig	Excavator	Compressor		Concrete pump and 9m3 concrete agitator drum			Combined Noise level [$L_{Aeq,T}$ (dB)]	Distance to Residential receptor (m)	Noise level at Residential receptor (m)
Sound power level	110	99	98	Sound pressure level at 10m	80					
% on time	50	20	50	% on time	20					
Attenuation (dB)	0	0	0	Attenuation (dB)	0					
On-time' corrected sound power level [L_{wA} (dB)]	107	92	95	On-time' corrected sound pressure level at 10m [$L_{Aeq,T}$ (dB)]	73					
				On-time' corrected sound pressure level at receptor (23m) [$L_{Aeq,T}$ (dB)]	66			107	23	**80**

Table B3: Predicted noise level from nearest point of groundworks to receptor.

Nearest point to receptor	Compactor	Excavator	Compressor		Generator			Combined Noise level [$L_{Aeq,T}$ (dB)]	Distance to Residential receptor (m)	Noise level at Residential receptor (m)
Sound power level	91	99	98	Sound pressure level at 10m	65					
% on time	30	40	30	% on time	100					
Attenuation (dB)	0	0	0	Attenuation (dB)	0					
On-time' corrected sound power level [L_{wA} (dB)]	86	95	93	On-time' corrected sound pressure level at 10m [$L_{Aeq,T}$ (dB)]	65					
				On-time' corrected sound pressure level at receptor (13m) [$L_{Aeq,T}$ (dB)]	63			97	13	**75**

Table B4: Predicted noise level from central point of groundworks to receptor.

Centre point to receptor	Compactor	Excavator	Compressor		Generator			Combined Noise level [$L_{Aeq,T}$ (dB)]	Distance to Residential receptor (m)	Noise level at Residential receptor (m)
Sound power level	91	99	98	Sound pressure level at 10m	65					
% on time	30	40	30	% on time	100					
Attenuation (dB)	0	0	0	Attenuation (dB)	0					
On-time' corrected sound power level [L_{wA} (dB)]	86	95	93	On-time' corrected sound pressure level at 10m [$L_{Aeq,T}$ (dB)]	65					
				On-time' corrected sound pressure level at receptor (23m) [$L_{Aeq,T}$ (dB)]	63			97	23	**71**

References

[i] BS 5228-1:2009+A1:2014 '*Code of practice for noise and vibration control on construction and open sites. Noise*'

[ii] BS 5228-2:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites. Vibration'