Resource & Environmental Consultants Ltd

Noise Impact Assessment

Proposed Residential Development
Land off Cork Lane
Glen Parva
Leicestershire

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EXECUTIVE SUMMARY

Noise Survey

Resource and Environmental Consultants (REC) Limited have been commissioned by Manor Oak Homes Limited to undertake a Noise Impact Assessment for proposed residential development on a parcel of land off Cork Lane in Glen Parva, Leicestershire. A series of Noise Surveys have been completed in order to measure the noise impact on the proposed development Site from key surrounding noise sources.

Noise Impact Assessment

This Noise Impact Assessment has identified that the key noise sources within the vicinity of the Site are from commercial noise to the east, rail traffic to the south and road traffic to the west. Accordingly appropriate consideration has been given towards the mitigation measures required to ensure a commensurate level of protection against noise for future occupants.

Recommended Mitigation Measures

This assessment has recommended the following mitigation measures in order to ensure an adequate level of protection from noise within living spaces:

- An acoustic-grade fence should be installed along the garden boundary of the plots detailed on Figure 2 of Appendix III; and,
- For habitable rooms which have direct line of sight to the commercial area, railway line and M1 Motorway, a scheme of alternative ventilation is required in order to gain a supply of fresh air to the room as an option to opening windows

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APPENDICES

1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Limited have been commissioned by Manor Oak Homes Limited to undertake a Noise Impact Assessment for proposed residential development on a parcel of land off Cork Lane, Glen Parva in Leicestershire LE2, to be referred to hereafter as 'the Site'.

This assessment has been undertaken to identify key noise sources in the vicinity of the Site which may have the potential to impact upon the proposed noise-sensitive residential development.

All acronyms used within this report are defined in the Glossary presented in Appendix II.

1.2 Site Location & Proposed Development

The Site is bound by a public footpath to the east with commercial units beyond. To the south lie existing residential dwellings along Swan Close and Navigation Drive. To the north lie existing residential dwellings along Westdale Avenue. Approximately 450m to the south west of the Site lies Whetstone Waste Site.

Approximately 1.5km to the west of the Site lies the M1 Motorway and approximately 450m to the south of the Site, the Birmingham New Street to Leicester railway line.

Proposals include for the construction of 166 dwellings comprising a combination of detached and semi-detached housing.

The key source of noise impacting upon the Site is commercial noise from units to the east of the Site.

This assessment has been undertaken with due regard to the supplied proposed site layout plan as shown on the following planning drawing:

- Proposed Masterplan, ref.7779/005 B dated 27th September 2013.

A site location plan is shown in Figure 1 of Appendix III.

1.3 Limitations

The limitations of this report are presented in Appendix I.

1.4 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

2.0 ASSESSMENT CRITERIA

2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) provides very brief guidance on planning and noise. The NPPF replaces Planning Policy Guidance (PPG) Note 24. Paragraph 123 of the NPPF document states that planning policies and decisions should aim to:

- '*avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and,*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*.'

This has been considered throughout the assessment where applicable.

No further guidance is given as to what a 'significant' impact would entail. It is therefore considered that meeting the criteria outlined in BS 8233 and recommendations contained within the World Health Organisation guidelines, "significant adverse impacts" on health and quality of life associated with noise would be avoided.

2.2 Local Authority Guidance and Criteria – Blaby District Council's Environmental Health Department

Consultation was undertaken with the Environmental Health Department on 24th October 2013 regarding the proposed Noise Survey methodology and assessment criteria. The following noise assessment criteria were proposed by REC and no objections were received from BDC:

- The steady noise level in external amenity areas should not exceed $L_{Aeq,T}$ 50dB, and 55dB should be regarded as the upper limit;
- The maximum permissible average noise level in habitable rooms shall not exceed the BS 8223 internal target 'good' criteria which is 30dB $L_{Aeq,T}$ in living rooms and bedrooms;
- The maximum noise level in bedrooms shall not exceed 45dB $L_{Amax,fast}$ during the night-time period; and,
- When assessing commercial noise, a change in ambient noise level of +3dB(A) will be considered significant and mitigation measures recommended.

In addition to the above, the use of BS4142:1997 is considered appropriate for determining the likelihood of noise complaints from fixed commercial noise sources. During consultation, BDC did not offer any guidance on their required noise criteria level for commercial noise, relative to the background noise level. Accordingly REC have adopted a noise rating criteria limit of no greater than 5dB below the background noise level ($L_{A,r} = L_{A90,t}$ -5dB). This limit is considered to be sufficiently low enough to protect residential amenity.

2.3 British Standard BS 8233:1999: Sound Insulation and Noise Reduction for Buildings – Code of Practice

The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including plots, as shown in Table 2.1.

Table 2.1: BS 8233 Recommended Internal Target Noise Levels

Criterion	Typical Situation	Design Range $L_{Aeq,T}$ dB	
		Good	Reasonable
Suitable resting / sleeping conditions	Living Room	30	40
	Bedroom	30	35
For a reasonable standard in bedrooms at night, individual noise events (measured with fast time weighting) should not normally exceed 45dB L_{Amax}			

BS 8233 goes on to recommend noise levels for gardens. According to BS8233, it is desirable that the steady noise level does not exceed $L_{Aeq,T}$ 50dB, and 55dB should be regarded as the upper limit.

2.4 World Health Organisation's (WHO) 'Guidelines for Community Noise'

The WHO gives guidance on desirable levels of environmental noise. The levels presented in the WHO Community Guidelines are those at which adverse effects become measurable. The 1980 WHO document suggested that "*general daytime outdoor noise levels of less than 55dB(A) $L_{eq,16hr}$ are desirable to prevent any significant community annoyance*" This level is an external free-field noise level. The 1980 document also stated in relation to internal levels "*that night-time noise levels of 35dB(A) $L_{eq,8hr}$ or less will not interfere with the restorative process of sleep*".

A report was submitted to the WHO in 1995 for consideration as a revision to the 1980 document and revised community guidelines were issued in 2000. In the 2000 guidelines, it is considered that the sleep disturbance criteria should be taken as an internal noise level of 30dB $L_{Aeq,8hr}$ or an external level of 45dB $L_{Aeq,8hr}$. It also recommends that internal L_{Amax} levels of 45dB and external L_{Amax} levels of 60dB should be limited where possible.

The 2000 WHO document also states that "*To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55dB $L_{Aeq,16hr}$ for a steady continuous noise.*" i.e. the daytime levels effectively remain unchanged.

2.5 IEMA/IOA Draft Guidelines for Noise Impact Assessment, 2002

Although the Institute of Environmental Management Assessment (IEMA)/Institute of Acoustics (IOA) Working Party Guidelines (IEMA/IOA, 2002) are still only a consultation draft at this stage, they are of some assistance in this exercise. The Working Party provides an example of how changes in noise level can be categorised by significance as detailed in Table 2.2.

Table 2.2: Example of Categorising the Ambient Noise Change

Noise Change (dB)	Category
0	No Impact
0.1 – 2.9	Slight Impact
3.0 – 4.9	Moderate Impact
5.0 – 9.9	Substantial Impact
10.0+	Severe Impact

2.6 British Standard BS4142: 1997: Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas

This standard is intended to be used to assess where noise from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises is likely to give rise to complaints from people residing in nearby dwellings.

The procedure contained in BS4142 for assessing the likelihood of complaints is to compare the measured or predicted noise level from the source in question, the 'specific noise level' immediately outside the dwelling, with the background noise level. Where the noise contains a 'distinguishable discrete continuous note (whine, hiss, screech, hum etc.) or if there are distinct impulses in the noise (bangs, clicks, clatters or thumps), or if the noise is irregular enough to attract attention' then a correction of +5dB is added to the specific noise level to obtain the 'rating level'.

The likelihood of noise provoking complaints is assessed by subtracting the background noise level from the rating noise level. BS4142 states:

> *"A difference of around 10dB or higher indicates that complaints are likely. A difference of around 5dB is of marginal significance. A difference of -10dB is a positive indication that complaints are unlikely."*

For the daytime, this assessment is carried out over a 1-hour period, and over a 5-minute period at night. The day and night-time periods are not defined in the Standard but it states that night should cover the times when the general adult population are preparing for sleep or are actually sleeping. For the purposes of this assessment it is assumed that the day and night periods reflect those stated in the now revoked Planning Policy Guidance Note 24 (PPG24), i.e. day is 07:00 to 23:00 hours and night 23:00 to 07:00 hours.

3.0 NOISE SURVEYS

A series of Noise Surveys have been completed at 3 Noise Measurement Positions (NMPs) within the vicinity of the Site to assess the following potential noise sources:

- Commercial Noise from the units to the east, across 2 measurement positions; and,
- Rail traffic noise from the Birmingham New Street to Leicester Railway Line to the south.

The NMPs are shown in Appendix III for reference.

The weather conditions during the noise surveys were conducive towards the measurement of environmental noise, being fine and dry with wind speeds of less than 5.0m/s.

Due to the distance from the M1 it was not practical to conduct a noise survey on Site as the measurements would include local noise sources. Therefore, REC have adopted recent library source data of the M1 motorway.

3.1 Commercial Units to the East

REC has conducted measurements of commercial noise associated with the units to the east of the Site during the following periods:

- Tuesday 29th October 2013: 09:45 – 10:15; and,
- Thursday 7th November 2013: 07:00 – 08:50.

The following noise measurement position was chosen for the surveys:

- Noise Measurement Position 1 (NMP1): Located 34m west of the commercial units, along the eastern Site boundary. The sound level meter was positioned adjacent to the public footpath which bounds the Site. The microphone was located at a height of 1.5m above ground level. It was noted that the dominant noise source at this location was intermittent banging from the units; and,
- Noise Measurement Position 2 (NMP2): Located 32m west of the commercial units, along the eastern Site boundary. The sound level meter was positioned adjacent to the public footpath which bounds the Site. The microphone was located at a height of 1.5m above ground level. It was noted that the dominant noise source at this location was intermittent banging from the units and a constant hum from the machinery.

A summary of the measured sound pressure levels are presented in Table 3.1.

Table 3.1: Summary of Measured Noise Levels for NMP1 & NMP2

Position	Noise Source	Measured Noise Level $L_{Aeq,T}$ (dB)	Measurement 'on-time' (hh:mm:ss)
NMP1	Banging and cutting machinery noise	53.7	00:21:48
NMP2	Banging noise	57.5	00:07:20

NMP1 was also used to measure the existing ambient and background noise levels immediately prior to operations beginning at the commercial units to the east. This period is considered to be most pertinent as it is the transition phase between no commercial noise and the commencement of commercial noise which can give rise to noise complaints.

Table 3.2 shows the measured 1 hour ambient and background noise levels prior to operations commencing.

Table 3.2: Summary of Measured Ambient and Background Noise Levels

Period Start	Measured $L_{Aeq,1hr}$ (dB)	Measured $L_{A90,1hr}$ (dB)
Thursday 7th November 2013 07:00	54.7	53.8

3.2 Rail Traffic Noise Survey

REC has conducted a rail traffic noise survey on Site. The railway line lies approximately 589m to the south of the Site and the coding feature on the sound level meter was used in order to measure the noise levels from passing trains. Due to the distance from the line, it was not possible to determine the provider/type of the trains.

The survey in which train noise was measured was undertaken during the following period:

- Thursday 7th November 2013: 09:00 – 10:12.

The following noise measurement position was chosen for the surveys:

- Noise Measurement Position 3 (NMP3): Located close to the existing residential properties on Swan Close. The position was considered representative of the closest proposed residential properties. The microphone was located at a height of 1.5m above ground level and approximately 547m from the centre of the railway line. It was noted that the dominant noise source at this location and train pass bys to the south. No commercial noise was audible.

A summary of the measured sound pressure levels are presented in Table 3.2.

Table 3.2: Summary of Measured Noise Levels for NMP3

Train Type	Measured Noise Level $L_{Aeq,t}$ (dB)	Measured Maximum Noise Level ($L_{Amax,fast}$) (dB)	Measurement Duration (hh:mm:ss)	Measurement Distance (m)
Passenger 1	54.7	58.0	00:00:40	456
Passenger 2	56.5	55.4	00:00:30	456
Freight 1	55.9	59.4	00:01:20	456
Freight 2	55.8	59.4	00:02:30	456

The Noise Surveys were completed using the following specification noise measurement equipment shown in Table 3.3.

Table 3.3: Noise Measurement Equipment

Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
NMP1, NMP2 & NMP3	Sound Level Meter	01dB-Metravib Black Solo	65771	27 August 2015
	Pre-amplifier	01dB-Metravib PRE 21 S	16640	
	Microphone	01dB Metravib MCE212	16539	
	Calibrator	01dB-Metravib CAL-21	34634218	29 August 2014

The sound level meter was field-calibrated on Site prior to and after noise measurements were taken. No significant drift was witnessed. Calibration certificates are available upon request.

3.3 M1 Motorway Noise

In the absence of being able to obtain reliable noise measurements of the M1 Motorway, due to the separation distance, REC have used recently measured noise data of the M1 for a Site which lies approximately 20 miles north of this Site. The measured noise data for the M1 was completed over a full 24-hour period.

The survey in which noise was measured was undertaken during the following period:

- Monday 22nd to Tuesday 23rd April 2013 starting and finishing at 11:00.

Noise measurements of the M1 were conducted at 15m from the nearside carriageway edge of the M1 which equates to 28m from the centre of the motorway. The microphone was located at a height of 1.5m above ground level. The noise survey was dominated by road traffic noise only.

A summary of the measured sound pressure levels are presented in Table 3.4.

Table 3.4: M1 Motorway – Library Data

Period	Measured Sound Pressure Level, freefield (dB)	
	$L_{Aeq,T}$	$L_{Amax,fast}$
Daytime 07:00 – 23:00	68.2	-
Night-time 23:00 – 07:00	65.0	75.2
*$L_{Amax,fast}$ parameter not applicable for daytime period		

The weather conditions during the noise survey were conducive towards the measurement of environmental noise, being fine and dry with wind speeds of less than 5.0m/s.

4.0 NOISE IMPACT ASSESSMENT

This Section has considered the following assessments:

- Commercial Noise Impact Assessment;
- M1 Motorway Road Traffic Noise Impact Assessment; and,
- Rail Traffic Noise Impact Assessment.

4.1 Commercial Noise Impact Assessment

4.1.1 BS4142 Assessment

Operations associated with the commercial units to the east of the Site have been assessed in accordance with the guidance stated in BS4142. The main source of noise during the noise survey was banging and machinery operation from within the units to the east.

The units operate during the daytime only and the measured noise levels have been extrapolated into the wider 1 hour daytime assessment noise level.

Table 4.1 determines the Calculated Noise Rating Level in the closest garden areas.

Table 4.1: BS4142 Assessment in Outdoor Amenity Areas during the Daytime Period

Source	Calculated Average Specific Noise Level $L_{Aeq,1hour}$ (dB)	Noise Rating Level $L_{A,r}$ (dB)	Calculated Noise Rating Level In closest Garden $L_{A,r}$ (dB)	Combined Noise Rating Level $L_{A,r}$ In closest Garden (dB)
Banging and Machinery Operation	51.4	56.4	53.0	56.2
Banging	52.3	57.3	53.4	

Table 4.2 details the BS4142 assessment for all operations associated with the units to the east.

Table 4.2: BS4142 Assessment in Outdoor Amenity Areas during the Daytime Period

Source	Calculated Noise Rating Level In closest Garden $L_{A,r}$ (dB)	Background Noise Level prior to Operations Beginning (dB)	Adopted Criteria Noise Level L_{A90} – 5dB (dB)	Difference +/- (dB)
All Operations	56.2	53.8	48.8	+7.4

Table 4.2 indicates that operations as a result of the units to the east results in a daytime noise level difference of +7.4dB which is in exceedence of the adopted criteria. Therefore, Section 5.0 discusses appropriate mitigation techniques.

4.1.2 Change in Ambient Noise Levels

This assessment has also quantified the predicted change in ambient noise levels at the closest proposed receptor as result of the commercial noise occurring. It is assumed that commercial operations only take place during the daytime period.

It is appropriate to assess the change in ambient noise levels in terms of the 1-hour noise level. Accordingly Table 4.3 calculates the 1-hour assessment level at the closest proposed residential dwelling which lies 42m away.

In calculating the noise level at the closest proposed residential dwelling the following equations have been used:

1. Distance attenuation from the centre of the commercial units to the façade by using the following formula:

$$L_{Aeq,2} = L_{Aeq,1} - (20 \times \log (D_2/D_1))$$

Where
$L_{Aeq,2}$ = noise level under investigation
$L_{Aeq,1}$ = measured noise level
D_2 = distance under investigation (m)
D_1 = measurement distance (m)

Table 4.3: Calculation of 1-Hour Noise Level at 50m

Measured Operation	Measurement Duration (hh:mm:ss)	Measured Noise Level (dB)	Calculated Equivalent 1-Hour Noise Level at Closest Residential Property (dB)
Banging and Machinery Operation	00:28:35	53.7	51.2
Banging	00:07:20	57.5	

Table 4.4 determines the change in ambient noise levels at the closest proposed residential property.

Table 4.4: Calculation of Change in Ambient Noise Level

Measured Operation	Calculated Equivalent 1-Hour Noise Level (dB)	Ambient Noise Level Prior to Operations Beginning (dB)	Combined Noise Level (dB)	Difference + / - (dB)	BDC Criteria Met?
All Operations	51.2	54.7	56.3	+1.6	Yes

Table 4.4 indicates that commercial operations to the east will result in a +1.6dB change in the ambient noise levels for the daytime periods. This falls in line with the BDC criteria of a change of no more than 3dB above the existing ambient.

To be robust, this assessment has also compared the resulting sound pressure levels from all operations and compared these to the internal noise criteria levels. Table 4.5 details the calculated noise levels for the habitable rooms (bedroom and living rooms) with standard thermal double glazing. The now revoked PPG24 suggests that the sound reduction index afforded by such glazing set in a standard brick block wall will reduce external to internal noise levels by approximately 33dB.

Table 4.5: Calculation of Internal Noise Levels with Standard Thermal Double Glazing

Calculated External Noise Level at Façade (dB)	Habitable Room	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference + / - (dB)
51.2	Living Room	18.2	30	-21.8

Table 4.5 indicates that standard thermal double glazing will be sufficient in reducing external to internal noise levels sufficiently.

Table 4.6 details the calculated noise levels for the habitable rooms (bedroom and living rooms) with a partially open window. During summer months it may be necessary to open windows in order to provide a supply of fresh air. BS8233 suggests that the sound reduction index of a partially open window will attenuate noise in the order of 10 – 15dB and so this assessment has adopted 12dB.

Table 4.6: Calculation of Internal Noise Levels with a Partially Open Window

Calculated External Noise Level at Façade (dB)	Habitable Room	Calculated Internal Noise Level with Windows Open (dB)	Internal Noise Criteria $L_{Aeq,16hour}$ (dB)	Difference + / - (dB)
51.2	Living Room	39.2	30	+9.2

Table 4.6 indicates that with a partially open window, the average noise level during the daytime period exceeds the adopted criteria. Accordingly Section 5 considers appropriate mitigation.

4.2 Road Traffic Noise Impact Assessment

This assessment has relied upon recently measured noise data for the M1 Motorway. The measured daytime and night-time noise levels have been detailed in Table 3.4.

4.2.1 External Amenity Areas

In order to accurately calculate the noise level within gardens, calculation has allowed for the following:

1. Distance attenuation from the centre of the M1 to the closest garden area by using the following formula:

$$L_{Aeq,2} = L_{Aeq,1} – (10 \times \log (D2/D1)$$

Where
$L_{Aeq,2}$ = noise level under investigation
$L_{Aeq,1}$ = measured noise level
D2 = distance under investigation (m)
D1 = measurement distance (m)

Analysis of the scheme masterplan indicates that garden areas will be placed on the rear of the dwellings which will afford partial line of sight removal to the M1. Accordingly a reduction in the order of 5dB can be reasonably expected due to this configuration.

Table 4.7 details the calculated noise level in the closest garden area.

Table 4.7: Calculation of Daytime Garden Noise Levels

Measured $L_{Aeq,16hr}$ (dB)	Measurement Distance (m)	Distance to Closest Garden (m)	Partial Line of Sight Removal (dB)	Calculated Noise Level in Garden $L_{Aeq,16hr}$ (dB)	Noise Criteria Limit $L_{Aeq,16hr}$ (dB)	Difference + / - (dB)
68.2	28	1547	-5	45.8	50	-4.2

Table 4.7 indicates that predicted noise levels will fall below the outdoor criteria limit.

4.1.2 Internal Habitable Rooms

Table 4.8 details the calculated noise levels for the habitable rooms (bedroom and living rooms) for the closest proposed plot with standard thermal double glazing. The now revoked PPG24 suggests that the sound reduction index afforded by such glazing set in a standard brick block wall will reduce external to internal noise levels by approximately 33dB.

Table 4.8: Calculation of Internal Noise Levels with Standard Thermal Double Glazing

Period	Calculated External Noise Level at Façade (dB)	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference + / - (dB)
Living Room (07:00 – 23:00)	68.2 $L_{Aeq,16hour}$	17.8	30	-12.2
Bedroom (23:00 – 07:00)	65.0 $L_{Aeq,8hour}$	14.6	30	-15.4
Bedroom (23:00 – 07:00)	75.2 $L_{Amax,fast}$	7.4	45	-37.6

Table 4.8 indicates that standard thermal double glazing will be sufficient in reducing external to internal break-in noise levels to meet the agreed noise criteria. During summer months it may be necessary to open windows in order to provide a supply of fresh air. Table 4.9 determines the internal noise levels for all plots. BS8233 suggests that the sound reduction index of a partially open window will attenuate noise in the order of 10 – 15dB and so this assessment has adopted 12dB.

Table 4.9: Calculation of Internal Noise Levels with Windows Open

Habitable Room /Period	Calculated External Noise Level at Façade (dB)	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference + / - (dB)
Living Room (07:00 – 23:00)	68.2 $L_{Aeq,16hour}$	38.8	30	+8.8
Bedroom (23:00 – 07:00)	65.0 $L_{Aeq,8hour}$	35.6	30	+5.6
Bedroom (23:00 – 07:00)	75.2 $L_{Amax,fast}$	28.4	45	-16.6

Table 4.9 indicates that the internal target noise level will be exceeded for the plots which face the M1 if windows are opened. Accordingly Section 5.0 considers alternative ventilation to opening windows.

4.3 Rail Traffic Noise Impact Assessment

4.3.1 External Amenity Areas

The measured noise levels for the train pass-bys have been converted to the 16-hour daytime noise level by using the following equation:

$L_{Aeq,16hr}$ = Average SEL – (10 x log (60 x 60 x 16) + 10 x log N

Where *Average SEL = Average Sound Event Level for Train Type / Provider*
60 x 60 x 16 = No. seconds in a 16-hour daytime period
N = No. Train pass-bys in a 16 hour daytime period

The measured noise levels for the train pass-bys, for each train type, have been converted to the 8-hour night-time noise level by using the following equation:

$L_{Aeq,8hr}$ = Average SEL – (10 x log (60 x 60 x 8) + 10 x log N

Where *Average SEL = Average Sound Event Level for Train Type / Provider*
60 x 60 x 8 = No. seconds in a 8-hour night-time period
N = No. Train pass-bys in a 8- hour night-time period

For passenger trains, the total number of train pass-bys has been obtained using internet-based train timetables. For freight, REC have consulted Freightmaster to establish freight movements along the line.

Table 4.10 calculates the Sound Event Level (SEL) for each train pass-by. The SEL is calculated using the following formula:

SEL = $L_{Aeq,t}$ +10 x log t

Where *$L_{Aeq,t}$ = measured average equivalent noise level*
T = Measurement duration in seconds

Table 4.10: Calculation of Sound Event Levels

Train Type	Measured Noise Level $L_{Aeq,t}$ (dB)	Measurement Duration (mm:ss)	Calculated SEL (dB)
Passenger 1	54.7	00:40	70.7
Passenger 2	56.5	00:30	71.3
Freight 1	55.9	01:20	74.9
Freight 2	55.8	02:30	77.6

In the interests of a worst case assessment, the highest calculated SEL for both passenger and freight trains have been used.

Table 4.11 details the calculated daytime and night-time noise levels for the First Trans Pennine passenger trains.

Table 4.11: Calculation of Daytime and Night-time Corrected Noise Average Levels

Train Type	Highest Calculated SEL (dB)	Time Corrected Daytime Noise Level ($L_{Aeq,16hr}$) (dB)	Time Corrected Night-time Noise Level ($L_{Aeq,8hr}$) (dB)
Passenger	71.3	23.7	26.7
Freight	77.6	30.0	33.0

Table 4.12 calculates the quantity and distance corrected average daytime and night-time noise levels for passenger and freight trains.

Table 4.12: Calculation of Daytime and Night-time Corrected Noise Average Levels

Train Type	Timetabled Quantity per Day	Time tabled Quantity per Night	Measurement Distance	Distance to Receptor	Calculated Day Level	Calculated Night Level
Passenger	89	7	456	547	42.4	34.3
Freight	20	0	456	547	42.2	-

Table 4.13 calculates the combined daytime and night-time noise levels for all trains.

Table 4.13: Calculation of Combined Daytime and Night-time Noise Levels

Calculated Combined Daytime Average Noise Level $L_{Aeq,16hr}$ (dB)	Calculated Combined Night-time Average Noise Level $L_{Aeq,8hr}$ (dB)	Highest Measured Maximum Noise Level $L_{Amax,fast}$ (dB)
45.3	34.3	57.8

Table 4.14 compares the calculated daytime noise level with the WHO external criteria noise level.

Table 4.14: Calculation of Daytime Garden Noise Levels

Calculated Combined Daytime Average Noise Level $L_{Aeq,16hr}$ (dB)	External Criteria Noise Level (dB)	Difference + / - (dB)
45.3	50	-4.7

Table 4.14 indicates that predicted noise level falls below the outdoor criteria limit.

4.1.2 Internal Habitable Rooms

Table 4.15 details the calculated noise levels for the habitable rooms (bedroom and living rooms) for the closest proposed plots to the railway line with standard thermal double glazing. The now revoked PPG24 suggests that the sound reduction index afforded by such glazing set in a standard brick block wall will reduce external to internal noise levels by approximately 32dB from rail traffic noise

Table 4.15: Calculation of Internal Noise Levels with Standard Thermal Double Glazing

Habitable Room / Period	Calculated External Noise Level at Façade (dB)	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference + / - (dB)
Living Room (07:00 – 23:00)	45.3 $L_{Aeq,16hour}$	13.3	30	-16.7
Bedroom (23:00 – 07:00)	34.3 $L_{Aeq,8hour}$	2.3	30	-27.7
Bedroom (23:00 – 07:00)	57.8 $L_{Amax,fast}$	25.8	45	-19.2

Table 4.15 indicates that standard thermal double glazing will be sufficient in reducing external to internal break-in noise levels to meet the agreed noise criteria. During summer months it may be necessary to open windows in order to provide a supply of fresh air. Table 4.16 determines the internal noise levels for all plots. BS8233 suggests that the sound reduction index of a partially open window will attenuate noise in the order of 10 – 15dB and so this assessment has adopted 12dB.

Table 4.16: Calculation of Internal Noise Levels with Windows Open

Habitable Room /Period	Calculated External Noise Level at Façade (dB)	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference + / - (dB)
Living Room (07:00 – 23:00)	45.3	33.3	30	+3.3
Bedroom (23:00 – 07:00)	34.3	22.3	30	-7.7
Bedroom (23:00 – 07:00)	57.8	45.8	45	+0.8

Table 4.16 indicates that the internal target noise level will be exceeded for the plots which face the M1 if windows are opened. Accordingly Section 5.0 considers alternative ventilation to opening windows.

5.0 MITIGATION

5.1 Commercial Noise

5.1.1 External Amenity Areas

The previous section has determined that the noise levels in garden areas of the closest proposed properties exceed the adopted noise criteria. The most appropriate method for controlling noise within garden areas is by use of acoustic grade fences in certain parts of the Site area.

In calculating the fence heights, the source height has been taken as 1.5m above ground level accounting for the centre of a roller shutter door, and the receiver height has been taken as 1.8m above ground level, accounting for a person stood in the centre of the applicable garden area.

Table 5.1 details the height of the acoustic fences for the closest proposed garden areas.

Table 5.1: Calculation of Acoustic Fence Heights

Calculated Noise Level in Garden with no Fence (dB)	Noise Criteria Level L_{A90} – 5dB (dB)	Acoustic Fence Required Performance (dB)	Required Path Difference + / - (dB)	Calculated Acoustic Fence Height (m)
56.2	48.8	7.4	0.03	1.8*

*A lower acoustic fence is required for the closest proposed properties; however, it is assumed that the standard height of the garden fence will be 1.8m high.

The fences should be free from holes, be sealed at the base and have a minimum mass of 28kg/m^2. The approximate locations of the fences are shown in Figure 2 of Appendix III.

5.1.2 Internal Habitable Rooms

The previous Section has determined that the adopted internal target noise levels will be met with standard thermal double glazing however with a partially open window the internal target noise levels will be exceeded.

In the interests of controlling internal noise levels without the need to open windows to provide fresh air into rooms, it is recommended that a through-frame window mounted trickle ventilator is incorporated into the glazing unit for the living rooms of the habitable rooms which have direct line of sight to the units to the east. One such acoustic trickle ventilator is as follows:

- Greenwoods EAR42W Trickle Ventilator, which provides acoustic attenuation of up to 42 dB $D_{n,e,w} + C_{tr}$ in its open position.

The trickle ventilator should be combined with a Mechanical Extract Ventilation (MEV) or Passive Extract Ventilation (PEV) system which extracts air from the habitable rooms.

5.2 Road Traffic Noise

5.2.1 Internal Habitable Rooms

The previous section has determined that the noise levels in living rooms and bedrooms meet the criteria noise levels with standard thermal double glazing. However with a partially open window, noise levels exceed the criteria. In the interests of controlling internal noise levels without the need to open windows to provide fresh air into rooms, it is recommended that a through-frame window mounted trickle ventilator is incorporated into the glazing unit for the living rooms of the habitable rooms along the western boundary. One such acoustic trickle ventilator is as follows:

- Greenwoods EAR42W Trickle Ventilator, which provides acoustic attenuation of up to 42 dB $D_{n,e,w} + C_{tr}$ in its open position.

The trickle ventilator should be combined with a Mechanical Extract Ventilation (MEV) or Passive Extract Ventilation (PEV) system which extracts air from the habitable rooms.

5.3 Rail Traffic Noise

5.3.1 Internal Habitable Rooms

The previous section has determined that the noise levels in living rooms and bedrooms meet the criteria noise levels with standard thermal double glazing. However with a partially open window, noise levels exceed the criteria. In the interests of controlling internal noise levels without the need to open windows to provide fresh air into rooms, it is recommended that a through-frame window mounted trickle ventilator is incorporated into the glazing unit for the living rooms of the habitable rooms along the southern boundary. One such acoustic trickle ventilator is as follows:

- Greenwoods EAR42W Trickle Ventilator, which provides acoustic attenuation of up to 42 dB $D_{n,e,w} + C_{tr}$ in its open position.

The trickle ventilator should be combined with a Mechanical Extract Ventilation (MEV) or Passive Extract Ventilation (PEV) system which extracts air from the habitable rooms.

6.0 CONCLUSION

Resource and Environmental Consultants (REC) Limited have been commissioned by Manor Oak Homes Limited to undertake a Noise Impact Assessment for proposed residential development on a parcel of land off Cork Lane, Glen Parva in Leicestershire. This Noise Impact Assessment has been completed with due regard to the requirements of BDC's Environmental Health Department.

This assessment has been undertaken to identify key noise sources in the vicinity of the Site which may have the potential to impact upon the proposed noise-sensitive residential development.

The key source of noise impacting upon the Site is commercial noise from units to the east of the Site. Accordingly, appropriate consideration has been given towards the mitigation measures required to ensure a commensurate level of protection against noise for future occupants. Noise is also audible from the distant M1 to the west and the Birmingham New Street to Leicester Railway Line to the south.

This Noise Impact Assessment has recommended the use of acoustic fences for certain dwellings in order to control noise levels within garden areas. In the interests of controlling noise within habitable rooms whilst gaining a supply of fresh air, this assessment has recommended the use of an alternative ventilation system for the dwellings which have direct line of sight to the units to the east, the M1 to the west and the railway line to the south.

It should be noted that all of the calculations performed in this assessment are based on worst-case assumptions and so the actual level of noise within external amenity areas and internal habitable rooms is likely to be lower than the calculated noise levels.

Subject to the incorporation of the identified mitigation measures, it is anticipated that a commensurate level of protection would be incorporated into the scheme for residential development.

APPENDIX I LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Limited and the Client as indicated in Section 1.2.

2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

3. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man-made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently there may be conditions present not revealed by this investigation.

4. REC cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.

APPENDIX II GLOSSARY OF ACOUSTICAL TERMINOLOGY

Noise

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 measurement, 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.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1: Typical Sound Pressure Levels

Sound Pressure Level dB(A)	Location
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Acoustic Terminology

Table A2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, 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_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX III FIGURES

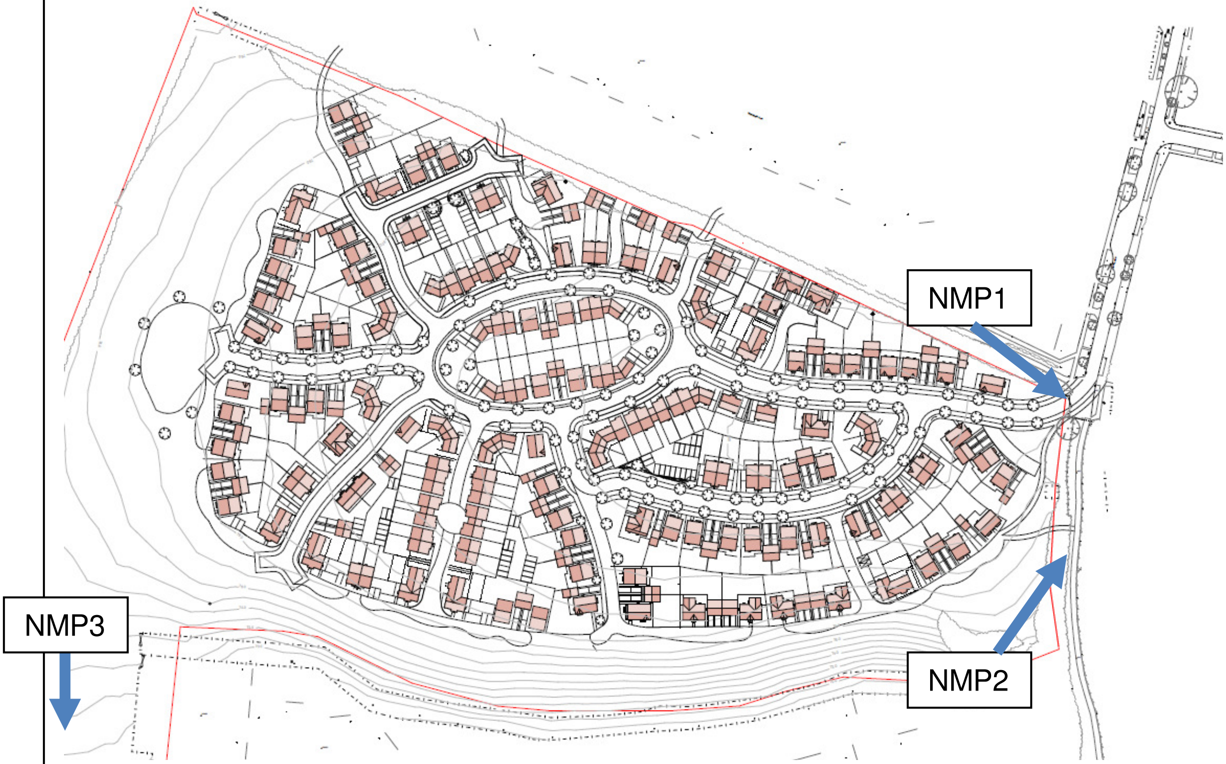

Figure 1

Site Layout, NMP1, NMP2 and NMP3

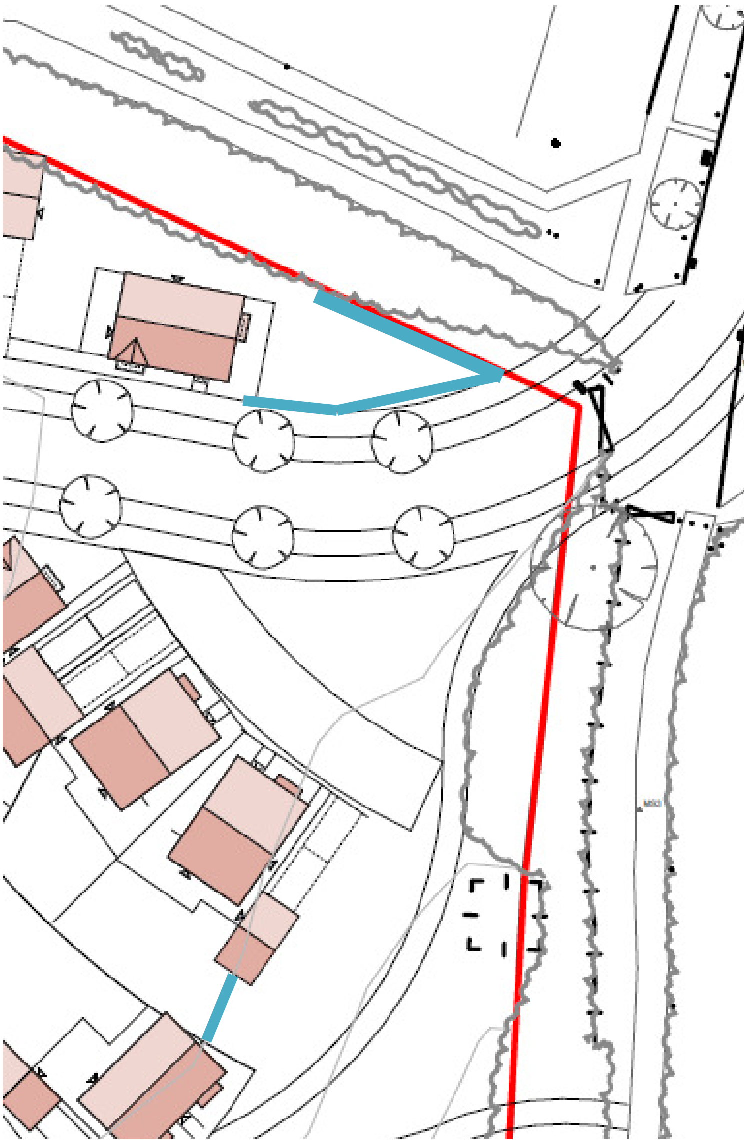

Figure 2

Acoustic Fences Locations

REC are a multi-disciplinary health, safety, environmental and energy consultancy. Our national coverage enables our local experts to provide cost effective and pragmatic consultancy services in an efficient and sustainable manner.

REC Environmental Management

- Environmental Management
- Divestment Services
- Environmental Management Systems
- CDM Co-Ordination
- Environment Permit Application

REC Renewable Energy

- Feasibility Studies
- Ground Source Heat Pumps Installation
- Air Source Heat Pump Installation
- System Design and Maintenance
- Solar Photovoltaic (PV) Systems
- Combined Heat and Power Systems

REC Acoustics

- Sound Insulation Testing
- Noise at Work Assessment
- Development Related Noise
- Environmental Noise

REC Geoenvironmental

- Geotechnical Investigation & Assessment
- Contaminated Land Investigation & Assessment
- Waste Management
- Groundwater Testing
- Environmental Impact Assessment

REC Asbestos & Legionella

- Asbestos Management Surveys
- Demolition/Refurbishment Surveys
- Analysis of Asbestos in Soils and Bulk Samples
- Air Testing for Clearances and Reassurance
- Legionella Risk Assessment

REC Air Quality

- Air Quality Impact
- Odour Assessment
- Dispersion Modelling
- Stack Emission Testing
- Pollution Monitoring

REC Ecology

- Phase 1 Habitat Surveys
- Invasive Species
- Legally Protected Species Surveys
- Mitigation Schemes
- Ecological Impact Assessment (EcIA)
- BREEAM & Code 4 Sustainable Homes
- Habitat Management Plans
- Management planning and targeted Biodiversity Action Plan survey
- Environmental Impact Assessment

REC Flood Risk

- Flood Risk & Consequence Assessment
- Strategic Flood Risk Assessment (SFRA)
- EIA Technical Chapters
- Assessment of Flood Levels
- Hydrology & Hydrogeology
- Flood Defence Structures
- Drainage Systems (SUDS) Design
- Mitigation Measures
- Soakaway Tests