REC

Resource & Environmental Consultants Ltd

Environmental Impact Assessment

Proposed Residential Development
Burlow Road
Harpur Hill
Buxton

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REC Acoustics

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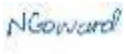
Signature			
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REC
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EXECUTIVE SUMMARY

Noise Survey

Resource and Environmental Consultants (REC) Limited have been commissioned by Knights Solicitors LLP to undertake a Noise Impact Assessment for proposed residential development on two parcels of land off land off Burlow Road in Buxton. A series of Noise and Vibration Surveys have been completed in order to measure the noise and vibration 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 road traffic noise from the adjacent Burlow Road, and to a lesser degree,road traffic noise from Heathfield Nook Road and rail traffic noise from the adjacent rail line.. 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 measure in order to ensure an adequate level of protection from noise within living spaces:

- Acoustic glazing has been recommended for certain habitable rooms in which should be combined with acoustic trickle-ventilators and an alternative ventilation system; and,
- 1.5m high acoustic fencing for external amenity areas with direct line of sight to Burlow Road.

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APPENDICES

1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Limited have been commissioned by Knights Solicitors LLP to undertake a Noise Impact Assessment for a proposed residential development on two parcels of land off Burlow Road, Harpur Hill in Buxton, 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 comprises two parcels of land to the north and south of Burlow Road, with the southern section measuring 6.37 hectares and the northern section measuring 13 hectares. North of Burlow Road, the Site is bound by Burlow Road to the west and Heathfield Nook Road to the south. To the east lies the railway line using for freight between Tunstead and Hindlow quarries. South of Burlow Road the Site is bound by Burlow Road to the north east.

Proposals include for the construction of 275 dwellings, areas of Public Open Space and allotments.

The key sources of noise impacting upon the Site are road traffic noise from Burlow Road and Heathfield Nook Road, and rail traffic noise. Noise associated with blasting operations associated with the Health and Safety Laboratory at Harpur Hill has also been considered.

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

- Illustrative Masterplan – Burlow Road, Harpur Hill.

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 REGULATORY AND POLICY FRAMEWORK

2.1 Planning Policies

2.1.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) [Ref.1] provides very brief guidance on planning and noise. The NPPF replaces Planning Policy Guidance (PPG) Note 24 [Ref.2]. 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 [Ref.3] and recommendations contained within the World Health Organisation guidelines, "significant adverse impacts" on health and quality of life associated with noise would be avoided.

2.1.2 High Peak Borough Local Plan

Policy 4 of the High Peak Borough Local Plan relates to noise and vibration in terms of amenity levels. Policy 4 states that:

GD5 – AMENITY

Planning Permission will be granted for development provided that it will not create unacceptable loss of, nor suffer from unacceptable levels of, privacy or general amenity, particularly as a result of:

- *Air, water, noise, light and other pollution.*

Where appropriate, conditions will be imposed and/or planning obligations sought, to ensure amelioration measures are taken to adequately address the impacts on amenity.

2.1.3 The Control of Pollution Act 1974, Part III

The Control of Pollution Act 1974 (COPA) [Ref.4] is specifically concerned with the control of noise pollution. Section 60, Part III of the COPA refers to the control of noise on

construction sites. It provides legislation by which local authorities can control noise from construction sites to prevent noise disturbance occurring. In addition, it recommends that guidance provided by BS 5228 [Ref.5] be implemented to ensure compliance with Section 60.

Section 61, Part III of the COPA refers to prior consent for work on construction sites. It provides a method by which a contractor can apply for consent to undertake construction works in advance. When a project is consented, and the stated method and hours of work complied with, then the local authority cannot take action under Section 60.

Section 72, Part III of the COPA refers to best practicable means (BPM). The COPA defines BPM as 'reasonably practicable, having regards among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications'. Whilst 'Means' includes 'the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and acoustic structures'.

2.1.4 Environmental Protection Act 1990

The Environmental Protection Act 1990 (EPA) [Ref.6] deals with statutory nuisance, including noise. Section 79, Part III of the EPA places a duty on local authorities to regularly inspect their areas to detect whether a statutory nuisance exists. This section also considers and defines the concept of BPM which originates in Section 72, Part III of the COPA where practicable is defined as 'reasonably practical having regard, among other things, to local conditions and circumstances, to the current state of technical knowledge and to the financial implications'.

Section 80, Part III of the EPA outlines the summary of proceedings for statutory nuisances. Under Section 79, the local authority must take such steps, as are reasonably practicable, to investigate any complaints of statutory nuisance within the area. Where the local authority is satisfied that a statutory nuisance does exist, or is likely to occur or reoccur, it must serve an abatement notice requiring the abatement of the nuisance or prohibiting or restricting its occurrence or recurrence; and/or the carrying out of such works or other action as maybe necessary to abate the nuisance.

2.2 British Standards and Guidance

2.2.1 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.

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

The WHO [Ref.7] 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.

2.2.3 Calculation of Road Traffic Noise 1988

The Calculation of Road Traffic Noise (CRTN) [Ref.8] memorandum, produced by the Department of Transport for the Welsh Office, describes the procedures for calculating noise from road traffic. Section III of this memorandum details the shortened measurement procedure whereby measurements of the L_{10} parameter are made over any three consecutive hours between 10:00 and 17:00. From the arithmetic average of the three 1-hour values, the $L_{10,18hr}$ noise levels is derived before calculation of the $L_{Aeq,16hr}$ value.

2.2.4 Transport Research Laboratory – Converting the UK Traffic Noise Index LA10,18hr to EU Noise Indices for Noise Mapping

This document [Ref.9] provides a method for converting the $L_{A10,18hr}$ level to the L_{night} level using the following formula, applicable to non-motorway roads.

$$L_{night} = 0.90 \times L_{A10,18hr} - 3.77dB$$

2.2.5 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) [Ref.10] 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

2.2.6 Design Manual for Roads & Bridges Volume 11

The Highways Agency's document Design Manual for Roads and Bridges (DMRB) [Ref.11] provides a method for evaluating both the immediate and long term noise effects on receptors of changes in traffic flows on public highways, assessed using 18-hour traffic flow (06:00 –24:00) data.

2.2.7 British Standard 5228: Noise and Vibration Control on Construction and Open Sites – Part 1:Noise: 2009 (BS 5228-1)

This British Standard [Ref.5] sets out techniques required to predict and assess the likely noise effects from construction works, based on detailed information on the type and number of plant being used, their location, and the length of time they are in operation.

The noise prediction method is used to establish likely noise levels in terms of the $L_{Aeq,T}$ over the core working day.

This British Standard also documents a database of information, comprising previously measured sound power levels for a variety of different construction plant undertaking various common activities.

Example criteria are presented for the assessment of the significance of noise effects. Such criteria maybe concerned with fixed noise limits and/or ambient noise level changes. With respect to fixed noise limits, BS 5228-1 presents the following noise limits which are taken as an average over a 10-hour working day:

- 70.0dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise; and,
- 75.0dB(A) in urban areas near main roads and heavy industrial areas.

2.2.8 BS 5228: Noise and Vibration Control on Construction and Open Sites - Part 2: Vibration: 2009 (BS 5228-2)

This standard [Ref.12] provides recommendations for basic methods of vibration control relating to construction and open sites. The legislative background to vibration control is described and guidance is provided concerning methods of measuring vibration and assessing its effects on the environment.

Guidance criteria are suggested for the assessment of the significance of vibration effects, such criteria are provided in terms of Peak Particle Velocities (PPV) and are concerned with both human and structural responses to vibration. Those applicable to human perception and disturbance are presented within Table 2.3.

Table 2.3: PPV Guidance Criteria – Human Perception

Vibration Level (PPV)	Effect
0.14mm/s	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3mm/s	Vibration might be just perceptible in residential environments.
1.0mm/s	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.
10mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

The Standard goes on to present guidance criteria applicable to the vibration response limits of buildings in terms of the component PPV, these are presented within Table 2.4.

Table 2.4: PPV Guidance Criteria – Buildings

Type of Building	Peak Component of Particle Velocity in Frequency Range of Predominant Pulse	
	4Hz to 15Hz	15Hz and above
Reinforced or framed structures Industrial and Heavy Commercial Buildings	50mm/s at 4Hz and above	50mm/s at 4Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/a at 40Hz and above

Note 1:Values referred to are at base of the building
Note 2:At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) is not to be exceeded.

It should be noted that the values presented within Table 2.4 are applicable to cosmetic damage only. It is stated within BS 5228-2 that minor damage is possible at vibration magnitudes which are greater than twice those given in the Table. It can be seen that the guide values for building damage are an order of magnitude higher than for human disturbance.

2.2.9 British Standard BS 6472: 2008: Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)

With respect to human exposure to building vibration, BS 6472 [Ref.13] provides guideline values of the vibration dose value (VDV) above which various degrees of adverse comment may be expected from the occupants of residential buildings. The VDV is defined mathematically as the fourth root of the time integral of the fourth power of the vibration acceleration, after it has been frequency weighted. The guideline values recommended by BS 6472 are shown in Table 2.5 below.

Table 2.5: BS 6472 Guideline Values

Place	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential Buildings (16 Hour Day)	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential Buildings (8 Hour Night)	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Where the vibration is intermittent rather than continuous in nature, BS 6472 defines procedures for calculating the estimated Vibration Dose Value (eVDV), based on the number and duration of vibration events and the recorded value of the root mean square frequency weighted vibration acceleration. The frequency weighting takes into account the response of the human body to vibrations of different frequency and whether the person is lying down or standing. The eVDV can then be taken as the VDV for use in the assessment of human exposure to vibration in buildings.

The above guidance relates to vibration measured at the point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper storey floor, rather than the point of entry into the building (a foundation element).

3.0 ASSESSMENT METHODOLOGY

3.1 Scoping and Consultation

A scoping opinion was sought from High Peak Borough Council (HPBC) and direct communication was made with Matthew Rhodes, Environmental Health Officer (EHO) at HPBC. The Officer was consulted and the proposed methodology and assessment criteria, which are detailed in the following sections were agreed. It was agreed that the following should be considered as part of the Noise and Vibration Assessment:

- The steady noise level in external amenity areas should not exceed 50dB $L_{Aeq,T}$, with an upper limit of 55dB $L_{Aeq,T}$ for a limited number of exceptions;
- 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,
- Any noise impact from the adjacent rugby pitches can be scoped out of the assessment as not considered to be significant.

3.2 Establishing Baseline Conditions

In order to establish the existing baseline noise environment for the Site, the following noise measurements have been taken:

- Noise Measurement Position 1: Located on the western Site boundary with Burlow Road in order to measure the noise impact from road traffic. The microphone of the sound level meter was installed in free-field conditions at a distance 16.5m from the nearside kerbstone of Burlow Road. A 24-hour road traffic noise measurement was undertaken. Noise measurements were taken during a typical weekday period;
- Noise Measurement Position 2: Located on the southern Site boundary with Heathfield Nook Road in order to measure the noise impact from road traffic. The microphone of the sound level meter was installed in free-field conditions at a distance of 15m from the nearside kerbstone of Heathfield Nook Road. A 3-hour road traffic noise measurement in accordance with the guidance stated in CRTN was undertaken. Noise measurements were taken during a typical weekday period. A sample train movement measurement was also taken at this location.

The following vibration measurements have been taken:

- Vibration Measurement Position 1: Located 21m from the centre of the rail line in order to measure the vibration impact from the railway.

Noise and vibration measurement positions are shown on Figure 1.

3.3 Significance Criteria

3.3.1 Construction Noise Significance Criteria

With respect to hours of work, BS 5228 makes reference to the fact that noise levels generated during the evening (19:00 to 23:00) may need to be lower than the daytime (07:00 to 19:00) period (a figure of 10dB is quoted) and also that for any night-time operations (23:00 to 07:00) levels should be quieter still. The Standard does not, however, offer guidelines with respect to acceptable levels.

Following the fixed noise level limits presented in BS 5228-1 for urban areas and regions close to main road traffic, where it is calculated that construction noise levels will exceed 75dB $L_{Aeq,T}$ (facade) applicable to the core working day, it is considered that a noise impact of 'major' magnitude could arise. Noise levels which are calculated to fall below this criterion are considered to give rise to a 'minor' magnitude of impact.

The significance of vibration effects has been assessed drawing upon the guidance criteria presented within BS 5228-2 as outlined in Table 3.1.

Table 3.1: Magnitude of Impact Criteria Applicable to Construction Vibration

Vibration Level (PPV)	Effect	Magnitude of Impact
<0.3 mm/s	Unlikely to be perceptible in residential environments	Negligible
0.3	Onset of perceptibility in residential environments.	Minor
1.0	Onset of complaints in residential environments	Moderate
>10.0 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	Major

Table 3.1 has been generated based upon the guidance on effects of vibration levels as presented within BS 5228-2, the corresponding vibration ranges and associated magnitude ratings adopted for the purpose of this assessment have also been included within the Table.

3.3.2 Completed Development Significance Criteria

3.3.2.1 Road Traffic Noise Impact Upon Existing Receptors

The assessment of noise impact due to changes in road traffic has been undertaken drawing upon the suggested classification of effect provided within the DMRB. The DMRB classification of effects has been adapted to produce a set of magnitude criteria ranging from insignificant to severe as presented within Table 3.2.

Table 3.2: Classification of Magnitude of Noise Impacts for Comparison of Future Noise against Existing Noise

Noise Level Change, $L_{A10,18hr}$ (dB)	Magnitude of Impact
0	No effect
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0+	Major
10.0+	Severe

3.3.2.2 Road Traffic Noise Impact Upon Proposed Development

During the baseline noise survey it was noted that noise generated by road traffic dominated the noise climate across the Site.

When considering the impact of baseline noise levels upon proposed new noise sensitive aspects of the Proposed Development it is appropriate to assess any impacts in terms of the guidance presented within the standards and documents referenced in the now revoked PPG24. This allows development design considerations to be included as part of the assessment such that wherever possible, any negative impacts can be designed out.

For the assessment of internal noise levels, the BS 8233 30dB $L_{Aeq,T}$ and 45dB L_{AFmax} applicable to bedrooms and 40dB $L_{Aeq,T}$ applicable to living rooms have been adopted for the night-time and daytime periods respectively. For external amenity area, such as gardens and roof gardens, the WHO upper guideline value of 55dB $L_{Aeq,T}$ has been adopted. Where noise levels are predicted to exceed these criteria, a 'major' magnitude of effect will be registered. Where these criteria are predicted to be met, a 'negligible' magnitude of effect will be registered.

3.3.2.3 Rail Traffic Noise Impact Upon Proposed Development

For the assessment of internal noise levels, the BS 8233 30dB $L_{Aeq,T}$ and 45dB L_{AFmax} applicable to bedrooms and 40dB $L_{Aeq,T}$ applicable to living rooms have been adopted for the night-time and daytime periods respectively. For external amenity area, such as gardens and roof gardens, the WHO upper guideline value of 55dB $L_{Aeq,T}$ has been adopted. Where noise levels are predicted to exceed these criteria, a 'major' magnitude of effect will be registered. Where these criteria are predicted to be met, a 'negligible' magnitude of effect will be registered.

3.3.2.4 Rail Traffic Vibration Impact Upon Proposed Development

The assessment of vibration impact due to rail traffic has been undertaken drawing upon the guideline values stated in BS 6472. The values have been adapted to produce a set of magnitude criteria ranging from negligible to major as presented within Table 3.3.

Table 3.3: Classification of Magnitude of Vibration Impacts

Place	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential Buildings (16 Hour Day)	0.2 – 0.4 mm/s	0.4 – 0.8 mm/s	0.8 – 1.6 mm/s
Residential Buildings (8 Hour Night)	0.1 – 0.2 mm/s	0.2 – 0.4 mm/s	0.4 – 0.8 mm/s
Magnitude of Impact	**Negligible**	**Minor**	**Major**

3.3.2.5 Blasting Impact Upon Proposed Development

The assessment of blasting operations associated with the Health and Safety Laboratories has been undertaken drawing upon the guidelines stated in the IEMA/IOA Working Party Guidelines, for the significance of change in ambient noise levels. The values have been adapted to produce a set of magnitude criteria ranging from no impact to severe as presented within Table 3.4.

Table 3.4: Classification of Magnitude of Vibration Impacts

Noise Change (dB)	Category
0	Negligible
0.1 – 2.9	Minor Impact
3.0 – 4.9	Moderate Impact
5.0 – 9.9	Major Impact
10.0+	Severe Impact

3.3.3 Sensitivity of Receptor

The sensitivity of local receptors depends upon their nature. Where the sensitivity of a receptor is greater, identified impacts could be more significant, and vice versa. For instance, it is commonly considered that heavy industrial installations are not particularly sensitive to noise whilst residential dwellings are. Between these two receptor types are other locations and places of work such as offices.

In determining the significance criteria it is necessary to consider the sensitivity of the receptor in conjunction with the predicted noise and vibration levels / level changes. Table 3.5 presents the criteria used to define the sensitivity of receptors in relation to noise and vibration impacts.

Table 3.5: Criteria Used to Describe Sensitivity of Receptors

Sensitivity	Description	Example Receptor
High	Receptors where people or operations are particularly sensitive to noise/vibration	Internal and external living areas associated with residential dwellings, quiet outdoor areas used for recreation, conference
Medium	Receptors moderately sensitive to noise/vibration where it may cause some distraction or disturbance	Offices, community facilities, scheduled Ancient Monuments/Listed Buildings
Low	Receptors with a low sensitivity to noise/vibration where it may in extreme cases cause some disturbance	Restaurants, commercial Installations
Negligible	Receptors where distraction or disturbance from noise/vibration is minimal	Factories, storage centres, Industrial sites

3.3.4 Impact Significance

The significance of noise and vibration impacts has been assessed against the magnitude of change and sensitivity of the receptor according to the impact matrix presented in Table 3.6.

Table 3.6: Matrix for Determining the Significance of Impact

		Sensitivity of Receptor			
		High	**Medium**	**Low**	**Negligible**
Magnitude of Impact	**Severe**	Severe to Major	Major	Moderate to Major	Negligible
	Major	Major	Moderate to Major	Minor to Moderate	Negligible
	Moderate	Moderate to Major	Moderate	Minor	Negligible
	Minor	Minor to Moderate	Minor	Negligible to Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

3.4 Assessment of Effects

3.4.1 Sources of Information

This section has relied on information from the following sources:

- Baseline Noise Survey, conducted around the Site during August 2013; and,
- Road traffic data supplied by SCP Transport.

This section considers the noise and vibration effects that will occur during the site preparation, construction and operational phases of the Proposed Development as summarised below:

3.4.2 Site Preparation, Earthworks and Construction Phase

- Increase in noise at existing local noise-sensitive receptors; and,
- Ground-borne vibration levels at existing local sensitive receptors.

3.4.3 Operational Phase

- The noise levels generated by Burlow Road and Heathfield Nook Road;
- The noise levels generated by the railway to the east;
- The noise levels generated by blasting operations; and,
- Changes in road traffic noise levels associated with the Proposed Development on existing local noise-sensitive receptors.

3.5 Limitations and Assumptions

Whilst basic information regarding machinery and plant to be used during the construction phase of the development has been supplied, assumptions have been made for any additional plant items used during construction. Accordingly the calculations performed are accurate to a reasonable level based on knowledge of other urban re-development schemes completed in the past.

Changes in road traffic noise levels, associated with development generated traffic, have been determined and assessed based on traffic data supplied by SCP Transport. These road traffic noise level changes have been determined up to the year 2029 as this is the furthest date in the future for which it is reasonable to forecast. Accordingly, road traffic noise level changes beyond 2029 have not been determined or assessed.

4.0 BASELINE CONDITIONS

4.1 Sensitive Receptors

The sensitive receptors listed in Table 4.1 have the potential to be affected by effects arising from the Proposed Development. The assessment has considered the effects listed in the table upon the identified sensitive receptors.

Table 4.1: Potentially affected sensitive receptors

Sensitive Receptor	Potential effect(s) considered
R1 Hillside	Construction & Operational Noise Impact
R2 Heathfield Nook Road	Construction & Operational Noise Impact
R3 Burlow Road	Construction & Operational Noise Impact

4.2 Baseline Noise and Vibration Surveys

In order to determine baseline noise levels at existing and proposed receptors, a Baseline Noise Survey has been carried out around the Site. The Baseline Noise Survey consisted of a Road Traffic Noise Survey, Rail Traffic Noise Survey and a Blasting Noise Survey as detailed in the following sub-sections.

4.2.1 Road Traffic Noise Survey – Burlow Road

REC has conducted a 24-hour road traffic noise measurement of Burlow Road over the following period:

- 11:00 21st August 2013 – 11:00 22nd August 2013.

The following noise measurement position was chosen for the survey:

- NMP1: Located 16.5m from the nearside kerbstone of Burlow Road which equates to 20.0m from the centre of Burlow Road. 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 road traffic noise from Burlow Road.

A summary of the measured sound pressure levels are presented in Table 4.2.

Table 4.2: Summary of Measured Noise Levels for NMP1

Measurement Position	Period	Measured Sound Pressure Level (dB), freefield			
		$L_{Aeq,T}$	$L_{Amax,fast}$ [1]	$L_{A90,T}$	$L_{A10,T}$
NMP1	Daytime (07:00 – 23:00)	60.5	82.8	39.2	63.5
	Night-time (23:00 – 07:00)	55.8		30.8	44.3

1 10th highest $L_{Amax,fast}$ from night-time period

4.3 Road Traffic Noise Survey – Heathfield Nook Road

REC has conducted a 3 hour Noise Survey of vehicle movements along Heathfield Nook Road in accordance with CRTN.

Noise measurements were conducted over the following period:

- 11:23 – 14:23 Wednesday 21st August 2013.

The following noise measurement position was chosen for the survey:

- NMP2: Located 15m from the nearside kerb of Heathfield Nook Road which equates to 18.5m from the centre of Heathfield Nook Road.The microphone was located 1.5m above ground level, along the southern Site boundary. It was noted the main noise source at NMP2 was road traffic noise from Heathfield Nook Road.

Table 4.3 details the measured ambient noise levels at NMP2 for the duration of the survey period.

Table 4.3: Summary of Measured Noise Levels for NMP2

Measurement Position	Period	Measured Sound Pressure Level (dB), freefield			
		$L_{Aeq,T}$	$L_{Amax,fast}$ [1]	$L_{A90,T}$	$L_{A10,T}$
NMP2	11:23 – 12:23	49.9	73.1	37.4	50.9
	12:23 – 13:23	50.2		37.0	51.4
	13:23 – 14:23	50.5		39.0	51.6

1 10th highest $L_{Amax,fast}$ from 3 hour period

4.4 Rail Traffic Noise Survey

The railway line runs approximately 15m to the east of the Site boundary. A Noise Survey of freight train movements along the railway line has been carried out. From examination of freight train timetables it is understood that trains travel between Tunstead and Hindlow quarries along this line. There are two scheduled movements per day.

A Noise measurement of a train pass-by was taken over the following period:

- 13:08 – 13:10 Wednesday 21st August 2013.

The following noise measurement position was chosen for the survey:

- NMP2: The microphone was located 1.5m above ground level along the eastern Site boundary, 21m from the centre of the rail line.

Table 4.4 details the measured noise levels at NMP2 during the train pass-by.

Table 4.4: Train Pass-by Measurement

Measured Sound Pressure Level $L_{Aeq,t}$ (dB)	Pass-by Measurement Duration (hh:mm:ss)	Measurement Distance to Centre of Line (m)
60.2	00:01:07	21

4.5 Blasting Noise Survey

A survey of blasting associated with the Health and Safety Laboratories at Harpur Hill has been carried out.

A Noise measurement of blasting activities was taken over the following period:

- 09:40 – 12:40 20th September 2013.

The following noise measurement position was chosen for the survey:

- NMP3: The microphone was located along the western boundary of the parcel of land to the south of Burlow Road, at a height of 1.5m above ground level. This was considered to be the closest area of the Site to the blasting location.

During the survey a blast was audible at 12:26.

Table 4.5 details the measured noise levels at NMP3 during the blasting survey.

Table 4.5: Blasting Measurement

Noise Source	Measured $L_{Aeq,t}$ (dB)	Measured $L_{Amax,f}$ (dB)
Blast	46.4	57.2

The measured 1 hour ambient noise levels throughout the survey at NMP3 are shown in Table 4.6.

Table 4.6: Ambient Noise Levels

Period	Measured $L_{Aeq,1hour}$ (dB)
09:40 – 10:40 (no blasting)	42.7
10:40 – 11:40 (no blasting)	45.0
11:40 – 12:40 (blasting)	41.4

4.6 Rail Traffic Vibration Survey

REC has conducted a Rail Traffic Vibration Survey in order to measure the level of vibration associated with the adjacent freight rail line. The survey was carried out over the following time period:

- 13:08 – 13:10 Wednesday 21st August 2013.

The following vibration measurement position was chosen for the Rail Traffic Vibration Survey:

- VMP1: The geophone of the Vibration Meter was located along the eastern Site boundary, 21m from the centre of the railway line. The geophone was located on hard ground and was weighted down to prevent movement.

The measured Peak Particle Velocity (PPV) vibration levels have been weighted in accordance with the guidance stated in BS 6472, where the W_b weighting is applied to the vertical axis (z axis) and the W_d weighting is applied to the horizontal axes (x and y axes). A summary of the measured weighted vibration levels from the vibration survey are presented in Table 4.6.

Table 4.6: Measured Peak Particle Velocity Vibration Levels

Date	Time	Type	Measured Vibration Level, by Axis (mm/s)		
			X Axis	Y Axis	Z Axis
21/08/2013	13:08-13:10	Freight	0.001	0.001	0.006

5.0 PREDICTED EFFECTS

Introduction

This section will detail the potential effects of the construction and operational phases of the development.

5.1 Construction Effects

5.1.1 Construction Noise

It is inevitable with any major development that there will be some disturbance caused to those nearby during the clearance and construction phases of the Site. However, disruption due to construction is only temporary, limited to the Site and is of medium term duration.

Specific details of the construction phases are unknown at this stage. It is anticipated that construction will take place on a plot-by-plot basis due to the nature of the Proposed Development. It would be expected that noise would be intermittent and would decrease in intensity over the duration of the construction period.

The predictions have followed the methodology contained within BS 5228-1 and are in terms of the $L_{Aeq,T}$ over the core working day, which is 08:00 to 18:00 hours Monday to Friday and 08:00 to 13:00 on Saturdays. The predictions are split into an 'average' case scenario and a 'worst' case scenario, which take the form of the following:

- Average case scenario: All plant being located at the approximate centre of the development Site; and,
- Worst case scenario: All plant is to be located in the centre of the development, except for the loudest item of plant, which is assumed to be located on the development Site boundary closest to the nearest noise-sensitive receptor being considered.

Table 5.1 sets out the typical plant type, number and assumed utilisation (percentage 'on-time') used in the prediction of noise levels during the key construction activities.

Table 5.1: Assumed Construction Plant

Plant Type	Sound Pressure Level @ 10m	No. of Plant	Assumed % 'on-time'
Cement Mixer Truck Idling	71.0	1	60%
Concrete Pump + Cement Mixer	67.0	2	80%
Truck Mounted Concrete Pump & Boom	80.0	2	80%
Mobile Telescopic Crane	77.0	2	40%
Telescopic Handler	79.0	1	50%
Tower Crane	76.0	2	80%

Circular Saw	85.0	1	40%
Diesel Generator	61.0	1	100%
Tractor	80.0	2	80%
Dump Truck	86.0	3	80%
Tracked Excavator	88.0	2	60%
Fork Lift Truck	88.0	3	70%
Wheeled Excavator with Hydraulic Breaker	78.0	2	70%
Diesel Generator	94.0	1	80%
Poker Vibrator	94.0	1	80%
Compressor	77.0	2	80%

Predictions have been carried out to determine noise levels likely to be generated during the construction phase. For the purpose of these predictions, it was assumed that the intervening ground between the construction noise sources and the receivers will be acoustically hard such that there will be no additional attenuation of sound due to ground absorption, and that no acoustic barriers such as local buildings will be present, thus informing a worst case assessment.

Noise predictions have been undertaken for the three off-Site noise sensitive receptors R1, R2 and R3. These noise sensitive receptors are detailed in Figure 1.

Table 5.2 sets out the average predicted unmitigated construction noise levels for the construction stage of the works. The range extends from the average to the worst case situation as described previously. A 75dB assessment criterion has been adopted in accordance with guidance contained in BS 5228 for suburban areas. Predicted noise levels above 75dB are indicated in bold type.

Table 5.2: Predicted Unmitigated Average/Worst Case Construction Noise Levels

Sensitive Receptor	Average/Worst Case Construction Noise Levels, $L_{Aeq,\ 10hr}$ (dB)
R1 Hillside	74.3/74.4
R2 Heathfield Nook Road	72.6/72.6
R3 Burlow Road	**79.5/79.5**

A review of Table 5.2 identifies that the calculated unmitigated average/worst case construction noise levels are below the 75dB $L_{Aeq,10hour}$ criterion adopted for this assessment for R1 and R2, and above for R3.

It should be noted that these predictions are worst case in that it is assumed that any mitigation measures, or screening afforded by site hoardings have not been implemented. Furthermore, it should be noted that it is unlikely that operations are to be conducted on the sections of the Site closest to the each of the identified receptors for significant periods of time. For the majority of the construction phase it is expected that activities will be conducted at greater distances from the receptors.

The sensitivity of receptors R1, R2 are categorised as 'high' and the magnitude of impact is categorised as 'minor'. Accordingly, there is predicted to be an adverse temporary short-term impact categorised as 'minor to moderate' significance prior to the implementation of mitigation measures.

The sensitivity of receptor R3 is categorised as 'high' and the magnitude of impact is categorised as 'major'. Accordingly, there is predicted to be an adverse temporary short-term impact categorised as 'major' significance prior to the implementation of mitigation measures.

5.1.2 Construction Vibration

Groundborne vibration calculations have been performed for typical construction activities / machinery based on the empirical prediction procedures and historical measurement data presented within BS 5228-2 and the TRL RR 246 [Ref.14]. Such predictions have been performed in order to determine the possible distances at which the adopted significance criteria may be registered based on a specified confidence limit (where applicable). In this regard, the groundborne vibration levels and associated distances have been identified for a sample of typical construction vibration sources as shown in Table 5.3.

Table 5.3: Predicted Groundborne Vibration Levels Applicable to Typical Generating Construction Activities

Operation	Confidence Limit	Distance (m)	PPV (mm/s)
Vibratory Rollers – start & end	95	60	0.3
	95	23	1.0
Vibratory Rollers – steady state[1]	95	3.3	10
HGV's[2]	N/A	50	≤0.3
	N/A	17	≤1.0
	N/A	2.5	≤1.0

1. Assumes 2 rollers, 0.4mm amplitude, drum width of 1.3m, e.g. heavy duty ride on roller
2. Assumes max height / depth of surface defect of 50mm, max speed of 30km/h, and that surface defect occurs at both wheels.
Note: Where alluvium soils are present, higher vibration levels can be expected.

It should be noted that the data presented within Table 5.3 is general in nature and is not specific to the Site, however the vibration levels and associated distances can be used to determine the typical distances at which specific impacts are likely to be registered.

It is evident from the current Site plan presented within Figure 1 that there is potential for construction activities to take place at distances of approximately 15m from receptor R1, 50m from R2 and 20m from R3 which are the closest existing dwellings. In this regard, Table 5.4 presents the predicted magnitude of impact at these dwellings. It should be noted that the magnitude ratings presented within the table, in some cases, have been generated based on a 95% confidence limit, in reality, it is likely that lower vibration levels will prevail for the majority of activities.

Table 5.4: Predicted Magnitude of Effects at 15m from Activities – Groundborne Vibration

Activity	Magnitude of Impact
Vibratory Rollers	Moderate
HGVs	Negligible

The sensitivity of receptors R1, R2 and R3 are categorised as 'high' and the magnitude of impact is categorised as 'moderate'. Accordingly there is predicted to be an adverse temporary short-term impact categorised as 'moderate to major' significance prior to the implementation of mitigation measures.

It should be noted that this is a worst case assessment based on the minimum possible distances at which construction activities could reasonably take place from existing vibration sensitive receptors. In reality, for the large majority of the earthwork / construction phase, it is expected that activities will take place at greater distances from such properties thus leading to lesser significance of effects. Furthermore it should be noted that the vibration predictions have utilised a large data set covering a range of measured levels applicable to each operation. It is evident from this data set that, for the majority of operations (approximately 95% in most cases), predicted levels will be lower than those presented within Table 5.4.

It should be noted that the above assessment has been undertaken based on vibration levels associated with a small range of groundborne vibration generative construction activities. It is possible that activities other than those presented may take place. Similarly some of those presented may not be applicable to the construction activities specific to the Site. The conclusions drawn from this assessment should therefore be used for indicative purposes only.

5.1.3 Construction Generated Road Traffic Noise

It is anticipated that in order to complete the preparation and construction phases of the development, it will be necessary to move a significant amount of material to and from the Site, thus resulting in a number of construction generated road traffic movements.

It should be noted that relatively large increases in road traffic movements would need to prevail in order for noticeable increases in road traffic noise levels to occur as a result of construction generated road traffic. As a general guide, although not accounting for changes in the percentage of HGVs, a 25% increase in traffic movements will only result in a 1dB increase in noise levels. Similarly a 58% increase would be required for 2dB and 100% increase for a 3dB increase. It should be noted that a 3dB increase in noise levels is generally barely perceptible to the average human.

Provided that increases in road traffic noise levels of below 3dB are expected, it is considered that the magnitude of change will be negligible at receptors located adjacent to the local road network.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'. Accordingly there is predicted to be a 'negligible' impact at all receptors. Furthermore it should be noted that any increase in noise levels associated with construction generated road traffic is expected to be limited to the daytime hours only.

Given the predicted effect on local receptors it is not necessary to consider mitigation measures.

5.2 Completed Development Effects

5.2.1 Road Traffic Noise from Burlow Road on the Proposed Development

Table 5.5 details the calculated daytime and night-time noise levels due to Burlow Road at NMP1. These levels have been used to calculate daytime and night-time noise levels at the nearest building facades to Burlow Road. Dwellings across the remainder of the Site will be shielded by the intervening dwellings, therefore they would be expected to experience significantly lower levels of noise impact from Burlow Road.

The impact of lorry movements associated with Lomas Distribution haulage has been considered as part of this assessment. Measured noise levels at NMP1 are considered to be representative of any movements along Burlow Road. It is understood that movements are distributed evenly throughout the day therefore there are no associated 'rush-hour' periods.

Table 5.5: Daytime and Night-time Road Traffic Noise Levels from Burlow Road

Measurement Position	Period	Calculated $L_{Aeq,T}$ (dB)	$L_{Amax,fast}$[1] (dB)	Measurement Distance from Burlow Road (m)
NMP1	Daytime (07:00 – 23:00)	60.5	82.8	20
	Night-time (23:00 – 07:00)	55.8		20

For the Site boundaries adjacent to Burlow Road, the daytime noise levels in garden areas and the daytime and night-time noise levels incident at the noise sensitive facades has been determined using the following equations:

$$L_{Aeq,2} = L_{Aeq,1} - (10 \times \log (D_2/D_1)$$

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

The following equation has been used to determine the resulting noise level from the night-time measured maximum noise level:

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

Where $L_{Amax,fast,2}$ = noise level under investigation
$L_{Amax,fast,1}$ =measured noise level
D_2 = distance under investigation
D_1 = measurement distance

Table 5.6 calculates the noise level in external amenity areas along the Site boundaries with Burlow Road. It has been assumed that gardens are located with direct line of sight to Burlow Road.

Table 5.6: Noise Impact in Outdoor Living Areas

Receptor	Measured Daytime Noise Level $L_{Aeq,16hr}$ (dB)	Measurement Distance from Centre of Burlow Road (m)	Distance to Centre of Garden (m)	Calculated Noise Level in Centre of Garden $L_{Aeq,T}$ (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
North western boundary	60.5	20	50	56.5	55	+1.5
Northern Boundary of southern area of Site			30	58.7		+3.7

Table 5.3 shows that measured $L_{Aeq,16hr}$ in the nearest garden areas to Burlow Road breach the required WHO external noise criteria level of 55dB $L_{Aeq,T}$. Accordingly, mitigation measures are considered in Section 6.0.

The sensitivity of the external amenity areas is categorised as 'high' and the magnitude of impact is categorised as 'major'. Accordingly there is predicted to be a 'major' impact on the external amenity areas nearest to Burlow Road with no mitigation in place.

Table 5.7 details the calculated noise levels for the habitable/sensitive rooms using standard thermal double glazing which affords approximately 33dB when set into a brick block wall from road traffic noise.

Table 5.7: Calculation of Daytime and Night-time Road Traffic Noise Levels Within Dwellings – Windows Closed

Receptor	Floor	Period	Measured Noise Level (dBA)	Distance to Nearest Facade (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
North western boundary	Ground	(07:00 – 23:00)	60.5 $L_{Aeq,16hr}$	45	57.0 $L_{Aeq,16hr}$	24.0 $L_{Aeq,16hr}$	30	-6.0
	First	(23:00 – 07:00)	55.8 $L_{Aeq,8hr}$		52.3 $L_{Aeq,8hr}$	19.3 $L_{Aeq,8hr}$	30	-10.7
			82.8 $L_{Amax,f}$		75.8 $L_{Amax,f}$	42.8 $L_{Amax,f}$	45	-2.2
Northern boundary of southern area of Site	Ground	(07:00 – 23:00)	60.5 $L_{Aeq,16hr}$	20	60.5 $L_{Aeq,16hr}$	27.5 $L_{Aeq,16hr}$	30	-2.5
	First	(23:00 – 07:00)	55.8 $L_{Aeq,8hr}$		55.8 $L_{Aeq,8hr}$	22.8 $L_{Aeq,8hr}$	30	-7.2
			82.8 $L_{Amax,f}$		82.8 $L_{Amax,f}$	49.8 $L_{Amax,f}$	45	+4.8

Table 5.7 indicates that the required internal noise criteria levels will be achieved if windows are closed for all building facades along the north western boundary. Internal criteria levels will be exceeded for building facades along the northern boundary of the southern area of the Site.

The sensitivity of the residential receptors is categorised as ‘high’ and the magnitude of impact is categorised as ‘negligible’. Accordingly there is predicted to be a ‘negligible’ impact on the proposed receptors along the northern western Site boundary as a result of Burlow Road with windows closed.

The sensitivity of the residential receptors is categorised as ‘high’ and the magnitude of impact is categorised as ‘major’. Accordingly there is predicted to be a ‘major’ impact on the proposed receptors along the northern Site boundary of the southern area of the Site as a result of Burlow Road with windows closed.

During summer months it may be necessary to open windows in order to provide a supply of fresh air and Table 5.8 determines the internal noise levels. BS 8233 suggests that the sound reduction index of a partially open window will attenuate noise in the order of 10 – 15dB(A). For the purposes of this assessment, 12dB(A) has been adopted.

Table 5.8: Calculation of Daytime and Night-time Road Traffic Noise Levels Within Dwellings – Windows Open

Receptor	Floor	Period	Measured Noise Level (dBA)	Distance to Nearest Facade (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
North western boundary	Ground	(07:00 – 23:00)	60.5 $L_{Aeq,16hr}$	45	57.0 $L_{Aeq,16hr}$	45.0 $L_{Aeq,16hr}$	30	+15.0
	First	(23:00 – 07:00)	55.8 $L_{Aeq,8hr}$		52.3 $L_{Aeq,8hr}$	40.3 $L_{Aeq,8hr}$	30	+10.3
			82.8 $L_{Amax,f}$		75.8 $L_{Amax,f}$	63.8 $L_{Amax,f}$	45	+18.8
Northern boundary of southern area of Site	Ground	(07:00 – 23:00)	60.5 $L_{Aeq,16hr}$	20	60.5 $L_{Aeq,16hr}$	48.5 $L_{Aeq,16hr}$	30	+18.5
	First	(23:00 – 07:00)	55.8 $L_{Aeq,8hr}$		55.8 $L_{Aeq,8hr}$	43.8 $L_{Aeq,8hr}$	30	+13.8
			82.8 $L_{Amax,f}$		82.8 $L_{Amax,f}$	70.8 $L_{Amax,f}$	45	+25.8

Table 5.8 indicates that the required internal noise criteria levels will be exceeded if windows are opened for all dwellings facing Burlow Road and so the mitigation section has considered alternative ventilation to opening windows.

The adoption of appropriate development design should be included when determining the effect of road traffic noise levels on the sensitive residential elements of the development. Such design considerations are detailed within the mitigation section.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'major'. Accordingly there is predicted to be a 'major' impact on the proposed receptors along the Site boundaries facing Burlow Road as a result of road traffic noise with windows open.

5.2.2 Road Traffic Noise from Heathfield Nook Road on Proposed Development

For the purposes of this assessment, the daytime and night-time average ($L_{Aeq,T}$) noise levels have been calculated based on the shortened measurement procedure detailed in CRTN. The respective daytime and night-time noise levels have been derived using the following calculations:

1. Calculation of the $L_{A10,18hr}$ noise level by using the following formula:
   $L_{10,18hr} = L_{10,3hr} - 1dB$

2. Calculation of the $L_{Aeq,16hr}$ noise level by using the following formula:
   $L_{Aeq,16hr} = L_{10,18hr} - 2dB$

3. Calculation of the night-time $L_{Aeq,8hr}$ noise level by using the following formula:
   L_{night} ($L_{Aeq,8hr}$) = 0.90 x $L_{10,18hr} - 3.77dB$

Table 5.9 details the calculated daytime and night-time noise levels due to Heathfield Nook Road along the southern Site boundary, representative of the proposed sensitive receptor locations. These levels have been used to calculate daytime and night-time noise levels at the nearest building facades to Heathfield Nook Road. Buildings across the remainder of the Site will be shielded by intervening dwellings, therefore they would be expected to experience significantly lower levels of noise impact from Heathfield Nook Road.

Table 5.9: Measured Daytime and Night-time Road Traffic Noise Levels from Heathfield Nook Road

Measurement Position	Period	Calculated $L_{Aeq,T}$ (dB)	$L_{Amax,fast}$ [1] (dB)	Measurement Distance from centre of Heathfield Nook Road (m)
NMP2	Daytime (07:00 – 23:00)	48.3	73.1	18.5
	Night-time (23:00 – 07:00)	41.5		

For the Site boundaries adjacent to Heathfield Nook Road, the daytime noise levels in garden areas and the daytime and night-time noise levels incident at the noise sensitive facades has been determined using the following equations:

$$L_{Aeq,2} = L_{Aeq,1} - (10 \times \log (D_2/D_1)$$

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

The following equation has been used to determine the resulting noise level from the night-time measured maximum noise level:

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

Where $L_{Amax,fast,2}$ = noise level under investigation
$L_{Amax,fast,1}$ =measured noise level
D_2 = distance under investigation
D_1 = measurement distance

Table 5.10 calculates the noise level in external amenity areas facing, and with direct line of sight to Heathfield Nook Road.

Table 5.10: Noise Level in External Amenity Areas along Boundary with Heathfield Nook Road

Receptor	Measured Daytime Noise Level $L_{Aeq,16hr}$ (dB)	Measurement Distance from Centre of Road (m)	Distance to Centre of Garden (m)	Calculated Noise Level in Centre of Garden $L_{Aeq,T}$ (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
Southern boundary with Heathfield Nook Road	48.3	18.5	30	46.2	55	-3.8

Table 5.10 indicates that external amenity areas along the boundary with Heathfield Nook Road fall below the required WHO criteria level.

The sensitivity of the external amenity areas is categorised as 'high' and the magnitude of impact is categorised as 'negligible'.

Accordingly there is predicted to be a 'negligible' impact on the external amenity areas nearest to Heathfield Nook Road with no mitigation in place.

Table 5.11 details the calculated noise levels for habitable rooms along the southern Site boundary with Heathfield Nook Road using standard thermal double glazing, which affords approximately 33dB(A) attenuation when set into a brick block wall.

Table 5.11: Daytime and Night-time Internal Noise Levels along Southern Site Boundary with Heathfield Nook Road – Windows Closed

Receptor	Floor	Period	Measured Noise Level (dBA)	Distance from Centre of Road (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Southern boundary with Heathfield Nook Road	Ground	(07:00 – 23:00)	48.3 $L_{Aeq,16hr}$	18.5	48.0 $L_{Aeq,16hr}$	15.0 $L_{Aeq,16hr}$	30	-15.0
	First	(23:00 – 07:00)	41.5 $L_{Aeq,8hr}$		41.2 $L_{Aeq,8hr}$	8.2 $L_{Aeq,8hr}$	30	-21.8
			73.1 $L_{Amax,f}$		72.4 $L_{Amax,f}$	39.4 $L_{Amax,f}$	45	-5.6

Table 5.11 indicates that the required internal noise criteria levels will be achieved if windows are closed for proposed dwellings along the southern Site boundary with Heathfield Nook Road, with standard thermal double glazing.

The adoption of appropriate development design should be included when determining the effect of road traffic noise levels on the sensitive residential elements of the development. Such design considerations are detailed within the mitigation section.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'.

Accordingly there is predicted to be a 'negligible' impact on proposed residential receptors along the southern Site boundary as a result of noise impact from Heathfield Nook Road.

During summer months it may be necessary to open windows in order to provide a supply of fresh air and Table 5.12 determines the internal noise levels. BS 8233 suggests that the sound reduction index of a partially open window will attenuate noise in the order of 10 – 15dB(A). For the purposes of this assessment, 12dB(A) has been adopted.

Table 5.12: Daytime and Night-time Internal Noise Levels along Southern Site Boundary with Heathfield Nook Road – Windows Open

Receptor	Floor	Period	Measured Noise Level (dBA)	Distance from Centre of Road (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Southern boundary with Heathfield Nook Road	Ground	(07:00 – 23:00)	48.3 $L_{Aeq,16hr}$	18.5	48.0 $L_{Aeq,16hr}$	36.0 $L_{Aeq,16hr}$	30	+6.0
	First	(23:00 – 07:00)	41.5 $L_{Aeq,8hr}$		41.2 $L_{Aeq,8hr}$	29.2 $L_{Aeq,8hr}$	30	-0.8
			73.1 $L_{Amax,f}$		72.4 $L_{Amax,f}$	60.4 $L_{Amax,f}$	45	+15.4

Table 5.12 indicates that the required internal noise criteria levels will be exceeded if windows are opened for all facades facing Heathfield Nook Road, therefore the mitigation section will consider alternative ventilation options to opening windows.

The adoption of appropriate development design should be included when determining the effect of road traffic noise levels on the sensitive residential and healthcare elements of the development. Such design considerations are detailed within the mitigation section.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'major'.

Accordingly there is predicted to be a 'major' impact on all proposed receptors along the southern Site boundary with Heathfield Nook Road as a result of noise impact from road traffic along this road.

5.2.3 Rail Traffic Noise on Proposed Development

The measured noise levels for the train pass-bys, has been converted to the 16-hour daytime periods by using the following equation formula:

$$L_{Aeq,16hr} = SEL - (10 \times \log (60 \times 60 \times 16) + 10 \times \log N$$

Where SEL = Sound Event Level
60 x 60 x 16 = No. seconds in a 16-hour daytime period
N = No. Train pass-bys in a 16 hour daytime period

It is not necessary to calculate the 8-hour night-time noise level, or consider the instantaneous maximum noise level from the railway line as movements only occur during daytime hours.

Table 5.13: Determination of Daytime Noise Levels at 21m from Centre of Rail Line

Measured Sound Pressure Level $L_{Aeq,t}$ (dB)	Pass-by (Measurement) Duration (mm:ss)	Calculated SEL (dB)	Daytime Timetable Movements	Calculated Daytime Noise Level $L_{Aeq,16hr}$ (dB)
60.2	00:67	78.5	2	27.8

Table 5.14 compares the predicted daytime noise levels for gardens at a distance of 15m from the centre of the rail line, with the required WHO external noise criteria level.

Table 5.14: Comparison of Predicted Garden Noise Levels with External Target Noise Level

Calculated Daytime Noise Level $L_{Aeq,16hr}$ (dB)	Calculated External Noise Level in Garden $L_{Aeq,16hr}$ (dB)	WHO External Noise Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dBA)
27.8	29.3	55	-25.7

Table 5.14 indicates that the external amenity areas for gardens at a distance of 15m from the centre of the rail line will fall significantly below the required WHO external noise criteria level with no mitigation in place. If the number of movements along the rail line were to increase in future years there is a significant amount of headroom before the WHO external criteria level is exceeded.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'.

Accordingly there is predicted to be a 'negligible' impact on all proposed receptors along the eastern Site boundary as a result of noise impact from rail traffic.

In calculating the internal noise levels, the now revoked PPG24 states that standard thermal double glazing, when set into a brick-block wall, will attenuate noise levels from diesel trains by 32dB and this level has been used in the calculations. The calculated external free-field noise level has been used in determining the internal noise levels for comparison with the determined noise levels detailed in Table 5.15.

Table 5.15: Calculation of Internal Noise Levels – Windows Closed

Floor	Period	Distance to Facade (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Ground	(07:00 – 23:00)	15	29.3 $L_{Aeq,16hr}$	-2.7	30	-32.7

Table 5.15 indicates that the calculated internal target noise levels accord with the required internal noise criteria level for dwellings at least 15m from the centre of the rail line.

During summer months it may be necessary to open windows in order to provide a supply of fresh air and Table 5.16 determines the internal noise levels. BS 8233 suggests that the sound reduction index of a partially open window will attenuate noise by approximately 12dB.

Table 5.16: Calculation of Internal Noise Levels – Windows Open

Floor	Period	Distance to Facade (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Ground	(07:00 – 23:00)	15	29.3 $L_{Aeq,16hr}$	17.3	30	-12.7

Table 5.16 indicates that the required internal target noise levels will be achieved if windows are opened with no mitigation in place.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'.

Accordingly there is predicted to be a 'negligible' impact on all proposed receptors along the eastern Site boundary as a result of noise impact from rail traffic.

5.2.4 Rail Traffic Vibration on Proposed Development

The total VDV for the daytime period, for freight trains has been calculated in accordance with the methodology presented in BS 6472: 2008 using the appropriate weightings.

The total number of movements has been obtained from internet based freight train timetables.

Table 5.17 below summarises the results of the vibration assessment.

Table 5.17: Summary of Predicted Vibration Levels

Train Type	Timetabled Train Movements	Predicted Vibration Dose Value (m/s $^{1.75}$)
Freight	2	0.007
	Total:	0.007

Comparing the predicted VDV levels with the guideline values from BS 6472:2008, it can be determined that there is 'less than a low probability of adverse comment likely'.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'.

Accordingly there is predicted to be a 'negligible' impact on all proposed receptors along the eastern Site boundary as a result of vibration impact from rail traffic.

5.2.5 Change in Road Traffic Noise Levels on Existing Receptors

Upon completion of the proposals, it is anticipated that local road traffic noise levels may change as a result of development generated vehicle movements. Therefore, it is appropriate to consider the magnitude of any impacts that might arise.

The results of the Transport Assessment undertaken by SCP Transport have been used as the basis for the road traffic noise assessment. This focuses on roads immediately surrounding the site before the development generated traffic is dispersed across the wider network. The traffic data supplied in the form of 18-hour AAWT flows was used in the calculations.

Where road traffic route alignments are to remain unchanged, road traffic noise calculations have been carried out in accordance with CRTN, being undertaken for a notional receptor location 10m from the edge of the carriageway of each road considered and 0.5m above ground level. A notional receptor has been used because the change in noise level adjacent to any given road will be the same at all locations where noise from this route is dominant.

The predicted changes in road traffic noise are shown in Table 5.13. This Table shows the difference between the assumed opening year (2022) without the development and the assumed opening year +15 (2029) with and without the development. Calculations have been carried out assuming traffic speeds as supplied by SCP Transport.

Table 5.13: Predicted Changes in Road Traffic Noise Resulting from Operation of the Development

Road	Predicted Noise Level $L_{A10,18hr}$			Change in Noise Level +/- (dB)
	Opening Year With Development	Opening Year +15 Without Development	Opening Year +15 With Development	
	A	B	C	(C-B)
Grinlow Road	64.8	65.2	65.2	0.0
Harpur Hill Road	62.7	62.7	63.0	+0.3
A515 London Road	68.6	68.7	69.0	+0.3
A515 Ashbourne Road - North of Heathfield Nook Road	69.4	69.6	69.8	+0.2
A515 Ashbourne Road - South of Heathfield Nook Road	68.2	68.7	68.7	0.0
Heathfield Nook Road - East of A515	52.8	53.7	53.7	0.0
Heathfield Nook Road - West of A515	59.1	56.8	59.5	+2.7
Burlow Road - East of Heathfield Nook Road	63.7	64.2	64.2	0.0
Burlow Road - West of Heathfield Nook Road	64.4	64.7	64.9	+0.2

Burlow Road - East of Harpur Hill Road	65.8	65.7	66.2	+0.5

It can be seen from Table 5.13 that the greatest predicted road traffic noise level change is expected along Heathfield Nook Road – West of A515 with an increase of +2.7dB.

Comparing this increase in road traffic noise levels as a result of the Proposed Development with the guidance contained in the DMRB (Table 3.2), it can be shown that the magnitude of impact is categorised as 'minor'. The sensitivity of the existing noise sensitive receptors is categorised as 'high' and the magnitude of impact is categorised as 'minor'. Accordingly there is predicted to be a 'minor to moderate' impact at the noise sensitive receptors.

5.2.4 Blasting Impact on Proposed Receptors

The impact of blasting associated with the Health and Safety Laboratory at Harpur Hill has been considered as part of the assessment. It is understood that blasting is infrequent in nature and only takes place between 09:00 – 17:00. As a result, only the daytime period has been considered in this assessment.

Table 5.14 details the change in ambient noise levels due to activities associated with the blasting operations.

Table 5.14: Change in Ambient Noise Levels

Measured $L_{Aeq,\ 1hour}$ including blast (dB)	Lowest $L_{Aeq,1\ hour}$ excluding blast (dB)	Noise Level Change dB(A)
41.4	42.7	-1.3

Table 5.14 shows that a noise change of -1.3dB(A) has been calculated due to activities associated with the blasting. Comparison with Table 3.4 shows that a noise change of -1.3dB(A) would expect to be of 'negligible' according to the criteria adapted from the draft IEMA/IOA Working Party Guidelines.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'.

Accordingly there is predicted to be a 'negligible' impact on all proposed receptors along the as a result of blasting impact associated with the Health and Safety Laboratories.

6.0 MITIGATION

Introduction

This Section details the mitigation measures required in order to reduce the significance of impacts predicted in the previous section.

6.1 Mitigation from Demolition and Construction Effects

Accepted safeguards exist to minimise the effects of construction noise, these include:

- The various EC Directives and UK Statutory Instruments that limit noise emissions from a variety of construction plant;
- Guidance set out in BS 5228-1 which covers noise control on construction sites; and,
- The powers that exist for local authorities under Sections 60 and 61 of the COPA 1974 to control noise from construction application sites.

The adoption of BPM, as defined in Section 72 of the COPA 1974 is usually the most effective means of controlling noise from construction sites. Such measures where appropriate may include the following:

- Any compressors brought on to the Site to be silenced or sound reduced models fitted with acoustic enclosures;
- All pneumatic tools to be fitted with silencers or mufflers;
- Care to be taken when erecting or striking scaffolds to avoid impact noise from banging steel. All operatives undertaking such activities to be instructed on the importance of handling the scaffolds to reduce noise to a minimum;
- The majority of deliveries to be programmed to arrive during normal working hours only. Care to be taken when unloading vehicles to minimise noise. Delivery vehicles to be routed so as to minimise disturbance to local residents. Delivery vehicles to be prohibited from waiting within or in the vicinity of the Site with their engines running;
- All plant items to be properly maintained and operated according to manufacturers' recommendations in such a manner as to avoid causing excessive noise;
- All plant to be sited so that the noise impact at nearby noise sensitive properties is minimised;
- Local hoarding, screens or barriers to be erected as necessary to shield particularly noisy activities; and,
- Problems concerning noise from construction works can often be avoided by taking a considerate and neighbourly approach to relations with the local residents. Works should only take place during given periods, e.g. during normal construction hours and not at night.

It is recommended that the above measures be included in any Construction Environmental Management Plan (CEMP) that may be issued to and agreed with the contractor(s) conducting the works.

Experience from other sites has shown that by implementing the above measures, typical noise levels from construction works can be reduced by approximately 5dB to 10dB.

6.1.1 Construction Vibration

It is possible to employ a number of physical and operational measures in order to reduce the potential effects resulting from construction generated vibration. These may include:

- Adoption of low vibration working methods. Consideration should be given to use of the most suitable plant;
- Where processes could potentially give rise to significant levels of vibration, on-Site vibration levels should be monitored regularly by a suitably qualified person;
- Where piling is to take place, any obstructions should first be removed;
- The provision of cut-off trenches in order to interrupt the direct transmission path of vibrations;
- Reduction of energy input per blow (applicable to piling); and,
- Application of piling techniques aimed at reducing resistance to penetration e.g. pre-boring for driven piles and adding water to the hole for impact bored piles.

It is expected that mitigation measures and operational considerations such as these would be incorporated within the development of the Site construction methodologies in order that the effects of groundborne construction vibration can be controlled wherever practically possible.

6.1.2 Construction Generated Road Traffic Noise

As there is unlikely to be any significant increase in noise levels on the local road network as a result of construction generated traffic, the implementation of mitigation measures is not required.

6.2 Mitigation from Completed Development Effects

6.2.1 Road Traffic Noise from Burlow Road on Proposed Development

Table 5.6 shows that measured $L_{Aeq,16hr}$ in the nearest garden areas to Burlow Road breach the required WHO external noise criteria level of 55dB $L_{Aeq,T}$. Table 6.1 details the required barrier height in order to achieve at least 55dB $L_{Aeq,T}$.

Table 6.1: Required Barrier Heights

Receptor	Measured Daytime Noise Level $L_{Aeq,16hr}$ (dB)	Measurement Distance from Centre of Burlow Road (m)	Distance to Centre of Garden (m)	Calculated Noise Level in Centre of Garden $L_{Aeq,T}$ (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)	Required Barrier Height (m)
North western boundary	60.5	20	50	56.5	55	+1.5	1.5
Northern Boundary of southern area of Site			30	58.7		+3.7	1.5

Table 6.1 shows that a barrier height of at least 1.5m would be required for gardens along the boundaries with Burlow Road, which have line of sight to the road. The barrier could be in the form of an acoustic grade fence. Fences should be free from holes, be sealed at its base and have a minimum mass of 28kg/m^2. The 1.5m high acoustic fence would expect to provide 5dB(A) noise attenuation which would ensure that the WHO external criteria level is comfortably achieved. The approximate location of proposed acoustic fencing is shown on Figure 2.

Table 5.7 indicates that the required internal noise criteria levels will be achieved if windows are closed for all building facades along the north western boundary with standard thermal double glazing. However, internal criteria levels will be exceeded for building facades along the northern boundary of the southern area of the Site.

The previous Section has indicated that proposed dwellings within 20m of the centre of Burlow Road, along the northern boundary of the southern area of the Site will exceed the criteria for the night-time LAmax,f. The most appropriate method for controlling these exceedences is by installation of upgraded glazing units.

Table 6.2 specifies the typical glazing configuration required in order to reduce the internal noise levels to achieve the required internal criteria level.

Table 6.2: Acoustic Glazing Specification

Receptor	Floor	Distance to Nearest Facade (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)	Required Sound Reduction Performance of Glazing (R_{TRA})* (dB)	Example Glazing
Northern boundary of southern area of Site	First	20	82.8 $L_{Amax,f}$	49.8 $L_{Amax,f}$	45	+4.8	34	4(8)8.4*

*Acoustic laminate glass

Table 6.2 has determined the required glazing specification for habitable rooms for plots along the northern boundary of the southern area of the Site which have been predicted to exceed the required internal noise criteria limits with standard thermal double glazing. For non-habitable rooms i.e. kitchens and bathrooms, standard thermal double glazing will be sufficient in controlling external to internal noise break-in. Standard thermal double glazing should be sufficient to achieve required internal noise levels across the remainder of the Site however it would be recommended to complete a detailed glazing specification for each plot once the final masterplan has been confirmed at the detailed planning stage.

The layout of rooms within dwellings should be taken into consideration. Where possible, habitable rooms should be located on the opposite side of the dwelling to any external noise sources, in order to reduce internal noise levels.

In order to control internal noise levels within proposed noise sensitive buildings, the façade specification fronting onto road traffic needs to be considered. It is also important to consider the noise levels if windows are opened in order to rapidly cool a room during warmer periods of the year.

In the interests of controlling internal noise levels without the need to open windows to provide fresh air to rooms, it is recommended that a through-frame window mounted trickle ventilator is incorporated into the glazing unit for the noise-sensitive rooms which have direct line of sight to Burlow Road. 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 sensitive room.

6.2.2 Road Traffic Noise from Heathfield Nook Road on Proposed Development

Table 5.10 indicates that external amenity areas along the boundary with Heathfield Nook Road fall below the required WHO criteria level. No further mitigation is therefore considered necessary.

Table 5.11 indicates that the required internal noise criteria levels will be achieved if windows are closed for proposed dwellings along the southern Site boundary with Heathfield Nook Road, with standard thermal double glazing. Table 5.12 indicates that the required internal noise criteria levels will be exceeded if windows are opened for all facades facing Heathfield Nook Road.

In the interests of controlling internal noise levels without the need to open windows to provide fresh air to rooms, it is recommended that a through-frame window mounted trickle ventilator is incorporated into the glazing unit for the noise-sensitive rooms which have direct line of sight to Burlow Road. 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 MEV or PEV system which extracts air from the sensitive room.

6.2.3 Rail Traffic Noise on Proposed Development

It has been determined that the required external and internal noise criteria levels can be achieved for proposed dwellings along the eastern Site boundary with no mitigation measures in places. Therefore, no further mitigation is considered necessary for the impact of rail traffic noise.

6.2.4 Rail Traffic Vibration on Proposed Development

Comparing the predicted VDV levels with the guideline values from BS 6472:2008, it has been determined that there is 'less than a low probability of adverse comment likely'. No mitigation is therefore considered necessary for the impact of rail vibration for proposed dwellings along the eastern Site boundary.

6.2.5 Change in Road Traffic Noise Levels on Existing Receptors

The previous section has determined that there will be a 'minor to moderate' impact at noise sensitive receptors as a result of development generated road traffic.

The greatest predicted road traffic noise level change is expected along Heathfield Nook Road – west of A515 with an increase of +2.7dB(A). All other links would give a noise change resulting in a 'negligible' impact. The now revoked PPG 24 stated that "a noise change of 3dB(A) is the minimum perceptible under normal conditions." A noise change of 2.7dB(A) would therefore not expect to be perceptible and as all other links fall within the 'negligible' criteria, consideration towards mitigation is not considered warranted.

6.2.6 Blasting Impact on Proposed Receptors

The previous section has determined that there will be a 'negligible' impact at proposed dwellings due to the blasting operations. There is no line of sight between the blasting location and the Site due to existing terrain elevations. No further mitigation is considered necessary.

7.0 RESIDUAL EFFECTS

7.1 Construction Phase

7.1.1 Construction Noise

The implementation of the recommended mitigation measures will serve to minimise any disturbance caused to nearby receptors as a result of earthworks and construction activity.

The sensitivity of receptors R1, R2 and R3 is categorised as 'high' and the magnitude of impact is categorised as 'minor'. Accordingly there is predicted to be an adverse temporary short-term impact categorised as 'minor to moderate' significance following the implementation of mitigation measures.

7.1.2 Construction Vibration

It has been determined that there will be a 'moderate to major' impact at noise sensitive receptors as a result of construction vibration due to the separation distance between the Site and the receptors. It is considered that this impact will be reduced following the implementation of the recommended mitigation measures.

The sensitivity of receptors R1, R2 and R3 is categorised as 'high' and the magnitude of impact is categorised as 'minor'. Accordingly there is predicted to be an adverse temporary short-term impact categorised as 'minor to moderate' significance following the implementation of mitigation measures.

7.1.3 Construction Generated Road Traffic Noise

Provided that increases in road traffic noise levels of below 3dB are expected, it is considered that the magnitude of change will be 'negligible' at receptors located adjacent to the local road network.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'. Accordingly there is predicted to be a 'negligible' impact at receptors. Furthermore, it should be noted that any increase in noise levels associated with construction generated road traffic is expected to be limited to the day time hours only.

7.2 Operational Phase

7.2.1 Road Traffic Noise on Proposed Development

The adoption of appropriate development design should be included when determining the effect of road traffic noise levels on the noise sensitive elements of the Site. Such design considerations are detailed within the Mitigation Section.

The sensitivity of the residential receptors is categorised as 'high' and the magnitude of internal noise impact is categorised as 'negligible'.

Accordingly there is predicted to be a 'negligible' internal noise impact on the proposed noise sensitive receptors.

7.2.2 Road Traffic Noise on Existing Receptors

The sensitivity of the existing noise sensitive receptors is categorised as 'high' and the magnitude of impact is categorised as 'minor'. Accordingly there is predicted to be a 'minor to moderate' impact at the noise sensitive receptors.

7.2.3 Rail Traffic Noise on Proposed Development

The sensitivity of the proposed noise sensitive receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'. Accordingly there is predicted to be a 'negligible' impact at the noise sensitive receptors.

7.2.4 Rail Traffic Vibration on Proposed Development

The sensitivity of the proposed sensitive receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'. Accordingly there is predicted to be a 'negligible' impact at the sensitive receptors.

7.2.5 Blasting Noise on Proposed Development

The sensitivity of the proposed sensitive receptors is categorised as 'high' and the magnitude of impact is categorised as 'negligible'. Accordingly there is predicted to be a 'negligible' impact at the noise sensitive receptors.

References

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4 The Control of Pollution Act, Part III (1974)
5 The British Standards Institute (2009), BS 5228: Noise and Vibration Control on Construction and Open Sites – Part 1: Noise
6 The Environmental Protection Act (1990)
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8 Department of Transport and the Welsh Office (1988): Calculation of Road Traffic Noise
9 Transport Research Laboratory Ltd (2002): Converting the UK Traffic Noise Index $L_{A10,18hr}$ to EU Noise Indices for Noise Mapping
10 Institute of Environmental Management and Assessment / Institute of Acoustics (2002): Draft Guidelines for Noise Impact Assessment
11 Department of Transport (1993) (amended August 2008) : The Design Manual for Roads and Bridges(DMRB): Volume 11:Environmental Assessment
12 The British Standards Institute (2009): BS 5228: Noise and Vibration Control on Construction and Open Sites – Part 2:Vibration
13 The British Standards Institute (2008), British Standard BS 6472: Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)
14 Transport and Road Research Laboratory Research Report 246 (1990): Traffic induced vibrations in buildings (TRL RR 246) (applicable to Heavy Goods Vehicles (HGV) induced vibration)

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.

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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

REC
Resource & Environmental Consultants

Figure 1
Noise Measurement
Location Plan

REC
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Figure 2
Proposed Acoustic Fencing & Glazing

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.

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- IOSH Accredited Training Courses
- IEMA Accredited Training Courses
- Asbestos Training
- Health & Safety Training
- CDM Training
- Health & Safety Consultancy

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

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- Noise at Work Assessment
- Development Related Noise
- Environmental Noise

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- Odour Assessment
- Dispersion Modelling
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- Contaminated Land Investigation & Assessment
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- 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

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