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Bloor Homes Western
Ledbury Urban Extension
Ledbury

NOISE ASSESSMENT

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EXECUTIVE SUMMARY

BWB Consulting Ltd have been commissioned by Bloor Homes Western to provide a noise assessment regarding the proposed mixed use development including the erection of up to 625 new homes (including affordable housing), up to 2.9 hectares of B1 employment land, a canal corridor, public open space (including a linear park), access, drainage and ground modelling works and other associated works on land north of the Viaduct, Ledbury. The proposal is for outline planning permission with all matters reserved for future consideration with the exception of access. Only the means of access into the site is sought as part of this outline application, not the internal site access arrangements. Vehicular access is proposed off the Bromyard Road.

The assessment has considered the existing effects from Industrial noise on the north-eastern boundary of the development, road traffic from Bromyard Road and train noise.

A previous noise report for the site was produced by Hoare Lea in July 2013. Herefordshire Council expressed concerns with the July 2013 report regarding noise from the existing Industrial area at proposed residential properties and this issue has been addressed in the report.

The assessment against BS4142:2014, which considers the external noise effects of commercial sound, indicates that there is likely to be an 'adverse impact' at less than 100m from the industrial boundary at noise measurement locations 1, 2 and 3 shown in Figure 1. The proposed employment area shown on the Illustrative Masterplan provides the necessary buffer. The assessment against BS8233:2014 and the WHO noise guidelines, which consider the internal noise levels, indicates that for the proposed dwellings closest to the boundary of the industrial area standard double glazing and acoustic ventilation would be required to meet internal noise targets in the day and night-time periods and that outdoor noise levels would be acceptable both on the boundary of the industrial site and those at the buffer distance of 100m. For dwellings further into the site it is likely that standard double glazing and standard ventilation methods will be sufficient from a noise perspective.

The noise measurements indicate that at the boundaries with the railway and Bromyard Road that appropriate sound insulation measures would be required to provide acceptable internal noise levels. To enable windows to be closed to meet the noise targets, acoustically treated ventilation should be provided to habitable rooms that face onto Bromyard Road and the Railway line to maintain the acoustic performance.

The Concept Plan does not specify the locations of the gardens at this stage of the application. However, the free-field noise levels measured adjacent to the railway are well below the acceptable range provided by both the WHO guidelines and BS8233:2014 and no further mitigation measures are required. The measured daytime noise levels adjacent to Bromyard Road are above the acceptable range provided by BS8233:2014 and noise mitigation options are outlined in section 4 of the report to reduce the outdoor noise level adjacent to Bromyard Road to within acceptable levels.

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1.0 INTRODUCTION

1.1 BWB Consulting Ltd have been commissioned by Bloor Homes Western to provide a noise assessment regarding the mixed use development including the erection of up to 625 new homes (including affordable housing), up to 2.9 hectares of B1 employment land, a canal corridor, public open space (including a linear park), access, drainage and ground modelling works and other associated works on land north of the Viaduct, Ledbury. The proposal is for outline planning permission with all matters reserved for future consideration with the exception of access. Only the means of access into the site is sought as part of this outline application, not the internal site access arrangements. Vehicular access is proposed off the Bromyard Road.

1.2 proposed mixed commercial/residential development on Bromyard Road, Ledbury. The assessment has considered the existing effects from industrial noise on the north-eastern boundary of the development, road traffic from Bromyard Road and train noise.

1.3 A previous noise report for the site was produced by Hoare Lea in July 2013. Due to concerns from Herefordshire Council regarding noise from the existing industrial area at proposed residential areas this noise report addresses the issue of Industrial Noise.

1.4 The assessment is based on the Concept Plan for the site. The following tasks have been undertaken as part of the noise assessment:

- Baseline noise measurements on the boundary with the industrial/commercial area, the boundary with Bromyard Road and adjacent to the raised railway line;
- Assessment of the noise effects at the nearest proposed residential receptors; and
- Consideration of practical noise mitigation measures to reduce the noise to within acceptable levels, if applicable.

1.5 A glossary of acoustic terms is shown in **Appendix 1**.

Site Setting

1.6 The site is located within land to the north of the B4214 Bromyard Road, Ledbury. The location of the site is shown in **Figure 1**.

1.7 The site is currently greenfield and is bound to the north and east by Bromyard Road and existing employment units. To the south is the railway line and to the west is additional agricultural land and the River Leadon.

2.0 GUIDANCE

NPPF

2.1 The National Planning Policy Framework (NPPF) [Ref 1] sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

2.2 Under Section 11; Conserving and enhancing the natural environment, the following is stated:

> *"The planning system should contribute to and enhance the natural and local environment by: preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability"*

2.3 The document goes on to state:

> *"avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new 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"*

BS8233: 2014

2.4 The British Standard BS8233:2014 [Ref 2] recommends design criteria for internal noise levels within residential properties. This standard suggests criteria, such as reasonable resting/sleeping conditions and proposes noise limits that will normally satisfy these criteria for most people.

2.5 Table 4 of BS 8233:2014 is reproduced below and recommends the following noise limits for indoor spaces within dwellings:

Table 2.1 - Summary of Recommended Guidance from BS 8233

Activity	Typical Situations	0700h to 2300h	2300h to 0700h
Resting	Living rooms	35 dB $L_{Aeq,16hour}$	--
Dining	Dining Room / Area	40 *dB* $L_{Aeq,16hour}$	--
Sleeping	Bedrooms	35 dB $L_{Aeq,16hour}$	30 $L_{Aeq,8hour}$

1.1 BS 8233 also recommends that a maximum noise level or SEL should be considered in bedrooms, where there are regular events.

World Health Organisation Guidelines

1.2 The international perspective is set by the World Health Organisation (WHO) document 'Guidelines for Community Noise', 1999 [Ref 3]. Table 10.2.1, of the WHO Guidelines provide a series of recommended noise exposure levels as summarised in Table 2.2 below. This standard provides a precautionary approach and must be used appropriately.

Table 2.2 - Guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	L_{eq} [dB(A)]	Time base [hours]	L_{Amax} fast [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility & moderate annoyance	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

1.3 The WHO guidelines also state that at night, sound pressure levels at the outside facades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax} so that people may sleep with bedroom windows open. These values have been obtained by assuming that the reduction from outside to inside with the windows partly open is 15 dB.

Design Manual for Roads and Bridges (DMRB)

1.4 The impact of any changes in road traffic noise levels has been considered against the principles and guidance presented within the Design Manual for Roads and Bridges (DMRB) Part 7 HD213/11 Noise and Vibration, 2011 [Ref 4]. DMRB presents an impact significance matrix for assessing the magnitude of changes in noise level for the short and long term and can be used as criteria for assessing the impact of any changes in road traffic noise levels, as shown below.

Table 2.3 - Semantic Descriptors for Traffic Noise in the Short Term

Change in Noise Level $L_{A10,18\ hr}$ dB	Magnitude of Impact
0	No Change
0.1 to 0.9	Negligible
1 to 2.9	Minor
3 to 4.9	Moderate
5+	Major

Table 2.4 - Semantic Descriptors for Traffic Noise in the Long Term

Change in Noise Level $L_{A10,18\ hr}$ dB	Magnitude of Impact
0	No Change
0.1 to 2.9	Negligible
3 to 4.9	Minor
5 to 9.9	Moderate
10+	Major

1.5 Table 2.3 is concerned with the short-term difference, which would be considered during the six months following the completion of the construction, thereafter, Table 2.4 applies. The criteria in Table 2.3 above reflect key benchmarks of human response to changes in noise level. For example, a 3 dB change is generally taken to be the smallest change perceptible in the human ear and a 10 dB changes is heard as a doubling or halving of the loudness of a source. The 5 dB category has been included as it provides greater definition of the assessment of changes in noise level.

1.6 The prediction methodology for traffic noise is the Calculation of Road Traffic Noise (CRTN), 1988. This is an established prediction methodology and enables the change in noise levels to be considered whilst taking the number of Heavy Commercial Vehicles into account.

BS4142: 2014

1.7 BS4142:2014 [Ref 5] provides a methodology that determines the significance of adverse impact at dwellings potentially affected by noise of an industrial nature. BS 4142 refers specifically to sound from fixed installations which comprise mechanical and electrical plant and equipment; sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site. The noise effect of HGVs and vans entering and leaving the yard of the proposed development units does not fall within the scope of BS4142 and so this standard has only been used to assess noise from loading activities and fixed items of plant.

1.8 The basis of the standard requires a comparison to be made between the 'background noise level' of the assessment area and the 'specific noise level' of the

noise source under consideration. There are five key definitions relating to this relationship;

- Background Noise Level - $L_{A90,T}$ - this is defined in the Standard as 'the 'A' weighted sound pressure level of the residual noise at the assessment position which is exceeded for 90 % of the given time interval, *T*, measured using time weighting F and quoted to the nearest number of whole decibels.

- Specific Noise Level - $L_{Aeq,T}$ - this is the equivalent continuous 'A' weighted sound pressure level over a given time interval.

- Residual Noise - this is defined as the ambient noise remaining in a given situation when the specific noise source is suppressed to a degree such that it does not contribute to the ambient noise.

- Ambient Noise - totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

- Rating Level - $L_{Aeq,T}$ - the specific noise level plus any adjustment made for the characteristic features of the noise.

1.9 The background level, wherever possible should be determined at the location where the assessment is to be made. Situations will arise where, due to circumstances which influence this level unduly, for example the specific noise level is operating continuously and thus the residual noise cannot be measured at this point, the background level may be determined in other ways. This may be, for example, by measuring at a different location or a different time which are nevertheless representative of the assessment position.

1.10 A further acoustic correction to the specific noise level is made if the sound has tonal or impulsive characteristics.

1.11 Once all necessary adjustments have been made, the background and the specific noise levels are compared. The standard states that the greater this difference is, the greater is the magnitude of the impact.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

1.12 The assessment should consider the level of uncertainty in the data and associated calculations. Where the level of uncertainty could affect the conclusion, reasonable practicable steps should be taken to reduce the level of uncertainty.

3.0 BASELINE NOISE

Noise Survey – March 2016

3.1 The baseline noise measurements were undertaken on the site over a 24 hour period on 3rd to 4th March 2016. A 24-hour measurement was taken on the boundary of the industrial/commercial area (Site 1) to determine the existing contribution of industrial/commercial activities. Daytime attended measurements were taken at three locations on the boundary of the industrial/commercial area to determine the source noise levels at sites 2, 3 and 4. Following discussions with the EHO at Herefordshire Council it was agreed that baseline noise measurements should also be taken at a 'representative' location that was not affected by industrial/commercial noise, especially in the night-time period to enable the BS4142 assessment to be undertaken at night. These baseline noise levels were taken at site 6, which was also selected to minimise the contribution from road and rail noise sources.

3.2 Additional daytime noise measurements were taken to assess the noise impact of traffic on Bromyard Road (B4214) at site 6. All measurements were taken in free-field locations with the mic 1.5m above the ground. The measurement locations are shown on **Figure 1**.

3.3 A summary of the day and night-time noise levels is shown in Table 3.1 and the long-term measurements at site 1 and site 6 are shown graphically in **Figure 2** and **Figure 3** respectively.

Table 3.1 - Summary of Measured Noise Levels 3rd/4th March 2016

Site	Period	Noise Levels, dB(A)			
	Hours	L_{eq}	Typical L_{max}	L_{10}	L_{90}
1	Day (0700-2300)	49.8	66.3	49.8	44.5
	Night (2300-0700)	46.7	56.2	45.3	41.0
6	Night (2300-0700)	46.0	54.7	42.2	33.9

3.4 A summary of the short-term attended noise measurements is shown in Table 3.2.

Table 3.2 - Summary of Short-Term Attended Noise Measurements 3rd March 2016

Site	Period	Noise Levels, dB(A)			
	Hours	L_{eq}	Typical L_{max}	L_{10}	L_{90}
2	1245-1345	54.0	76.8	52.5	41.0
3	1400-1445	44.3	60.5	46.3	39.5
4	1450-1520	45.8	64.4	46.0	38.4
5	1045-1215	58.7	74.8	61.8	41.5
6	1600-1800	47.2	61.2	48.5	43.2
	1800-2300	48.2	62.4	48.3	39.6
	0700-0930	45.6	62.1	45.9	41.0

3.5 Local observations of the noise sources at each site were taken throughout the daytime survey. A summary of these observations is shown below for each site.

- Site 1 – Mic was located on boundary of industrial area, 1.5m above the height of the yard area and 2.5m above the height of the site. Generally observed to be a quiet location with little activity from industrial units. Activities included forklift movements in the rear yard area (approx. 10% on-time) with occasional reverse bleeper, occasional car movements, distant plant noise (at a low noise level) and talking from staff using the covered smoking area located approx. 10m from mic.

- Site 2 – Mic located with clear line of sight to 'Goods In' bay with occasional lorry movements and unloading. Distant noise observed from metal shutter doors and mobile lorry crane (engine revs and bangs). Fork lift movements with very occasional horns and some talking from staff.

- Site 3 – Very little industrial noise observed at site 3. Distant forklift movements and HGV parking with reverse bleepers but these have no significant effect on ambient noise levels. Occasional train noise is more dominant at this location.

- Site 4 – Occasional lorry movement and engine idling (approx. 20m from boundary). Train pass-bys are dominant noise source but these are infrequent.

- Site 5 – Noise dominated by traffic on Bromyard Road (B4214). Mic located 12m from road.

- Site 6 – A quiet location with minimal noise from industrial area and occasional train pass-by noise. Traffic on Hereford Road (A438) was audible.

- Site 7 – No industrial noise was observed on this boundary during the survey except for very occasional vehicle movements. Road traffic noise from B4142 dominates at this location and no noise measurements were taken.

3.6 The noise equipment used for the survey comprised a Larson Davis 824 sound Analyser, a Larson Davis 820 sound level meter and a Larson Davis CAL200 calibrator. The equipment was calibrated both before and after each survey and no drift in calibration level was observed.

3.7 The weather at the start of the survey on 3rd March consisted of mild, overcast but dry conditions with a light northerly breeze of 1 to 2 m/s. The weather remained dry during the survey and at 1600 hrs was sunny (10 degrees C) with a light north-westerly breeze. The weather at 0900 hrs on 4th March consisted of sunny conditions with a light north-westerly breeze (1m/s) and a temperature of 2°C.

Noise Survey - November 2016

3.8 The baseline noise measurements were undertaken on the site over a 2-day period on 1st to 3rd November 2016. Long-term measurements were taken on the boundary of Bromyard Road and adjacent to the Railway line. Additional daytime attended measurements were taken at a distance of 40m from the raised railway viaduct to determine source noise levels of train pass-bys.

3.9 The measurements at sites 5 and 8 were taken in free-field locations with the mic 1.5m above the ground at site 8 and 1.8m above the road height and 9m from the road at site 5. The measurement locations are shown on **Figure 1**.

3.10 A summary of the day and night-time noise levels is shown in Table 7 and the long-term measurements are shown graphically in **Figures 4 & 5**.

Table 3.3: Summary of Measured Noise Levels 1 to 3rd November 2016

Site	Date	Period	Noise Levels, dB(A)			
		Hours	L_{eq}	Typical L_{max}	L_{10}	L_{90}
8 5	1 Nov	Day (1530-2300)	43.0	57.9	43.1	36.1
	2 Nov	Day (0700-2300)	45.2	59.4	45.0	38.6
	1/2 Nov	Night (2300-0700)	39.8	51.3	39.2	34.3
	1 Nov	Day (1600-2300)	64.0	78.0	64.9	38.9
	2 Nov	Day (0700-2300)	65.6	78.3	68.3	45.2
	3 Nov	Day (0700-1400)	65.3	78.6	69.8	46.9
	1/2 Nov	Night (2300-0700)	55.6	59.8	43.6	29.5
	2/3 Nov	Night (2300-0700)	55.7	60.6	45.1	34.6

3.11 A summary of the short-term attended noise measurements at a distance of 40m from the railway viaduct at position 8 is shown graphically in **Figure 6**. Individual train pass-bys are denoted on the Figure and the noise levels are summarised below:

- Westbound passenger train, 2 carriages, stopped at lights – $L_{Aeq,2\ min}$ 52.3 dB, $L_{Amax,f}$ 61.0 dB
- Eastbound passenger train, 2 carriages – $L_{Aeq,1\ min}$ 58.6 dB, $L_{Amax,f}$ 68.3 dB
- Eastbound Intercity train, 9 carriages - $L_{Aeq,1\ min}$ 65.5 dB, $L_{Amax,f}$ 73.0 dB

3.12 Local observations of the noise sources at each site were taken during the daytime survey. A summary of these observations is shown below for each site.

- Site 5 – Noise dominated by traffic on Bromyard Road (B4214). Mic located 9m from road. Some noise from farming activity is field on opposite side of road.
- Site 8 – A quiet location with occasional train pass-by noise. Traffic on Hereford Road (A438) was audible.

3.13 The noise equipment used for the survey comprised a Larson Davis 824 sound Analyser, x2 Larson Davis 820 sound level meters and a Larson Davis CAL200 calibrator. The equipment was calibrated both before and after each survey and no drift in calibration level was observed.

3.14 The weather at the start of the survey on 1st November consisted of dry, mild and overcast conditions (11°C) with a light north-easterly breeze of 2 m/s. The weather

remained dry during the survey and at 1400 hrs on 3rd November was overcast and dry (9°C) with a light south-westerly breeze of 1 to 2 m/s.

Feb/March 2012 Noise Measurements

3.15 Additional noise measurements were undertaken in February/March 2012 by Hoare Lea and detailed in the July 2013 Noise Report for the site. A summary of the long-term noise measurements at Positions 1 to 4 is shown in Table 3.4, below. These measurement locations are denoted at P1 to P4 on Figure 1.

Table 3.4 - Summary of Feb/ March 2012 Noise Measurements
Source – Hoare Lea Noise Report, July 2013

Position	Period	Average Measured LAeq, T(dB)	Average Measured LA90, T(dB)
1	Daytime	47.5	42.2
	Night-time	43.4	37.2
2	Daytime	47.3	40.9
	Night-time	42.2	32.2
3	Daytime	51.6	39.8
	Night-time	43.0	33.4
4	Daytime	45.1	35.5
	Night-time	41.4	29.6

3.16 Hoare Lea also reported a calculated noise level based on the shortened measurement procedure in CRTN of $L_{Aeq,16\ hr}$ 68.5 dB measured approx. 2m from the nearside kerb of the B4214. Typical train pass-by event noise levels at a distance of approx. 50m from the railhead are also provided in the Hoare Lea Noise Report. Train pass-bys towards Ledbury Station (right to left across viaduct) provided $L_{Aeq,T}$ 54.3 dB and away from Ledbury Station provided $L_{Aeq,T}$ 54.6 dB. The typical pass-by time for each train was approx. 75 secs with a maximum noise level of $L_{Amax,f}$ 65.3 dB.

4.0 NOISE ASSESSMENT

4.1 The key issue that was raised by Herefordshire Council following the 2013 Noise Report for the site was the effect of Industrial activities on the proposed residential area. The noise assessment considers industrial noise based on both day and night-time noise measurements.

4.2 Noise from the railway and road traffic noise on Bromyard Road are also considered below.

Industrial Noise

4.3 There are numerous separate industrial/commercial units located on the north-eastern boundary of the Development site and it would not be practicable to identify each individual noise source from each unit. Based on site observations it was considered that noise measurements at the 'noisiest' locations on the industrial site boundary would enable an assessment against BS4142:2014.

4.4 The issue of night-time noise was discussed with Herefordshire Council. It was agreed that the best approach would be to measure both close to the 'noisiest' industrial location (considered to be site 1) and simultaneously measure at a location that was considered to be representative of the background noise levels at site 1 but was not significantly affected by the industrial noise (site 6).

4.5 The industrial noise has been considered at sites 1, 2, 3 and 4 in the daytime and at site 1 in the night-time.

Site 1

4.6 At site 1 the noise level on the site boundary in working hours between 0800-1800 hrs was $L_{Aeq,T}$ 49.4 dB and in the worst case hourly period (0800-0900 hrs) was $L_{Aeq,T}$ 52.9 dB. The noise at this location was made up from a combination of sources including fork-lift and vehicle movements, distant plant noise and staff talking in the smoking area. As the noise was continuous, noise measurements were taken at a 'representative' location (site 6) to determine the residual and background noise levels. The residual noise levels consider the same time period as the worst case hourly levels. The background noise levels were taken from 0800 to 0930 hrs and 1600-2300 hrs to represent the daytime noise levels and from 2300-0700 hrs to represent the night-time period. The mode values for the background noise levels have been calculated at site 6 for the day and night periods, as shown below and these have been used in the BS4142 assessment:

- Daytime background noise level – $L_{A90,T}$ 39 dB
- Night-time background noise level – $L_{A90,8hr}$ 29 dB

4.7 At site 1 the noise was generally quiet with low level plant noise and intermittent noise from fork lift trucks. The layout of the residential area is not presently known and so for the purpose of the noise assessment it has been assumed that there will be a 100m buffer between the industrial site boundary and the nearest residential. The noise was not considered to be tonal in character with the exception of very occasional bleeper noise from the fork lift trucks and distant reversing HGV's. The BS4142 assessment has included a 2 dB tonal correction as the bleepers are considered to be just perceptible

at 100m. The operation of the fork-lift was considered to be just perceptible at the nearest proposed receptors, which provides a +3 dB impulsivity correction.

4.8 At present a site layout plan showing the location of the nearest residential properties is not available. For the purpose of the assessment it has been assumed that there will be buffer between the industrial and residential of 100m. As the noise sources at site 1 are both mobile and fixed, and in some cases the source cannot be determined, the predictions have made the assumption that the measurements are on average 20m from the dominant noise source and act as a point source. On this basis the measured noise level reduces by 14 dB at 100m from the boundary.

4.9 The BS4142 assessment at site 1 in the daytime period is shown below:

Table 4.1 - BS4142 assessment at Site 1 in the daytime period

BS4142 Assessment at Site 1 - Daytime	
Ambient noise Level at boundary (worst case hour 0800-0900 hrs)	$L_{Aeq,1hr}$ 52.9 dB
Residual noise level, L_r	$L_{Aeq,T}$ 45.6 dB
Specific Noise Level at boundary, $L_{s(boundary)}$	$L_{Aeq,1hr}$ 52 dB
Specific Noise Level at 100m from boundary, L_s	$L_{Aeq,1hr}$ 38 dB
Background noise level (from site 6)	$L_{A90,T}$ 39 dB
Tonal and Impulsivity Correction	+5 dB
Rating Level	(38+5) = 43 dB
Excess of rating over background level	(43-39) = +4 dB

4.10 The night-time BS4142 assessment was undertaken at site 1, which was observed to be representative of the location with the most site activities on the boundary with the Development site.

4.11 The BS4142 assessment at site 1 in the night-time period considered both the worst case hourly period (2300-0000 hrs) and the 8 hour night-time period. However, as the residual noise level (site 6) was higher than the ambient level at site 1 between 2300-0000 hrs it is not possible to calculate specific level at site 1. The assessment has therefore considered the 8 hour night-time period, as shown below.

Table 4.2 - BS4142 assessment at Site 1 in the night-time period

BS4142 Assessment at Site 1 – Night-time	
Ambient noise Level at boundary (worst case hour 0800-0900 hrs)	$L_{Aeq,8hr}$ 46.7 dB
Residual noise level, L_r	$L_{Aeq,\ 8\ hr}$ 46.0 dB
Specific Noise Level at boundary, $L_{s(boundary)}$	$L_{Aeq,1hr}$ 38.4 dB
Specific Noise Level at 100m from boundary, L_s	$L_{Aeq,15\ min}$ 24 dB
Background noise level (from site 6)	$L_{A90,T}$ 29 dB
Tonal and Impulsivity Correction	+5 dB
Rating Level	(24+5) = 29 dB
Excess of rating over background level	(29-29) = 0 dB

4.12 The assessment indicates low impact in the night-time period and that there is unlikely to be an adverse impact in the daytime at a distance of 100m from the boundary at site 1. The uncertainty in the assessment is based on the variability in activities on the industrial site although the daytime measurements were attended and all sources noted during the survey.

Sites 2, 3 and 4

4.13 The daytime BS4142 assessments in the daytime period for sites 2, 3 and 4 are shown below. At site 2 the assessment has been undertaken 100m from the site boundary and the same assumptions have been used as those at site 1.

Table 4.3 - BS4142 assessment at Site 2 in the daytime period

BS4142 Assessment at Site 2 - Daytime	
Ambient noise Level at boundary (worst case hour 0800-0900 hrs)	$L_{Aeq,1hr}$ 54.0 dB
Residual noise level, L_r	$L_{Aeq,T}$ 45.6 dB
Specific Noise Level at boundary, $L_{s(boundary)}$	$L_{Aeq,1hr}$ 53.3 dB
Specific Noise Level at 100m from boundary, L_s	$L_{Aeq,1hr}$ 39 dB
Background noise level (from site 6)	$L_{A90,T}$ 39 dB
Tonal and Impulsivity Correction	+5 dB
Rating Level	(39+5) = 44 dB
Excess of rating over background level	(44-39) = +5 dB

4.14 At site 2 there is unlikely to be an adverse impact in the daytime at a distance of 100m from the boundary. The uncertainty in the assessment is based on the variability in activities on the industrial site although the measurements were attended and all sources noted during the survey.

4.15 At site 3 there was very little noise from the industrial estate and the measured ambient level at the boundary was below the residual noise level and so the specific noise level could not be calculated. It is considered that the noise would provide a low noise impact at the proposed residential properties at site 3.

4.16 The BS4142 assessment at site 4 has been undertaken at the noise measurement location on the boundary of the site.

Table 4.4 - BS4142 assessment at Site 4 in the daytime period

BS4142 Assessment at Site 4 – daytime	
Ambient noise Level at boundary (1450-1520 hrs)	$L_{Aeq,1hr}$ 45.8 dB
Residual noise level, L_r	$L_{Aeq,T}$ 45.6 dB
Specific Noise Level at boundary, $L_{s(boundary)}$	$L_{Aeq,1hr}$ 32 dB
Background noise level (from site 6)	$L_{A90,T}$ 39 dB
Tonal and Impulsivity Correction	+5 dB
Rating Level	(32+5) = 37 dB
Excess of rating over background level	(37-39) = -2 dB

4.17 The BS4142 assessment indicates a low impact in the daytime at site 4. Residential use is proposed in the area of locations 3 and 4 with a landscape buffer between the properties and the employment area. Based on the BS4142 assessment no additional noise mitigation measures are required at these locations.

BS8233:2014

4.18 The noise at the boundary of the industrial areas has also been considered against the guidance provided in BS8233:2014 in the day and night-time periods.

4.19 The noise measurement data at the boundary of the development site has been utilised to determine potential noise levels at the nearest façades of the proposed development. The 24 hour noise measurements at site 1 indicate that the daytime noise level is $L_{Aeq,16\ hr}$ 49.8 dB and $L_{Aeq,8\ hr}$ 46.7 dB at night at the site boundary.

4.20 The internal target noise levels that have been adopted for the residential development are from BS8233:2014 with a night-time level of $L_{Aeq'T}$ 30 dB for bedrooms and the $L_{Aeq'T}$ 35 dB in the daytime for living rooms. The internal maximum noise level target from the WHO guidelines is $L_{Amax,f}$ 45 dB at night

4.21 The mitigation strategy is formulated on the following basis:

- Ensure that internal noise levels comply with WHO/BS8233 criteria. For internal noise, it has been assumed that the minimum amelioration measure available to an occupant will be to close bedroom windows.

4.22 Therefore, in order to assess the acoustic performance of the proposed residential properties, it is appropriate in the first instance to explore the level of protection that will be afforded by the performance of the glazing elements.

4.23 At the boundary of the site in the daytime the windows need to provide R_w 17 dB and at night need to provide R_w 19 dB to meet the internal noise targets, when taking the façade reflection into account. Standard double glazing with a specification of 4mm glass, 6 to 20 mm airgap, 4mm glass (or similar glazing design) will provide a façade sound insulation performance of R_w 29 dB.

4.24 As can be seen from the above, standard double glazing would be sufficient to comply with internal WHO/BS8233 criteria on the boundary of the industrial area.

4.25 There is the potential to locate the B1 employment uses between the industrial area and the new residential as full or part mitigation, especially at Location 2.

4.26 At site 1 on the boundary of the industrial area the night-time $L_{max,f}$ levels were typically 56 dB(A) and there were 4 measurement periods with a maximum noise level between 70 to 77 dB(A) and all other measured levels were below a level of 70 dB(A). The source of these maximum noise events is not known but likely to be either staff in cars/talking or the operation of the forklift truck. With a buffer zone of 100m, as discussed above, the maximum noise level would only exceed $L_{max,f}$ 60 dB(A) on one occasion per night based on the measured noise levels.

4.27 The WHO guidelines state that at night, sound pressure levels at the outside facades of the living spaces should not exceed 60 dB L_{Amax} so that people may sleep with bedroom windows open. These values have been obtained by assuming that the reduction from outside to inside with the windows partly open is 15 dB. Based on the WHO guidance, at a distance of 100m from the site boundary only one event would require windows to be closed to meet the internal maximum target noise level.

Outdoor Daytime Noise Levels

4.28 The measured noise levels at the site boundary at Site 1 provide free-field noise levels of 49.8 dB $L_{Aeq,16\ hr}$ during the day. These levels are at the lower guidance levels provided by both BS8233:2014 and the WHO guidance, which provides daytime noise limits for outdoor living areas of between $L_{Aeq,16\ hr}$ 50 to 55 dB. This indicates that outdoor noise levels would be acceptable both on the boundary of the site and at a buffer distance of 100m from the boundary.

Road and Rail Noise Assessment

4.29 The noise measurement data at the proposed line of the nearest elevations of residential properties on the development site to Bromyard Road and the railway line have been utilised in the noise assessment. The measured noise levels indicate that at Site 8 (adjacent to the railway) the free-field noise levels are 45 dB $L_{Aeq,16\ hr}$ during the day and 40 dB $L_{Aeq,8\ hr}$ at night. At Site 5 the free-field noise levels are 66 dB $L_{Aeq,16\ hr}$ during the day and 56 dB $L_{Aeq,8\ hr}$ at night at a distance of 9m from the road.

Noise Assessment and Mitigation Measures

4.30 The baseline noise measurements indicate that at Site 8, the internal guideline values in BS8233:2014 would be achieved with partially open windows in both the day and night-time periods. Standard double glazing units should be considered for residential properties located adjacent to the railway line such as 6mm glass/6 to 20 airgap/4mm glass construction, which provides a façade sound insulation performance of $R_w + C_{tr}$ 28 dB. This glazing will also provide R_w 32 dB for sources that do not contain the road traffic spectrum.

4.31 The noise measurements indicate that at Site 5 located 9m from Bromyard Road, appropriate sound insulation measures would be required. In the daytime, the windows at site 5 would need to provide a minimum of $R_w + C_{tr}$ 33 dB and at night need to provide $R_w + C_{tr}$ 28 dB to meet the internal noise targets, when taking the façade reflection into account. However, the Concept Plan indicates that a roundabout will

be constructed at site 5, which will affect the traffic speeds and noise levels at this location. Furthermore, site layout plans are not available at this stage of the application to determine noise levels at the nearest proposed residential elevations.

4.32 To provide an indication of the required sound insulation measures at site 5, it has been assumed that the nearest residential properties will be located 20m from Bromyard Road. Assuming that the noise from traffic on Bromyard Road acts as a line source then the noise at the nearest receptors would be a facade noise level of $L_{Aeq,16\ hr}$ 64.6 dB in the daytime and $L_{Aeq,8\ hr}$ 54.7 dB at night. In the daytime, the windows overlooking Bromyard Road need to provide a minimum of $R_w + C_{tr}$ 30 dB and at night need to provide $R_w + C_{tr}$ 25 dB to meet the internal noise targets. For a road traffic noise spectrum ($R_w + C_{tr}$), acoustic double glazing with a specification of 10 mm glass/ 60 to 20 mm airgap/ 6 mm glass (or similar) provides a façade sound insulation performance of $R_w + C_{tr}$ 32 dB. This glazing will also provide R_w 35 dB for sources that do not contain the road traffic spectrum.

4.33 As can be seen from the above, acoustic double glazing would be sufficient to comply with internal WHO/BS8233 criteria at the nearest residential properties to the railway line and Bromyard Road. However, external L_{Amax} noise levels will remain above the WHO criterion at sites 5 and 8. In the night-time period the maximum noise levels were between $L_{Amax,f}$ 41 to 64 dB at Site 8. In the night-time period the maximum noise levels were between $L_{Amax,f}$ 32 to 82 dB at Site 5. Assuming the maximum noise events can be considered as a point source, the maximum noise levels at a distance of 20m from the road is predicted to be a free-field noise level of $L_{Amax,f}$ 77. The source of the maximum noise events is not known at site 5 as the night-time survey was unattended but the noise is likely to be due to lorry pass-bys.

4.34 The proposed glazing on the residential at 20m from Bromyard Road would provide R_w 35 dB and façade levels of $L_{Amax,f}$ 80 dB (equates to a free-field level of $L_{Amax,f}$ 77 dB) would exceed the internal maximum target noise level. There were no events that were predicted to exceed a free-field noise level of $L_{Amax,f}$ 77 dB during the night-time period at 20m from Bromyard Road.

4.35 Section 3.4 of the WHO Guidelines states that for good sleep, indoor noise levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times/night. With the proposed glazing the indoor noise level would not be exceeded during the night based on the measured/predicted noise levels. The WHO Guidance considers this to be well within an acceptable number of maximum noise events per night.

4.36 To enable windows to be closed to meet the noise targets, acoustically treated ventilation should be provided to habitable rooms to maintain the acoustic performance of these elevations.

Outdoor Daytime Noise Levels

4.37 BS8233:2014 states that for traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such

a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB LAeq,T or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.

4.38 The Concept Plan shown in **Figure 1** does not specify the locations of the gardens at this stage of the application. However, the free-field noise levels measured at Site 8 are well below the acceptable range provided by both the WHO guidelines and BS8233:2014 and no further mitigation measures are required to reduce the effects of railway noise. The measured daytime noise level at site 5 of $L_{Aeq,16hr}$ 65.6 dB at a distance of 9m from Bromyard Road is above the acceptable range provided by BS8233:2014. The following measures will need to be considered to reduce the outdoor noise level adjacent to Bromyard Road:

- If the gardens are located 20m from Bromyard Road an acoustic barrier would be required to reduce the noise levels to within the acceptable range provided by BS8233:2014.

- If gardens are located to the rear of properties overlooking Bromyard Road then they will be protected from road traffic noise by the buildings themselves and with appropriate building design, no further mitigation would be required.

- The noise from Bromyard Road reduces by 3 dB with doubling of distance (assuming that the road traffic noise acts as a line source). The greater the distance that residential properties are located from Bromyard Road the less noise mitigation will be required.

4.39 When a site layout plan is available then a detailed noise assessment will be undertaken to determine appropriate noise mitigation measures to meet the BS8233:2014 guidelines for outdoor living areas.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 BWB Consulting Ltd have been commissioned by Bloor Homes to provide a noise assessment regarding the proposed mixed commercial/residential development on Bromyard Road, Ledbury. The assessment has considered the existing effects from industrial noise on the north-eastern boundary of the development, road traffic from Bromyard Road and train noise.

Existing Industrial Noise

5.2 The assessment against BS4142:2014 indicates low impact in the night-time period and that there is unlikely to be an adverse impact in the daytime at a distance of 100m from the boundary. The assessment against BS8233:2014 and the WHO noise guidelines indicates that, for proposed dwellings closest to the boundary of the industrial area, standard double glazing and acoustic ventilation would be required to meet internal noise targets in the day and night-time periods and that outdoor noise levels would be acceptable both on the boundary of the industrial site and at a buffer distance of 100m. For dwellings further into the site it is likely that standard double glazing and standard ventilation methods will be sufficient from a noise perspective.

Road and Rail Noise

5.3 The noise measurements indicate that at the boundaries with the railway and Bromyard Road that appropriate sound insulation measures would be required to provide acceptable internal noise levels. To enable windows to be closed to meet the noise targets, acoustically treated ventilation should be provided to habitable rooms that face onto Bromyard Road and the Railway line to maintain the acoustic performance.

5.4 The Concept Plan does not specify the locations of the gardens at this stage of the application. However, the free-field noise levels measured adjacent to the railway are well below the acceptable range provided by both the WHO guidelines and BS8233:2014 and no further mitigation measures are required. The measured daytime noise levels adjacent to Bromyard Road are above the acceptable range provided by BS8233:2014 and noise mitigation options are outlined in section 4 of the report to reduce the outdoor noise level adjacent to Bromyard Road to within acceptable levels.

6.0 REFERENCES

(i) National Planning Policy Framework (NPPF)
(ii) BS8233:2014 Sound Insulation and Noise Reduction for Buildings
(iii) World Health Organisation (WHO) Guidelines for Community Noise, 1999
(iv) Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3 Part 7 – HD 213/11 Noise and Vibration
(v) BS4142:2014 Methods for rating and assessing industrial and commercial sound

FIGURES

FIGURE 1

NOISE MEASUREMENT LOCATIONS

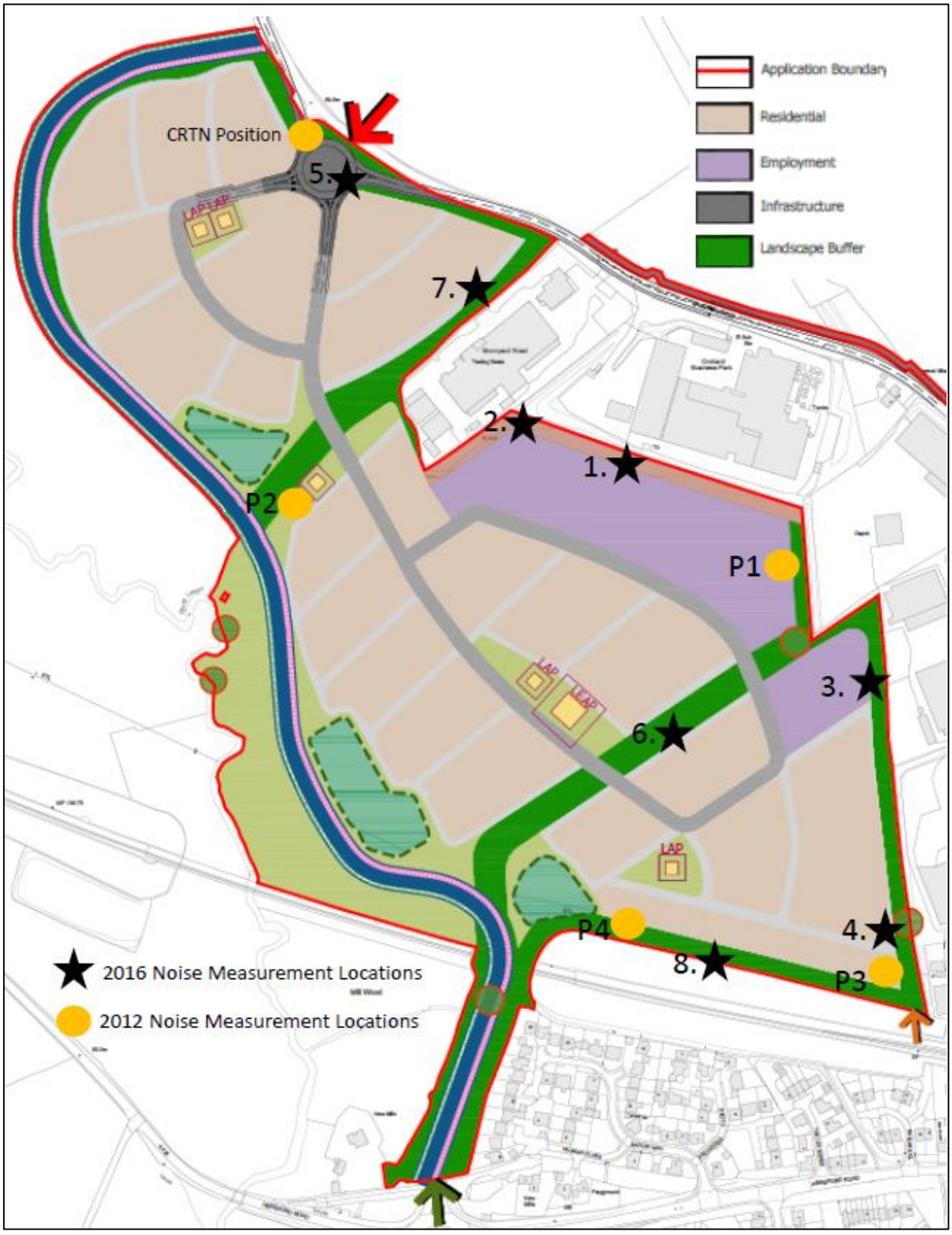


FIGURE 2

BASELINE NOISE LEVELS AT SITE 1

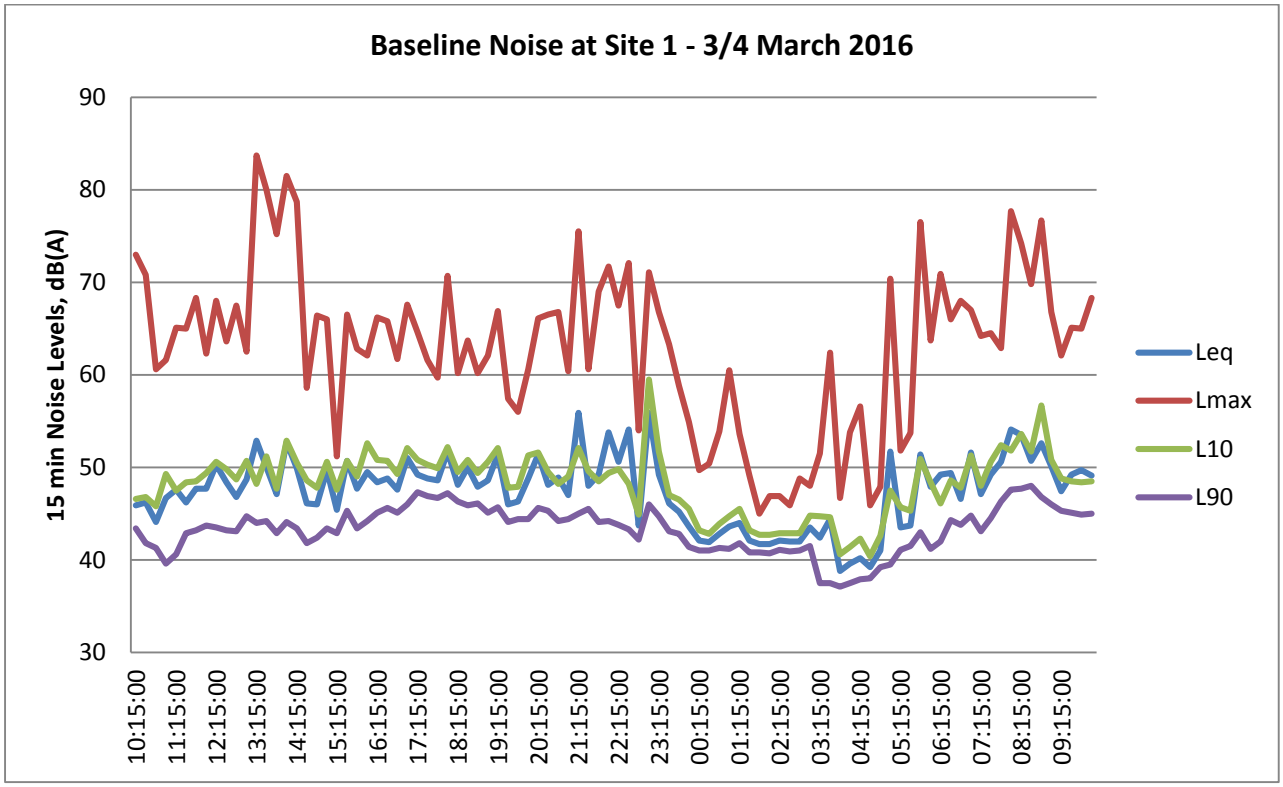


FIGURE 3

BASELINE NOISE LEVELS AT SITE 6

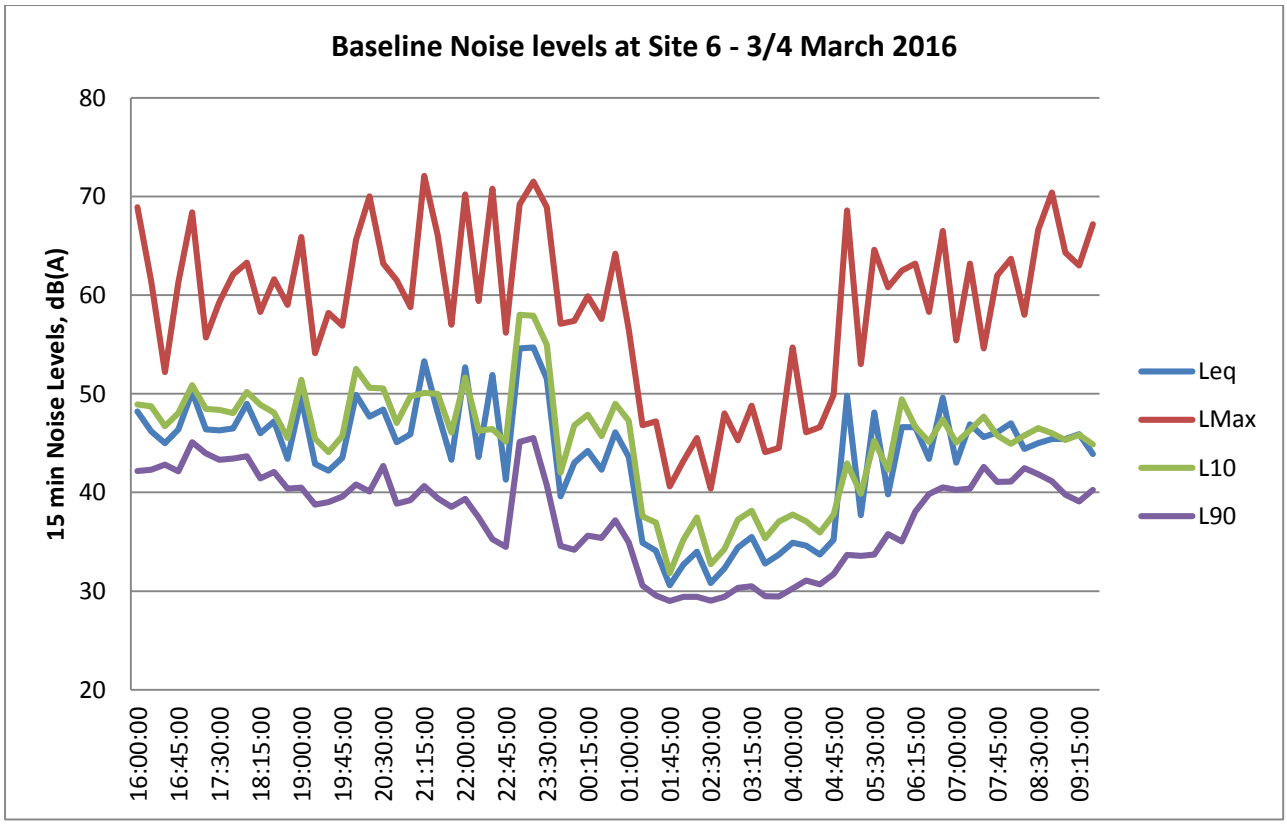


FIGURE 4

BASELINE NOISE LEVELS AT SITE 8

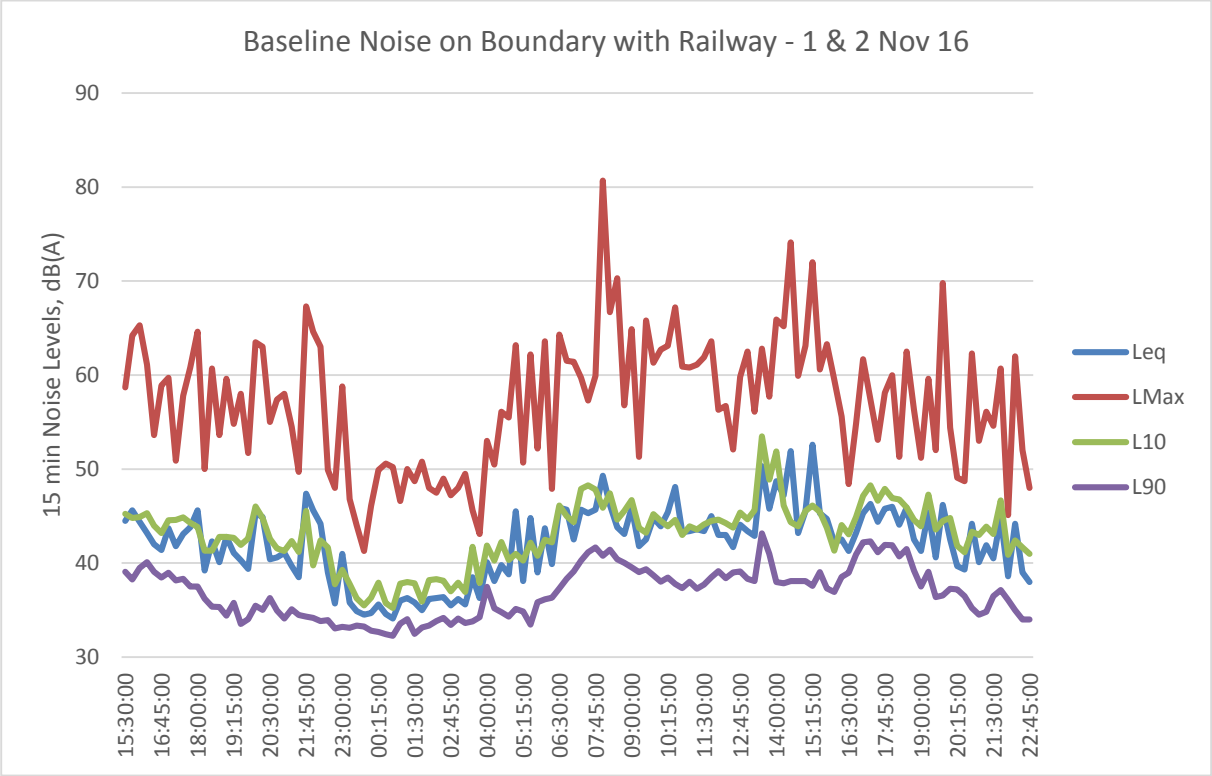


FIGURE 5

BASELINE NOISE LEVELS AT SITE 5

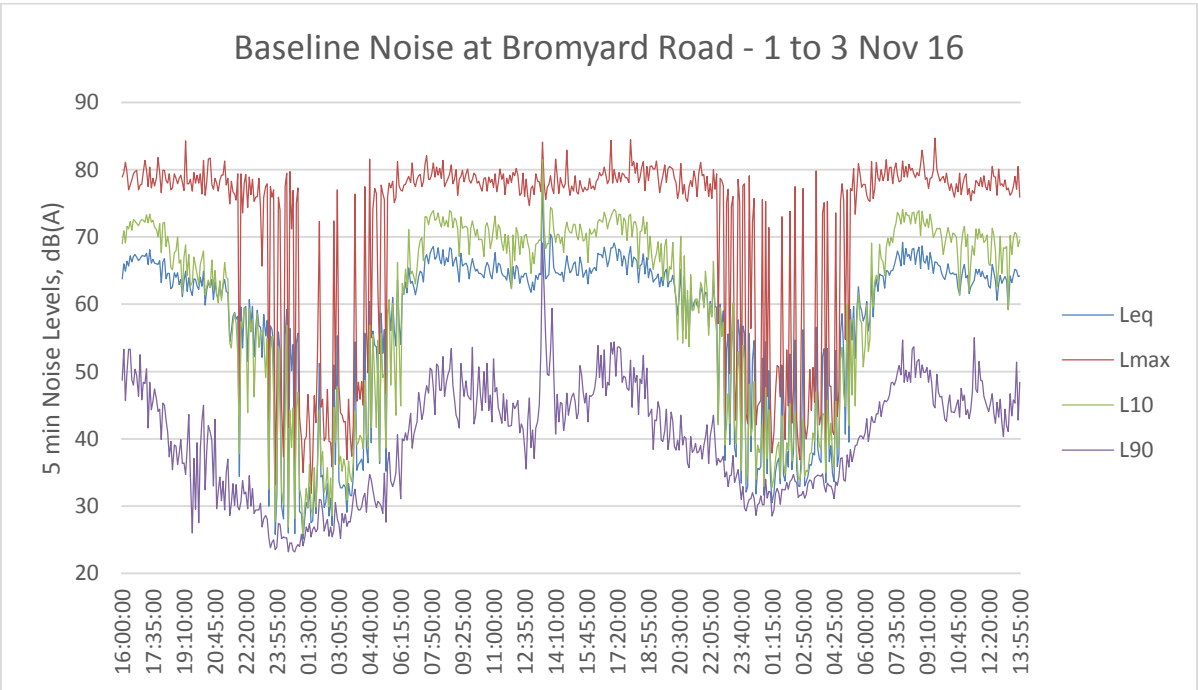
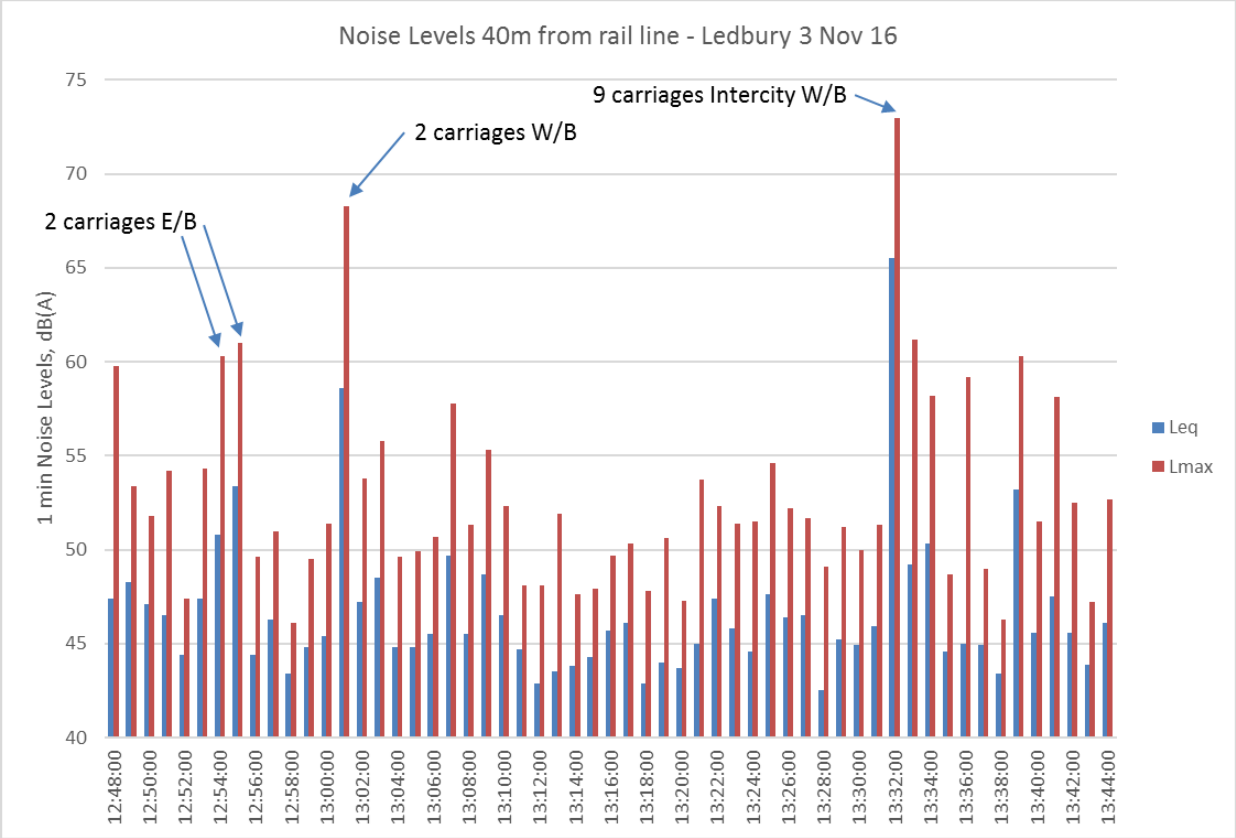


FIGURE 6

NOISE LEVELS 40m FROM RAILWAY VIADUCT



APPENDIX 1

GLOSSARY OF ACOUSTIC TERMS

Noise is defined as unwanted sound. The range of audible sound is from 0dB to 140dB. The frequency response of the ear is usually taken to be about 18Hz to 18,000Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than at the lower and higher frequencies, and because of this, the low and high frequency component of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most used and which correlates best with the subjective response to noise is the dB(A) weighting. This is an internationally accepted standard for noise measurements.

The ear can just distinguish a difference in loudness between two noise sources when there is a 3dB(A) difference between them. Also when two sound sources of the same noise level are combined the resultant level is 3dB(A) higher than the single source. When two sounds differ by 10dB(A) one is said to be twice as loud as the other.

A few examples of noise of various levels are shown in the Table below:

Sound Level dB(A)	Environmental Condition
0 to 10	Threshold of hearing
10 to 20	Broadcasting Studio
20 to 30	Bedroom at night
30 to 40	Library
40 to 50	Living room in urban area
50 to 60	Typical business office
60 to 70	Conversational speech
70 to 80	Traffic noise on street corner
80 to 90	Inside a moving bus
90 to 110	1m from an alarm clock
110 to 120	1m from loud car horn
120 to 130	1m from pneumatic drill
130 to 140	Threshold of pain

The subjective response to a noise is dependent not only upon the sound pressure level and its frequency, but also its intermittency. Various indices have been developed to try and correlate annoyances with the noise level and its fluctuations. The indices and parameters used in this report are defined below:

- Equivalent Continuous Sound Pressure Level (L_{Aeq}): The A-weighted sound pressure level of a steady sound that has, over a given period, the same energy as the fluctuating sound under investigation.
- L_N: the A-weighted sound level exceeded for N% of the measurement period.
- L_{AMAX}: The maximum 'A' weighted noise level recorded during the measurement period.
- R_w: Weighted Sound Reduction,

- C_{tr}: An adjustment to the Rw scale that accounts for noise from sources such as urban road traffic and other sources with a large low frequency component.

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