Appendix 12.2 - Assessment of Environmental Noise

Herbert Road, Newport

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Herbert Road, Newport

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Executive Summary

Waterman Energy, Environment & Design Limited was commissioned to undertake an assessment of environmental noise in order to determine the suitability of land at Herbert Road, Newport for residential development.

The proposed development site is approximately 3.9ha in area and is currently vacant land, surrounded by the Glan Usk Primary School to the north, a railway with residential properties beyond to the east, an industrial unit to the south and the River Usk to the west.

Attended and unattended noise surveys were carried out between the 21st and 22nd February 2013 during the daytime (07:00 to 23:00) and night-time (23:00 to 07:00) periods. The prevalent noise source during the survey period was noted to be road traffic noise with rail noise audible toward the eastern boundary and localised noise from Crawford Trading Estate.

Monitored noise levels have been assessed against the guidance provided in Technical Advice Note 11 'Noise' (1997). The assessment results indicate that the noisiest boundaries of the proposed Development would fall into NEC B. As areas of the proposed Development fall into NEC B, mitigation measures have been suggested to ensure that a good level of amenity for future residents could be obtained.

Additionally, the potential for night-time operation of adjacent industrial uses has been assessed in terms of the potential for sleep disturbance.

Mitigation measures include the use of a suitable glazing specification and the provision of acoustically attenuated trickle ventilation for the worst effected facades so as to minimise the need for residents to open windows.

Additionally a 2.6m acoustic barrier is proposed near to the western boundary of JS Payne Ltd, extending to the north of the yard as indicated on Figure 3 and Figure 4.

It is considered that with the proposed mitigation measures in place a good level of amenity could be obtained for all future residents of the proposed Development and as such the proposed Development site would be suitable for residential development.

1. Introduction

Waterman Energy, Environment & Design Limited (hereafter Waterman) was instructed by Green Hill Construction (the Applicant) to undertake a noise and vibration assessment for land at Herbert Road, Newport. The applicant is looking to gain detailed planning permission for a residential development at the Site.

Waterman has been appointed to undertake a noise and vibration assessment in support of the planning application, this document aims to provide guidance with regards to the existing noise and vibration levels present on and in vicinity of the proposed development and identify potential planning constraints and mitigation measures which may be required.

A glossary of the acoustic terminology used in this report is presented in Appendix A.

2. Site Description and Proposed Development

2.1 Site Description

The Site is located on the eastern bank of the River Usk to the north of Newport city centre within a predominantly residential area; refer to Figure 1. The indicative boundary of the Site is shown in Figure 2**.** The Site is approximately 0.43ha in area and is currently vacant land, surrounded by the Glan Usk Primary School to the north, a railway with residential properties beyond to the east, an industrial unit to the south and the River Usk to the west. No buildings exist on the Site.

The Site is accessed to the south west via Collier Street, an existing residential road with emergency access provided from Herbert Road to the south east. Pedestrian access is also provided to the north east via an undercroft below the railway line accessed from Charnwood Road.

The closest residential dwellings to the Site are located within the residential development to the east, including Margaret Avenue, Orchard Street, Charnwood Road and Filey Road. Residential dwellings are also situated directly to the south of the development on Herbert Road, Morgan Street, Courtney Street and Collier Street.

2.2 Proposed Development

The development proposals for the Site (hereafter referred to as the 'Proposed Development') comprise a residential estate. Also proposed are additional parking facilities for Glan Usk Primary School to relive pressure on the existing bridge access on Bank Street.

3. Environmental Noise Assessment Criteria

3.1 Site Suitability for Residential Development

Noise can have a significant impact on the environment and quality life enjoyed by individuals and communities. The main guidance document with regards to noise for planners in Wales is Planning Guidance Technical Advice Note 11 '*Noise*'[1]. The principal purpose of the guidance is to determine the suitability of the land for residential development, especially where land is affected by noise from transportation or industrial sources. However, the TAN also provides general guidance with respect to matters to be taken into account in determining planning applications both for noise-sensitive developments and those activities which will generate noise.

TAN11 provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on the development or adding unduly to the costs and administrative burdens of business. As such, it outlines some of the main considerations with local planning authorities should take into account when determining planning applications for development that will either generate noise or be exposed to existing noise sources.

In addition, as a general principle, TAN11 advocates spatial separation of 'noisy' developments and noise-sensitive receptors. However, TAN11 recognises that this is not always possible or even desirable. In such circumstances mitigation through design and control and through planning conditions are cited as the preferred solution.

When assessing the suitability of a site for proposed noise sensitive development TAN11 provides guidance in the form of Noise Exposure Categories (NEC), the NEC criteria relevant to mixed noise sources i.e. road and rail are presented in Table 1 below.

Table 1: Recommended noise exposure categories for new dwellings near rail traffic

NEC	$L_{Aeq,T}$ dB (07:00–23:00)	$L_{Aeq,T}$ dB (23:00–07:00)	Advice
A	<55	<45	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.
B	55–66	45–59	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.
C	66–74	59–66	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	>74	>66	Planning permission should normally be refused

Notes:

(1) Sites where individual noise events during the night-time (23:00-07:00) regularly exceed 82 dB L_{Amax} (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq,8h}$ (except where the LAeq,8h already puts the site in NEC D).

The guidance provided within TAN11 also requires that attention be given to internal noise levels. BS 8233:1999 '*Sound insulation and noise reduction for buildings*'[2] aims to provide recommendations with regards to 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

[1] Government of Wales, 1997, '*Planning Guidance, Technical Advice Note 11 'Noise'*
[2] British Standards Institute, 1999, '*BS 8233:1999 Sound insulation and noise reduction for buildings - Code of Practice*', BSI.

buildings undergoing a change in use. However, it can be used to assess the changes in the existing external noise climate on existing sensitive receptors.

The standard suggests good and reasonable internal noise levels for various uses. The criteria relevant to the residential component of the proposed development are presented in Table 2.

Table 2: Indoor ambient noise levels (BS 8233, 1999)

Location	Internal Noise Level
Living rooms (0700-2300hrs)	Good Standard 30 dB L_{Aeq} Reasonable Standard 40 dB L_{Aeq}
Bedrooms (2300-0700hrs)	Good Standard 30 dB L_{Aeq} Reasonable Standard 35 dB L_{Aeq} Maximum Noise Level 45dB L_{Amax}

With regards to external noise levels BS 8233 states, "Is is desirable that the steady state noise level does not exceed 50 dB $L_{Aeq,T}$ and 55 dB $L_{Aeq,T}$ should be regarded as the upper limit."

The World Health Organisation (WHO)[3] provides guidance of a similar nature to BS 8233, although places more emphasis on the potential health impacts associated with noise. Specifically, the document recommends internal and external noise levels that would provide an acoustic environment that is conducive to un-interrupted speech and sleep.

3.2 Fixed Mechanical Plant and Industrial Noise

When assessing the noise impacts of fixed mechanical plant, the guidance provided within BS 4142:1997 'Method for Rating industrial noise affecting mixed residential and industrial areas'[4] has been used. The standard sets out a methodology whereby the likelihood of complaints as a result of an industrial noise source can be assessed. The measured or predicted noise level from the source in question, the 'specific noise' level, immediately outside of the dwellings is compared with 'background noise' level. Where the noise contains a 'distinguishable discreet continuous note (whine, hiss, screech, hum etc) or if there are distinct impulses in the noise (bangs, clinks, clatters or thumps), or if the noise is irregular enough to attract attention' then a correction of +5 dB is added to the specific noise level to obtain the 'rating noise' level.

The likelihood of noise provoking complaints is assessed by subtracting the background noise level from the rating noise level. The likelihood of complaints is then assessed against the criteria provided in Table 3.

Table 3: Likelihood of complaints as a result of industrial noise (As taken from BS 4142)

Difference in noise levels (dB(A))	Likelihood of complaints
-10	Complaints Unlikely
+5	Marginal likelihood of complaints
+10	Positive indication that complaints are likely

For the daytime, this assessment is carried out over a one hour reference period and over a five minute period during the night. Day and night are not defined in the Standard but it states that night should cover the times when the general adult population are preparing for sleep or actually sleeping. For the purpose of this assessment it has been assumed that the day and night periods reflect those stated in TAN11, i.e. daytime is 07:00 – 23:00 and night 23:00-07:00.

[3] World Health Organisation, 2000, *'Guidelines for Community Noise'*, WHO Geneva
[4] British Standards Institute. Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas. BS 4142: 1997

3.3 Consultation

3.3.1 Initial Consultation February 2013

Consultation was carried out with Newport Council (NC) prior to noise surveys being carried out. The scope of works for the survey and assessment were agreed in principle with a Senior Environmental Health Officer (EHO) of the Environmental Protection Department. The following standard Planning Conditions were suggested for the development:

'Railway Noise – Internal

Prior to commencement of development a scheme shall be submitted to and approved in writing by the Local Planning Authority to provide that all habitable rooms exposed to external railway noise in excess of 55 dBA Leq 16 hour (free field) during the day (07.00 to 23.00 hours) or 45 dBA Leq 8 hour (free field) at night (23.00 to 07.00 hours) shall be subject to sound insulation measures to ensure that all such rooms achieve an internal noise level of 40 dBA Leq 16 hour during the day and 35 dBA Leq 8 hour at night. The submitted scheme shall ensure that habitable rooms subject to sound insulation measures shall be able to be effectively ventilated without opening windows. No dwelling shall be occupied until the approved sound insulation and ventilation measures have been installed to that property in accordance with the approved details. The approved measures shall be retained thereafter in perpetuity.

Reason: To ensure that the amenities of future occupiers are protected.

Railway Noise – External

Prior to the commencement of development a scheme shall be submitted to and approved in writing by the Local Planning Authority to provide that the maximum day time noise level in outdoor living areas exposed to external railway noise shall not exceed 55 dBA Leq 16 hour [free field]. The scheme of noise mitigation as approved shall be constructed in its entirety prior to the first occupation of any dwelling and shall be retained thereafter in perpetuity.

Reason: To ensure that the amenities of future occupiers are protected.

Railway Vibration

Prior to commencement of development a scheme shall be submitted to and approved in writing by the Local Planning Authority to provide that the dwellings are designed and constructed so as to ensure that vibration dose values do not exceed 0.4m/s1.75 between 07.00 and 23.00 hours, and 0.26m/s1.75 between 23.00 and 07.00 hours, as calculated in accordance with BS 6472-1:2008, entitled "Guide to Evaluation of Human Exposure to Vibration in Buildings", [1Hz to 80Hz]. The dwellings shall be constructed in accordance with the approved scheme.

Reason: To ensure that the amenities of future occupiers are protected.'

The above conditions will be considered in the assessment.

3.3.2 Additional Consultation June 2013

Further to the above, additional consultation was carried out with a separate NC Senior EHO with regard to the assessment of existing unrestricted industrial use adjacent to proposed residential uses. The following comments were agreed upon with NC:

- The EHO has concerns over the potential for intensification of operation within the [adjacent industrial] JS Payne Ltd site, which may include night time operation;
- Whilst difficult to quantify potential future night-time operations, an assessment period of 06:00 to 07:00 was agreed, representing early morning operation of the site within the night-time shoulder hour;

- A night-time L_{Amax} assessment will be carried out to meet BS 8233 internal criteria for bedrooms for the prevention of sleep disturbance. The assessment will take into account the measured daytime L_{Amax} levels as a worst case;
- We discussed the appropriateness of using L_{Amax} levels to assess daytime disturbance, and the relevance to national policy and guidance. While we will make a general comment on the L_{Amax} levels by reporting the 1sec Lp measurements and their relation to L_{Amax}, there is inherent difficulty in interpreting these to relevant guidance;
- We discussed the effective height of the proposed barrier including the lower ground level of the JS Payne site and its expected reduction on noise levels in gardens, with the potential for close boarded wooden fences around garden areas too;
- Regarding further mitigation for houses to the north of the JS Payne site, orienting garden areas towards the river was preferred, along with non-habitable rooms such as kitchens and bathrooms facing the JS Payne site.

4. Noise and Vibration Surveys

4.1 Baseline Noise Surveys

Baseline noise surveys were undertaken from the 21st and 22nd February 2013. Monitoring locations were selected to represent the proposed potentially sensitive receptors within the Development. The selected monitoring locations are described in Table 4 and illustrated on Figure 2.

Table 4: Noise Monitoring Locations

Monitoring Location (Figure 2)	Description	Observations and Predominant Noise Sources
LT1	Long term unattended noise measurement of railway	Noise climate dominated by infrequent rail noise and distant road traffic noise
ST1	Short term attended measurement representative of nearest proposed dwelling to Crawford Trading Estate	Noise climate dominated by infrequent rail noise and distant road traffic noise with noise audible from Crawford Trading Estate
ST2	Short term attended measurement representative of western site boundary	Noise climate dominated by infrequent rail noise and distant road traffic noise
ST3	Short term attended measurement representative of nearest proposed dwelling to Glan Usk Primary School	Noise climate dominated by road traffic noise and distant rail noise.
ST4	Snapshot measurement location of freight train noise, approximately 14m from rail head	Freight train noise dominant during measurements, Crawford Trading Estate Noise occasionally audible

The parameters logged throughout the survey period were L_{Aeq}, L_{Amax}, L_{Amin}, L_{A90} and L_{A10}. The L_{Aeq} level is the equivalent continuous sound pressure level over the measurement period; L_{Amax} is an indicator of the highest sound level during the measurement period; the L_{Amin} is the lowest level during the measurement period; L_{A90} is used as a descriptor of background noise levels and L_{A10} is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.

The sound level meters were calibrated both before and after each monitoring period; no drift from the reference level of 94 dB was recorded. All measurements were undertaken under free-field conditions. The weather was dry and wind speeds were less than 5 m/s. A wind shield was fitted to the monitoring equipment at all times.

Monitoring was undertaken by trained and competent staff either being a member of the Institute of Acoustics (IOA). The monitored noise levels are summarised in Table 5 and Table 6 below.

Table 5: Long-term baseline noise measurements

Location (Figure 2)	Monitoring Period	$L_{Aeq,T}$*	$L_{A10,T}$*	$L_{A90,T}$*+	L_{Amax}	
					Max#	90th Percentile
LT1	Daytime (07:00–23:00)	51	51	40	86	73
	Night-time (23:00–07:00)	45	47	35	80	70

Notes:
* During the daytime, T is 16 hours. During the night-time, T is 8 hours.
# Maximum monitored noise level during survey period.
+ Minimum monitored noise level during survey period.

Table 6: Short-term baseline noise measurements

Location (Figure 2)	Monitoring Period	$L_{Aeq,T}$*	$L_{A10,T}$*	$L_{A90,T}$*+	L_{Amax}	
					Max#	90th Percentile
ST1	Daytime (07:00–23:00)	56	59	49	90	75
ST2	Daytime (07:00–23:00)	53	54	49	70	64
ST3	Daytime (07:00–23:00)	55	57	51	74	65
ST4	Daytime (07:00–23:00)	58	60	49	82	77

During the daytime period monitored noise levels were found to be relatively constant across the site due to ambient noise emanating from constant traffic the M4 motorway bridge and localised noise from works to the south. Noise levels ranged ranging between 51 and 56dB $L_{Aeq,T}$ (see Table 5 and Table 6). The surveyor noted the dominant noise sources in the area of the proposed development to road traffic and rail noise.

The elevated short-term noise levels measured at ST1 were caused by noise emanating from steel fabricators in Crawford Trading Estate.

The elevated short-term noise levels measured at ST3 were caused by noise emanating from children playing at lunchtime in Glan Usk Primary School.

The elevated short-term snapshot noise levels measured at ST4 were caused by freight trains idling and pulling away at signals.

During the night-time period noise levels were typically lower (45dB $L_{Aeq,8hr}$) than those experienced during the daytime period as a result of reduced road traffic and rail noise during this period.

4.2 Baseline Vibration Surveys

A subjective assessment of vibration levels was undertaken at each noise monitoring location, including additional positions along the eastern boundary with the rail line. The closest existing source of vibration to the site boundary is the existing railway line located some 20m from the nearest proposed residential dwelling.

The proposed Newport Council Planning Condition regarding vibration from trains requires a minimum criterion of $0.26m/s^{-1.75}$ not to be exceeded. It is considered that to exceed this criterion, vibration levels would have to be clearly perceptible at the site boundary during train passes, particularly where the rail line passes close to the site boundary (approximately 8m distance from the rail head).

The subjective assessment of vibration during the survey (including at the closest passing point of the rail head to the site boundary) did not reveal any perceptible levels of vibration along the eastern boundary during both passenger and freight train passes.

Additionally, vibration measurements were undertaken for a residential development approximately 400m south of the site that also lies adjacent to the rail line located on Turner Street (planning application number 11/0843). This site has been granted planning permission and is understood to be complete. The vibration measurements were undertaken at a distance of approximately 30m from the rail head and are detailed in Table 7.

Table 7: Vibration Measurements and Corresponding Semantic Rating

Monitoring Location		Maximum Vibration Dose Value ($m/s^{1.75}$)					
		x-axis		y-axis		z-axis	
		$VDV_{d,16hr\ day}$	$VDV_{d,8hr\ night}$	$VDV_{d,16hr\ day}$	$VDV_{d,8hr\ night}$	$VDV_{b,16hr\ day}$	$VDV_{b,8hr\ night}$
1	Measurement	0.020	0.018	0.030	0.026	0.033	0.029
	Semantic Rating	Adverse Comment Not Expected	Adverse Comment Not Expected	Adverse Comment Not Expected	Adverse Comment Not Expected	Adverse Comment Not Expected	Adverse Comment Not Expected

The vibration survey indicates levels that are well below those that would result in a low probability of adverse comment and are significantly under the minimum Newport Council criteria of $0.26m/s^{-1.75}$. Given the similarities of the Turner Street site to the proposed development on Herbert Road, these measurements are deemed representative of the development.

5. Environmental Noise Assessment

5.1 Site Suitability for Residential Development

5.1.1 TAN11 Assessment

Monitored noise levels for locations 1 and 2 have been have been compared against the NEC criteria for mixed noise sources as provided in TAN11 and summarised in Table 1. The monitored noise levels and corresponding NEC's are presented in Table 8.

Table 8: Averaged ambient noise levels and corresponding NEC

Location (Figure 2)	Period	Noise Indices	Noise Level (dB(A))	NEC
LT1	Daytime	$L_{Aeq,\ 16hour}$	51	A
	Night-time	$L_{Aeq,\ 8hour}$	45	B
ST1	Daytime	$L_{Aeq,\ T}$	56	B
ST2	Daytime	$L_{Aeq,\ T}$	53	A
ST3	Daytime	$L_{Aeq,\ T}$	55	B

The unmitigated monitored noise levels at locations LT1, ST1, ST2 and ST3 (see Table 8), place the Site into NEC B at ground level. When a site falls into NEC B, TAN11 states:

'Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.'

In addition to the above TAN11 states that if maximum noise levels through the night regularly exceed 82dB $L_{Amax,S}$ the site should be classified as NEC C unless it is already categorised as NEC D. With reference to Appendix B it can be seen that the 82dB L_{Amax} criteria is not exceeded several times during the night. As such, the site classification should remain as presented in Table 8.

Given that the proposed development falls into NEC B, it is considered that through careful design and the use of appropriate mitigation measures reasonable living conditions could be obtained within the proposed residential dwellings. Potential mitigation measures are discussed in greater detail in the relevant section below.

5.1.2 External Amenity Space

In addition to the above, it is important to consider noise levels within proposed external amenity spaces. The current proposals include for gardens to the front and rear of properties.

When considering external living amenity spaces the WHO's 'Guidelines for Community Noise' recommends an external noise level of 55dB $L_{Aeq,T}$ to prevent the onset of community annoyance. In considering the application of the 55dB $L_{Aeq,T}$ criterion for outdoor living spaces, it is important to take account of the feasibility of achieving such a level. A review of National Physics Laboratory Report CMAM 16[5] reported the following:

> *"Perhaps the main weakness of both WHO inspired documents is that they fail to consider the practicality of actually being able to achieve any of the stated guideline values...We know from the most recent survey of noise exposure carried out in England and Wales that around 56% of the population are exposed to daytime noise levels exceeding 55dB $L_{Aeq,T}$ and that around 65% are exposed to night-time noise levels exceeding 45dB $L_{Aeq,T}$ (as measured outside of the house in each*

case). The percentage exposed above the WHO guideline values could not be significantly reduced without drastic action to virtually eliminate road traffic noise and other forms of transportation noise (including public transport) from the vicinity of the houses. The social and economic consequences of such an action would be likely to be much greater than any environmental advantages of reducing the proportion of the population annoyed by noise. In addition there is no evidence that anything other than a small minority of the population exposed to such noise levels find them to be particularly onerous in the context of their daily lives."

The monitored noise levels presented in Table 5 have been input to a noise prediction model created in CADNA-A. Note that the model has not taken into account any localised screening effects from garden fences. The model has predicted the levels of noise incident on garden areas and is presented in Figure 3 and Figure 4.

Based on the prevailing noise climate across the site from dominant noise sources of road and rail, the CADNA-A noise model indicates that guideline external noise limit of 55dB $L_{Aeq,T}$ would not be exceeded within garden areas.

5.1.3 School Noise

Proposed dwellings to the north of the site, would face onto Glan Usk Primary School. Noises from external school activities, particularly playtimes have the potential to cause disturbance to future residents of the proposed development. As such, noise measurements were undertaken during an entire lunch break at approximately 6m from the northern boundary of the development adjacent to the school (representative of the nearest proposed residential property). The results are provided in Table 9.

Table 9: School Lunchtime Break Noise

Location (Figure 2)	Period	Noise Indices	Noise Level (dB(A))
ST3	Lunchbreak 12:30 – 13:15	$L_{Aeq,\ 45\ min}$	58
	Lesson Time 12:10 – 12:30	$L_{Aeq,\ 20min}$	54

It is evident that during playtime, noise levels at the nearest residential property exceed 55dB $L_{Aeq,T}$ criterion recommended by the WHO. However this is a temporary exceedance during playtime hours only, as is evident from the ambient noise measured during lesson time (Table 9).

When averaged out over the full monitoring period during the baseline survey, the level of noise at the properties to the north of the development nearest to the school would reduce to under 55dB $L_{Aeq,T}$ as per the ambient noise measurement during lesson time indicated in Table 9. Additionally, when considering the quieter periods of the daytime between 19:00 and 23:00, (which were not considered in the assessment) these noise levels would reduce further. As such it is considered that playtime noise would not give rise to significant community annoyance.

There are floodlit sports pitches to the north of the school site which have the potential to be operated outside of school hours. However this is not considered an issue in terms of noise given the separation distance of 120m to the nearest dwelling and the intervening building structures that would provide significant screening to noise.

5.1.4 Noise from Crawford Trading Estate

Noise measurements undertaken at ST1 were subject to sources emanating from the Crawford Trading Estate. Noise sources were identified as emanating from the rear of JS Payne Ltd Structural Architectural Steel and Stainless Steel Fabricators.

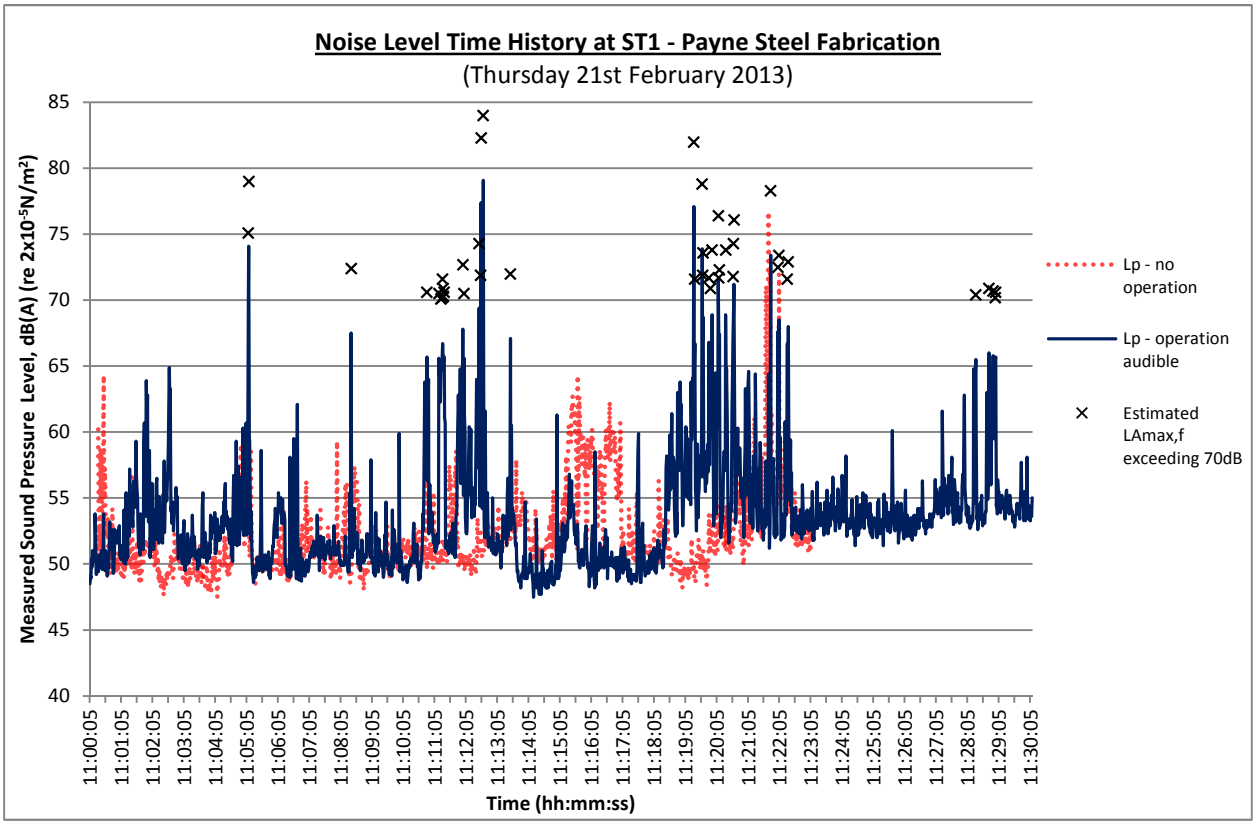
Noise sources predominantly included fork lift truck movements in the yard and grinding noises emanating from the building, which was noted to have access doors open during operations, presumably for ventilation purposes. The specific noise measurement of activities in JS Payne Ltd is summarised in Table 10 and detailed in Appendix B.

Table 10: Noise measurements - JS Payne Ltd

Location (Figure 2)	Monitoring Period	$L_{Aeq,30min}$	$L_{A10,30min}$	$L_{A90,30min}$	L_{Amax}	
					Max	90th P/C
ST1	Operational Noise 11:00 – 11:30	57	58	49	84	83
	Ambient noise (no audible operations) 15:00 – 15:30	53	55	49	67	66

It is evident from the short term measurements that noise from JS Payne Ltd causes a temporary exceedance of the 55dB $L_{Aeq,T}$ criteria during the measurement period. Additionally there are relatively high $L_{Amax,f}$ peaks during the measurement which could potentially cause disturbance. However the ambient noise during further measurements at this location reduces to 53dB $L_{Aeq,30min}$, suggesting operations from JS Payne Ltd have the potential to increase noise levels in the immediate area around ST1 by 4dB. The 1 second Lp measurements for the operational noise at ST1 are presented below.

Chart 1: High Time-Resolution Noise measurements of JS Payne Site



For the most part, the ambient noise levels during operation are similar to those without operation audible from the JS Payne site, with the exception of intermittent high noise levels causing the increase in average noise levels over the assessment period. The highest 1 second Lp measurement was 79.1dB occurring at 11:12. This corresponds to the highest L_{Amax} level occurring between 11:10 and 11:15. As can be seen from the trace of 1 second measurements, the noise emanating from the JS Payne site is

intermittent in nature, with occasional peaks in noise from operations in the service yard such as movement of metal stock.

Interrogating the Lp results during JS Payne operations presented in Chart 1, an estimation of the $L_{Amax,f}$ parameter for each 1 second Lp measurement has been provided (for all predicted levels over 70dB $L_{Amax,f}$) by taking the differential of the maximum Lp measurement (79.1dB – See Chart 1) and the maximum $L_{Amax,f}$ measurement (84dB – See Table 10) and applying the difference to all Lp,1sec figures.

Note that when considering the highest $L_{Amax,f}$ measurement of 84dB and assuming a typical building façade noise attenuation of 35dB $D_w + C_{tr}$ [6], this would equate to an internal instantaneous noise level of 49dB $L_{Amax,f}$ within the nearest dwelling. Refer to Appendix C for noise break-in calculation.

There is no available guidance on assessing instantaneous maximum noise levels during the daytime, as this type of noise issue relates to sleep disturbance. As such, to assess the potential for complaints from future residents, a BS 4142 assessment has been carried out for the nearest proposed dwellings to the west of the industrial facility, the results of which are provided as Table 11.

Table 11: BS 4142 Assessment - Western Scrap Yard Boundary

Parameter	Noise Level (dB(A))
$L_{Aeq,T}$ of source at receptor	57
Background Level (L_{A90})	49
Acoustic Feature Correction[1]	+5
Rating Level	62
Difference to Background $L_{A90, 1hr}$	13

Note [1]: As the nature of the noise emanating from the JS Payne Site is intermittent in nature (refer to Chart 1) a 5dB correction has been included for noticeable features.

The BS 4142 assessment concludes that in the absence of mitigation complaints would be likely at the nearest façade of the proposed dwellings to the industrial facilities. Note should be taken here that the assessment does not take into account any intervening barriers, landscaping or building structures that may screen the receptors from noise sources.

Additionally it is important to note that yard operations near to the boundary from JS Payne Ltd were observed to be infrequent and short-term in nature, hence the results from the BS 4142 assessment should be considered as an absolute worst-case and in reality could be tempered to account for the temporary nature of the works.

Notwithstanding the above, given the nature of the noise emanating from JS Payne Ltd, along with the potential increase in noise over the prevailing ambient noise climate it is considered that mitigation measures would be required.

Night-time L_{max} Levels

For the vast majority of the site, the dominant noise sources were noted to be rail and road traffic. Industrial noise was dominant, intermittently only adjacent to JS Payne Ltd. Additionally, this business operates during daytime hours only. However the EHO of NC has noted that the industrial use is unrestricted and can potentially operate 24 hours a day.

It is highly unlikely that JS Payne Ltd will begin 24 hour operations and it is impractical to make assumptions of noise levels from any replacement 24 hour operation that may be located at the JS Payne Site, should it be vacated by the current business. However for the purposes of this report an assessment

[6] (40dB Rw + Ctr for wall, 32dB Rw + Ctr for glazing based on 40% coverage of window)

of potential night-time operation has been carried out using the existing daytime measured data presented in Chart 1 in terms of the estimated $L_{Amax,f}$ noise levels.

This approach is to define the potential for future night-time operations of the JS Payne site to cause sleep disturbance to future residents of the proposed adjacent dwellings.

External Night-time Noise Limits

Note that TAN 11 states:

"Sites where individual noise events during the night-time (23:00-07:00) regularly exceed 82 dB LAmax (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the LAeq,8h (except where the LAeq,8h already puts the site in NEC D)."

As a rule of thumb the difference between an L_{Amax} fast time weighting and L_{Amax} slow time weighting ($L_{Amax,s}$) is 5dB, with the slow time weighting measurement being lower due to the sound level meter sampling over a number of discrete 1 second periods rather than 125ms periods.

As an initial guideline limit for this assessment, external levels should not regularly exceed 82dB L_{Amax} (S time weighting) within the assessment period (2300-0700). The highest measured L_{Amax} fast time weighting ($L_{Amax,f}$) during JS Payne operations was 84dB, which can be interpreted as 79dB $L_{Amax,s}$ and is 3dB under the guideline limit.

Internal Night-time Noise Limits

Note should be taken here that the WHO document 'Guidelines for Community Noise' quotes the findings of Vallet & Vernet (1991) which is that:

"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB LAmax more than 10–15 times per night…"

For the purposes of this assessment it is proposed that the internal noise criteria for bedrooms at night will be no greater than 45dB L_{Amax} 2 times in any hour. Based on the previous assumption of an overall noise attenuation provided by the building façade of 35dB, this equates to an external noise limit of no greater than 2 occurrences of 80dB $L_{Amax,f}$ externally to the nearest proposed dwelling.

Based on these estimated $L_{Amax,f}$ noise levels (showing 3 exceedances of 80dB $L_{Amax,f}$ over 30 mins), this limit would be exceeded six times in the early morning shoulder hour. As such, mitigation would be required.

5.1.5 Freight Train Noise

Attended measurements were undertaken for freight train movements during the survey at ST4. A summary of the noise levels is provided in Table 12 and detailed in Appendix B.

Table 12: Noise measurements - Freight Train

Location (Figure 2)	Monitoring Period	$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$	L_{Amax}	
					Max	90th Percentile
ST4	Freight Train Noise 10:20 – 10:25	65	65	53	82	80
	Ambient noise 10:25 – 10:27	52	53	49	56	56

It is evident, as expected, that during train movements ambient noise levels are elevated with higher maximum noise levels. This is caused by engine idling noise, pressure release from brakes and the train

pulling away from the signals. However, although short term elevated noise levels are experienced during train passes, these passes are infrequent enough to allow the $L_{Aeq,16hr}$ noise level to fall well below the recommended 55dB $L_{Aeq,T}$ WHO guideline value and the $L_{Aeq,16hr}$ value recommended by Newport Council (reference Section 3.3) as indicated in Table 5 from measurements at LT1. As such, the current noise levels are considered suitable for the protection of residential amenity and no mitigation measures would be required.

6. Mitigation Measures

6.1 Noise

Given that the proposed development falls into NEC B, consideration has been given to appropriate acoustic attenuation measures to provide a commensurate level of protection against noise for future occupants.

BS 8233 suggests good and reasonable internal noise levels for various uses. The criteria relevant to the Development are presented in Table 2.

The amount of insulation provided by a building element is defined by the weighted sound reduction index (R_w). The R_w is commonly quoted with the spectrum adaption term C_{tr}. The spectrum adaption terms are added to the R_w and are used to take into account the characteristics of a particular noise spectrum. The term C_{tr} is used for low frequency noise, such as road traffic, low speed railway traffic, aircraft at large distances and factories which emit low frequency noise.

The façade of the proposed Development would be required to provide sufficient attenuation as to ensure that the guideline internal noise levels as provided in BS 8233 are met. Indicative calculations have been completed to indicate the level of attenuation which the worst affected façade would be required to provide (Table 14). It should be noted that the level of attenuation that the facade would be required to provide would decrease with increasing distance (i.e. height) from the source.

Table 13: Indicative Required Façade Attenuation Levels

Representative Location (Figure 3, Figure 4)	Period	Calculated external facade noise levels (dB(A))*	Internal target noise levels 'good' / 'reasonable' (dB(A))	Required overall façade sound insulation performance (dB $D_w + C_{tr}$)***	Typical glazing performance requirement (dB $R_w + C_{tr}$)****
Eastern Boundary	Daytime	57	30 / 40	27 / 17	25
	Night-time	51	30 / 35	21 / 16	
	Night-time L_{Amax}	70	45	25	
Southern Boundary**	Daytime	56	30 / 40	26 / 16	30
	Night-time	46	30 / 35	16 / 11	
	Night-time L_{Amax}	77	45	32	
Western Boundary	Daytime	56	30 / 40	26 / 16	24
	Night-time	50	30 / 35	20 / 15	
Northern Boundary	Daytime	58	30 / 40	28 / 18	26
	Night-time	52	30 / 35	22 / 17	

Notes:
* Noise levels include a +3dB façade correction.
** Noise levels include the assessment of JS Payne Ltd yard noise and the inclusion of 2.6m barrier.
*** Overall façade performance includes all elements including solid wall construction, glazing and ventilation openings
**** Glazing requirement applicable if equal to or less than 40% glazing to rooms. If a greater percentage of glazing is proposed to rooms, acoustic performance may have to increase.

With glazing in place that would meet the acoustic performance provided in Table 14 and with windows closed the 'good' standard presented in BS8233:1999 would be met. However, when windows are opened, the attenuation afforded by a window can drop to as low as 10dB. Consequently, it will be necessary to provide a form of passive or mechanical ventilation to negate the requirement for residents to open windows for ventilation purposes.

The Building Regulations on ventilation recommend that habitable rooms in dwellings have background ventilation. Trickle ventilators can provide this, and sound attenuating types are available. Where sound insulation requirements preclude opening windows for rapid ventilation and cooling, acoustic ventilation units incorporating fans are available for insertion in external walls; these can provide sound reduction comparable with domestic double glazing.

Where appropriate, the preferred choice of ventilation is through the use of natural ventilation openings, such as trickle vents, air bricks and passive ventilation systems. Such ventilators can be used to meet the requirements of the Building Regulations Approved Document F[7] for background ventilation. The future occupants would then have the option of keeping windows closed for most of the time and opening windows for rapid ventilation and summer cooling.

The Building Research Establishment (BRE) has published an information paper on the acoustic performance of such passive ventilation systems. IP4/99:1999 '*Ventilators: Ventilation and Acoustic Effectiveness*'[8] details a study into the sound reduction performance of fourteen different window mounted trickle ventilators and seven different though wall passive ventilators. The measured sound reduction performance after taking into account flanking sound paths (i.e. sound paths that do not travel directly through the vent) and the effective area of the ventilator were 14-46 dB(A) for 'passive through wall ventilators'.

It can be seen from these figures that trickle vents or passive through wall ventilators are available that meet the requirements of the Building Regulations Approved Document F for background ventilation and also provide sound reduction performance that meets or exceeds that required from the glazing elements.

6.1.1 Noise from Crawford Trading Estate

Given that noise levels are elevated due to operations from JS Payne Ltd to proposed dwellings in the vicinity of measurement location ST1, mitigation measures would be required to attenuate noise breakout from the yard.

Currently the yard to JS Payne Ltd is mostly surrounded by palisade fencing that provides little attenuation of noise. It is recommended that a 2.6m acoustic barrier be erected along the western boundary of the yard along the access road to adequately screen noise egress from operations on and around the yard. As the current ground levels are undulating and drop off toward the service yard of JS Payne Ltd, this barrier should be erected on the elevated part of the intervening ground to ensure optimum screening of noise from the yard. An explanation of this is provided in Appendix C.

The specification of the acoustic barrier would be agreed in writing with Newport Council prior to the commencement of any work however the barrier should have a minimum surface density of 10kg/m^2 and will continue to ground level with no visible gaps underneath or between slats (if a close boarded wooden fence is used).

Constructing a barrier to this effect will ensure that noise levels emitted from the yard result in worst-case BS 4142 assessments levels of marginal significance as indicated in Table 15.

Table 14: BS 4142 Assessment - Western Yard Boundary with 2.6m barrier

Parameter	Noise Level	
$L_{Aeq,T}$ of source at receptor	57	dB(A)
2.6m Barrier correction (see Appendix C)	-11	dB(A)
Background Level ($L_{A90,T}$)	49	dB(A)

[7] Approved Document F Ventilation
[8] IP4/99:1999 '*Ventilators: Ventilation and Acoustic Effectiveness*

Acoustic Feature Correction?	Yes	+5dB(A)
Rating Level	52	dB(A)
Difference to Background $L_{A90,T}$	2	dB(A)

Although the BS4142 results indicate noise levels would potentially still exceed the lowest prevailing background noise levels by 2dB, it is considered that the due to the temporary nature of yard noises from JS Payne Ltd, noise levels when averaged over a one hour period would be in the region of 3dB lower. This is given a typical 50% 'on-time' of yard noises during the day.

As such, the level of mitigation provided is considered appropriate for the development to protect both the amenity of future residents and the on-going operation of JS Payne Ltd once the development is operational.

Night-time L_{max} Levels

Although the TAN 11 criteria of 82dB $L_{Amax,s}$ for external noise levels is met without a barrier in place, consideration is needed for mitigation of $L_{Amax,f}$ levels within proposed dwellings adjacent to the JS Payne site.

The effect of the barrier in place as described above would also have an effective improvement on night-time maximum noise levels received at first floor level of the nearest proposed dwellings to the JS Payne site. The calculation of the reduction in noise levels due to the effect of the barrier can be seen in Appendix C, and equates to a reduction of 7.3dB.

Based on the highest measured $L_{Amax,f}$ level of 84dB, this would mean noise levels are reduced to a maximum external noise level of 77dB $L_{Amax,f}$ and a maximum internal noise level of 42dB $L_{Amax,f}$. This would be under the 45dB $L_{Amax,f}$ internal noise criterion and would be suitable for night-time operation of the JS Payne Site.

7. Conclusions

Waterman was commissioned to undertake an assessment of environmental noise in order to determine the suitability of land at Herbert Road, Newport for residential development.

Noise surveys were carried out between the 21st and 22nd February 2013 during the daytime (07:00 to 23:00) and night-time (23:00 to 07:00) periods. The prevalent noise source during the survey period was noted to be road traffic and rail noise with some localised daytime noise from Crawford Trading Estate.

Monitored noise levels have been assessed against the guidance provided in Technical Advice Note 11 'Noise'. Results of the noise survey indicate that proposed building façades at the boundaries of the site on would fall into NEC B. As some areas of the proposed Development fall into NEC B mitigation measures have been recommended to ensure that a reasonable level of amenity for future residents could be obtained.

Additionally, the potential for night-time operation of adjacent industrial uses has been assessed in terms of the potential for sleep disturbance.

Mitigation measures include the use of a suitable glazing specification and the provision of acoustically attenuated trickle ventilation for the worst affected facades so as to minimise the need for residents to open windows.

A 2.6m acoustic barrier is proposed along the western boundary of JS Payne Ltd, extending to the north of the yard as indicated on Figure 3 and Figure 4.

It is considered that with the proposed mitigation measures in place a good level of amenity could be obtained for all future residents of the proposed Development and as such the proposed Development site would be suitable for residential development

FIGURES

Figure 2: Site Location

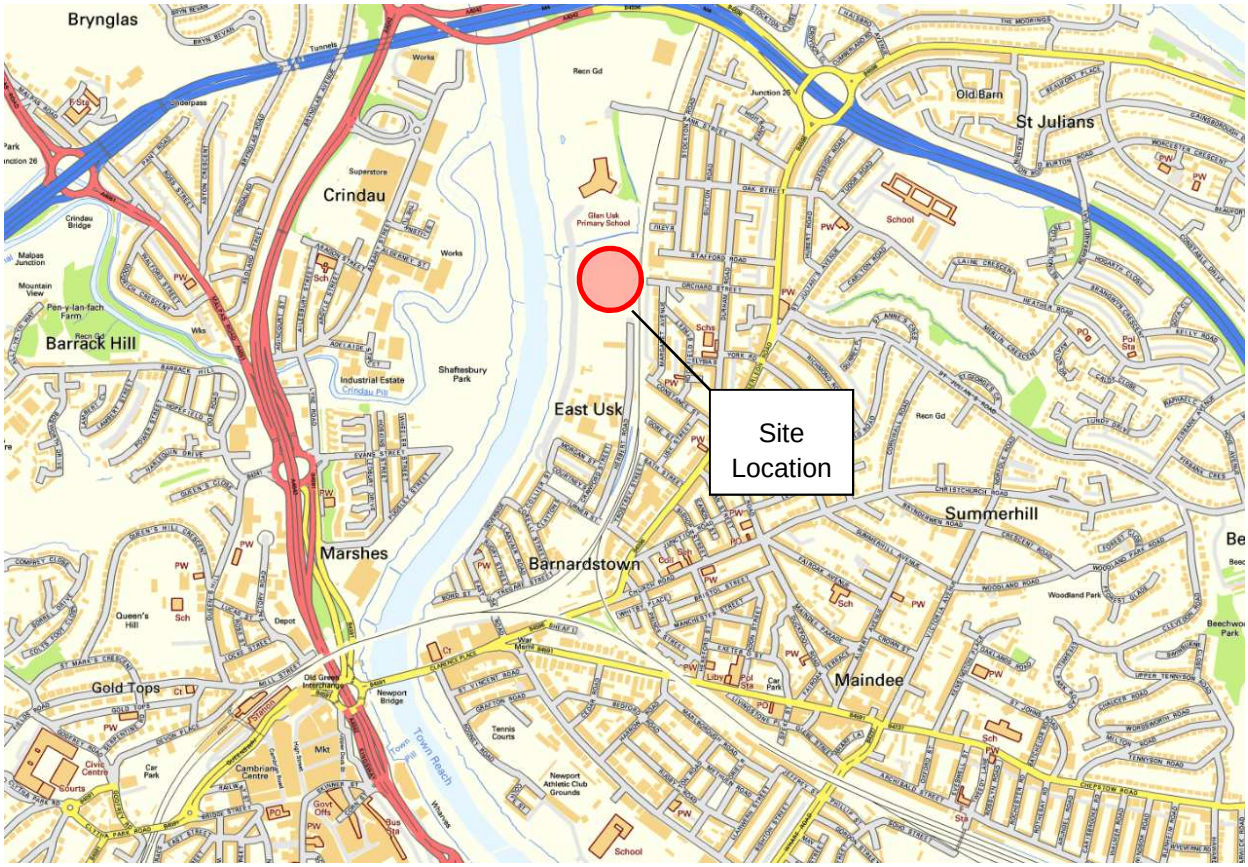


Figure 3: Site layout and Noise Monitoring Locations

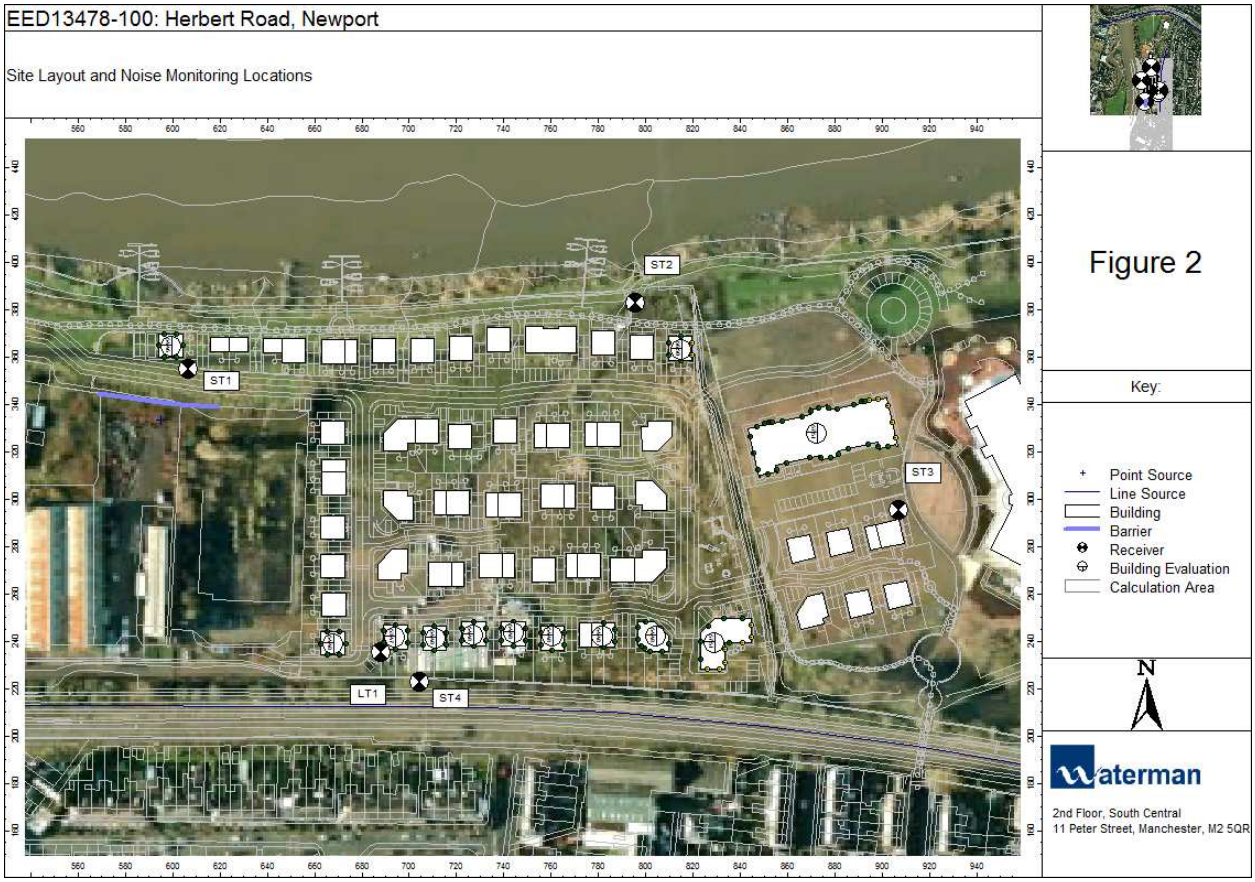


Figure 4: Predicted Noise Levels - Daytime

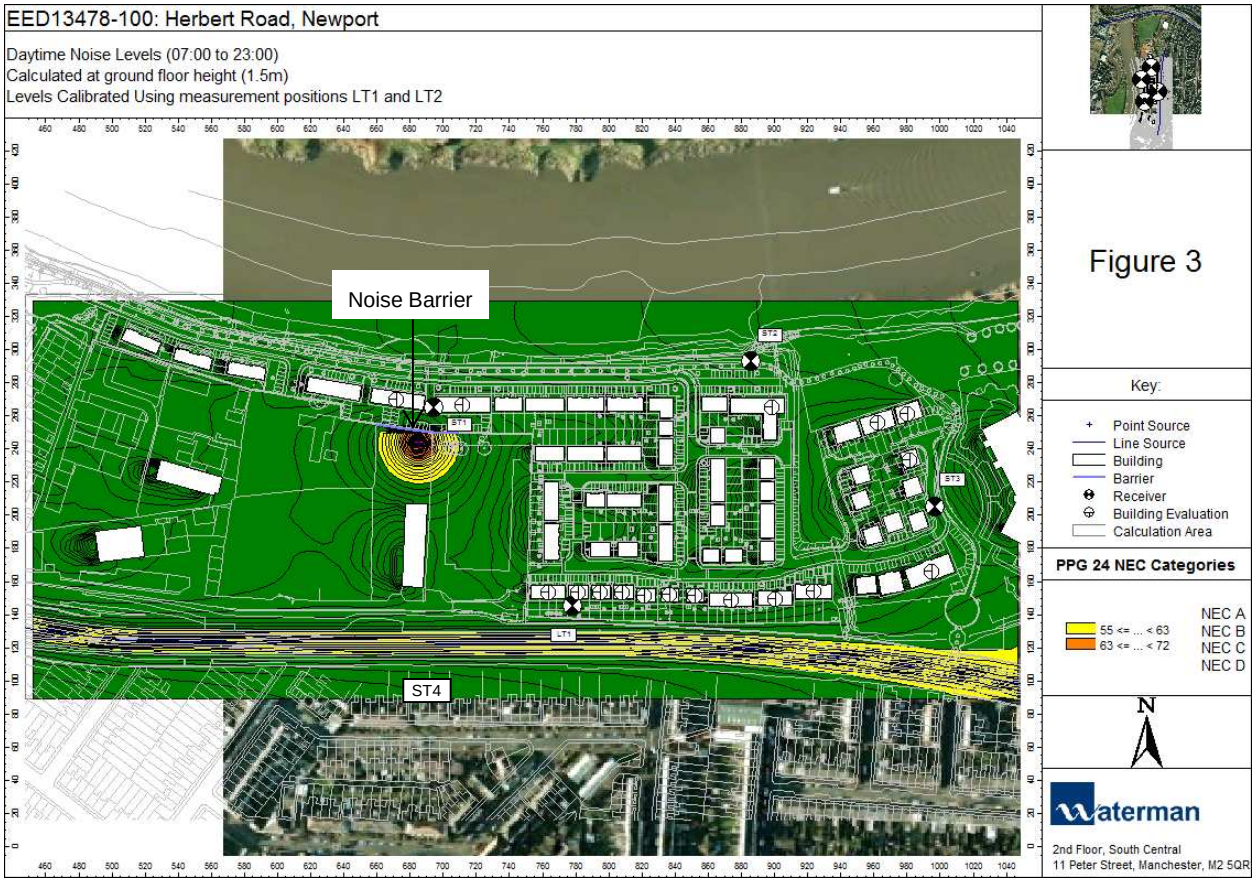
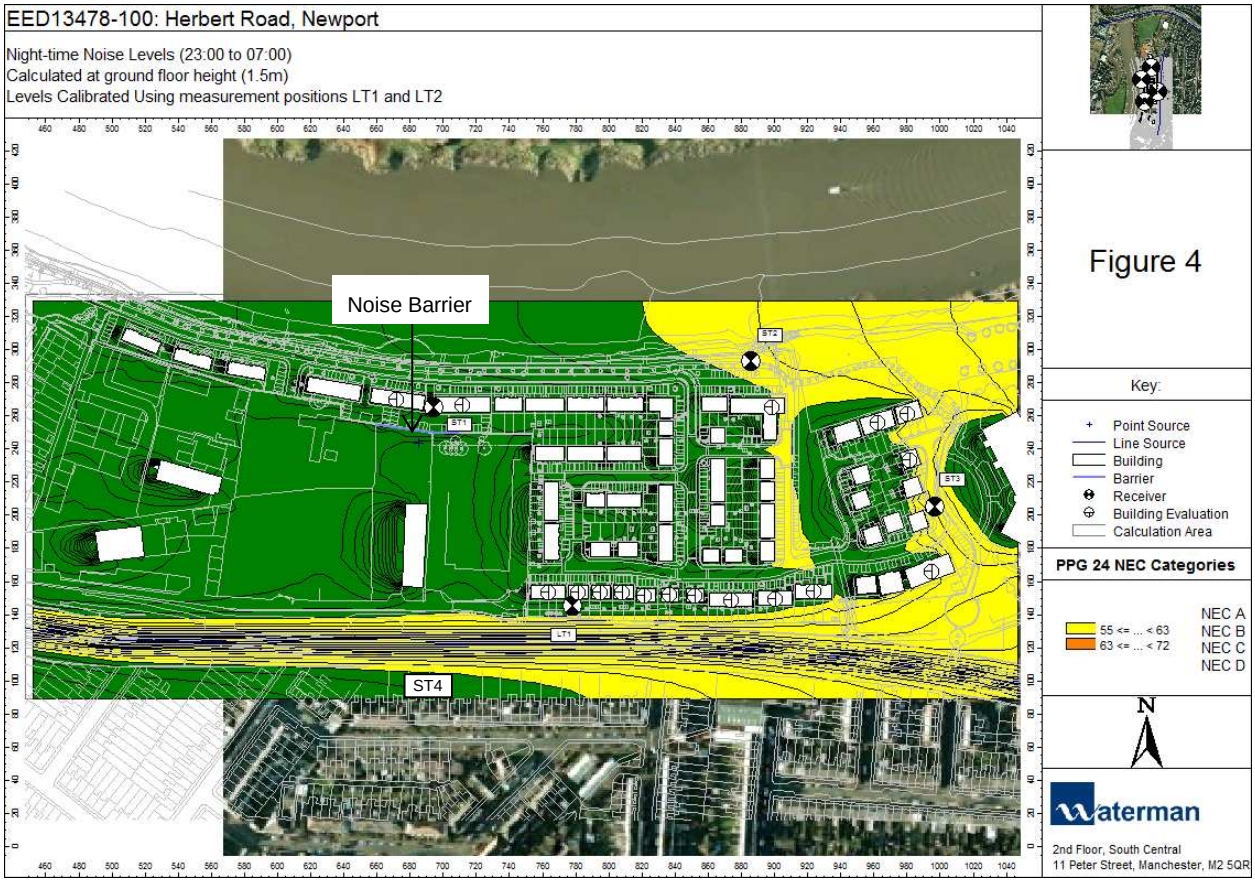


Figure 5: Predicted Noise Levels - Night-time



APPENDICES

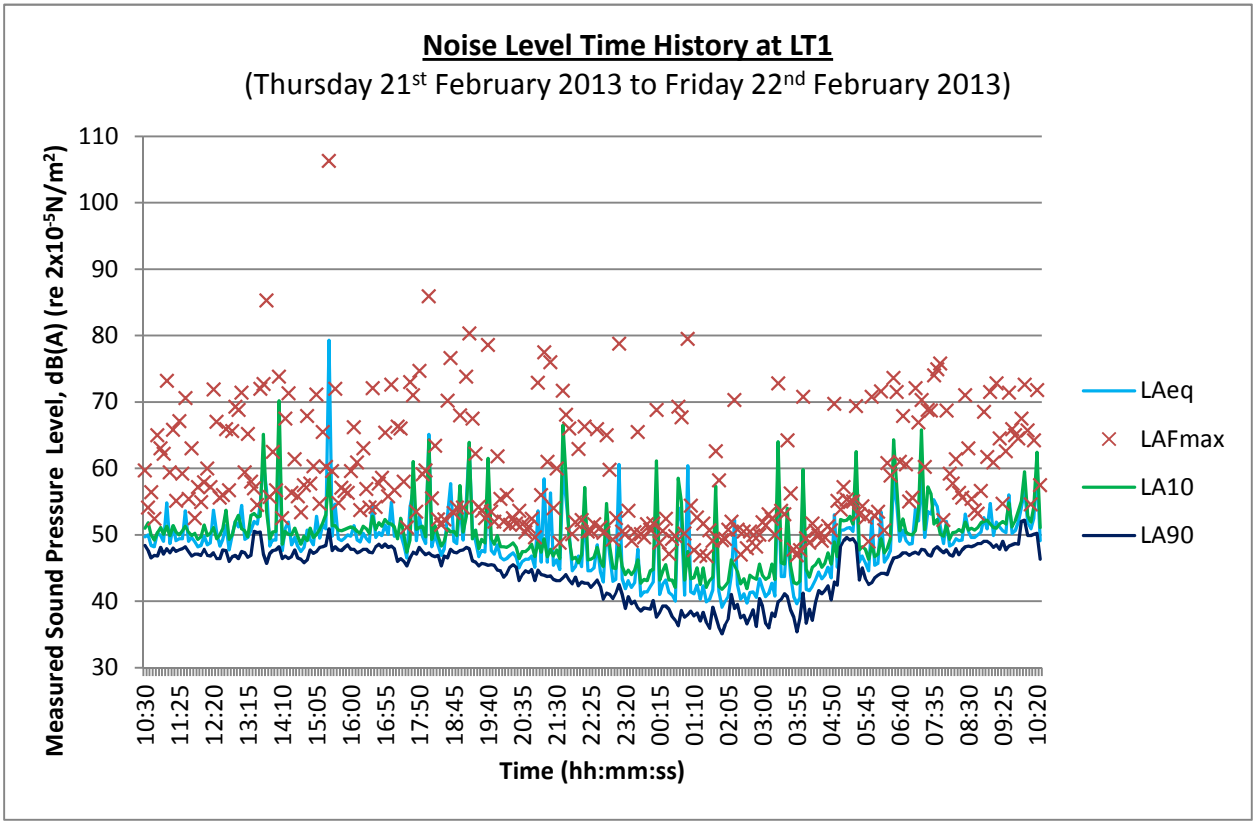
Appendix A Glossary of Acoustic Terminology

Glossary

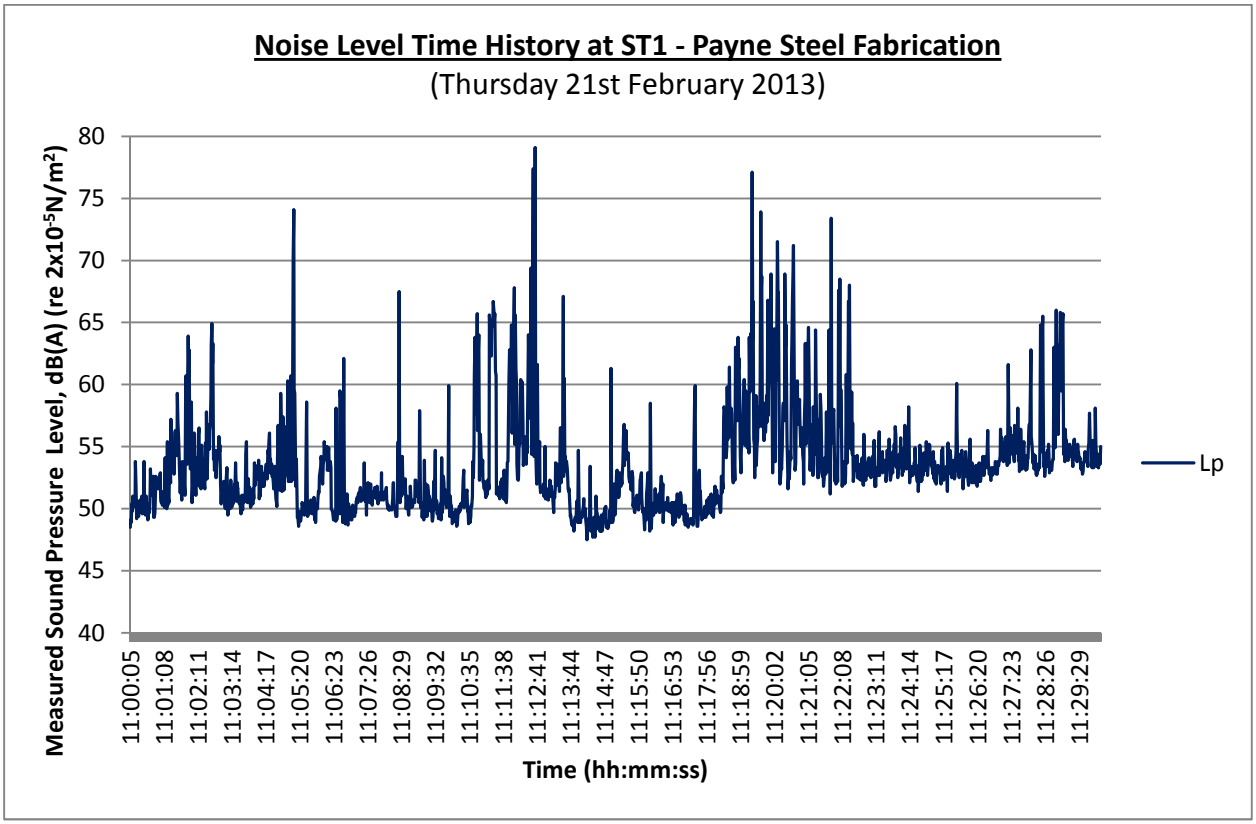
Ambient sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
A-weighting	A frequency weighting applied to measured or predicted sounds levels in order to compensate for the non-linearity of human hearing.
Background noise	Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).
Broadband	Containing the full range of frequencies.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound is heard. The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping. Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day sounds;
dB(A): A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the 'A' filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Do-Minimum	Describes a scenario under which the road scheme that is under consideration does not proceed.
Façade Noise Level	A noise level measured or predicted at the façade of a building, typically at a distance of 1m, containing a contribution made up of reflections from the façade itself (+3bB).

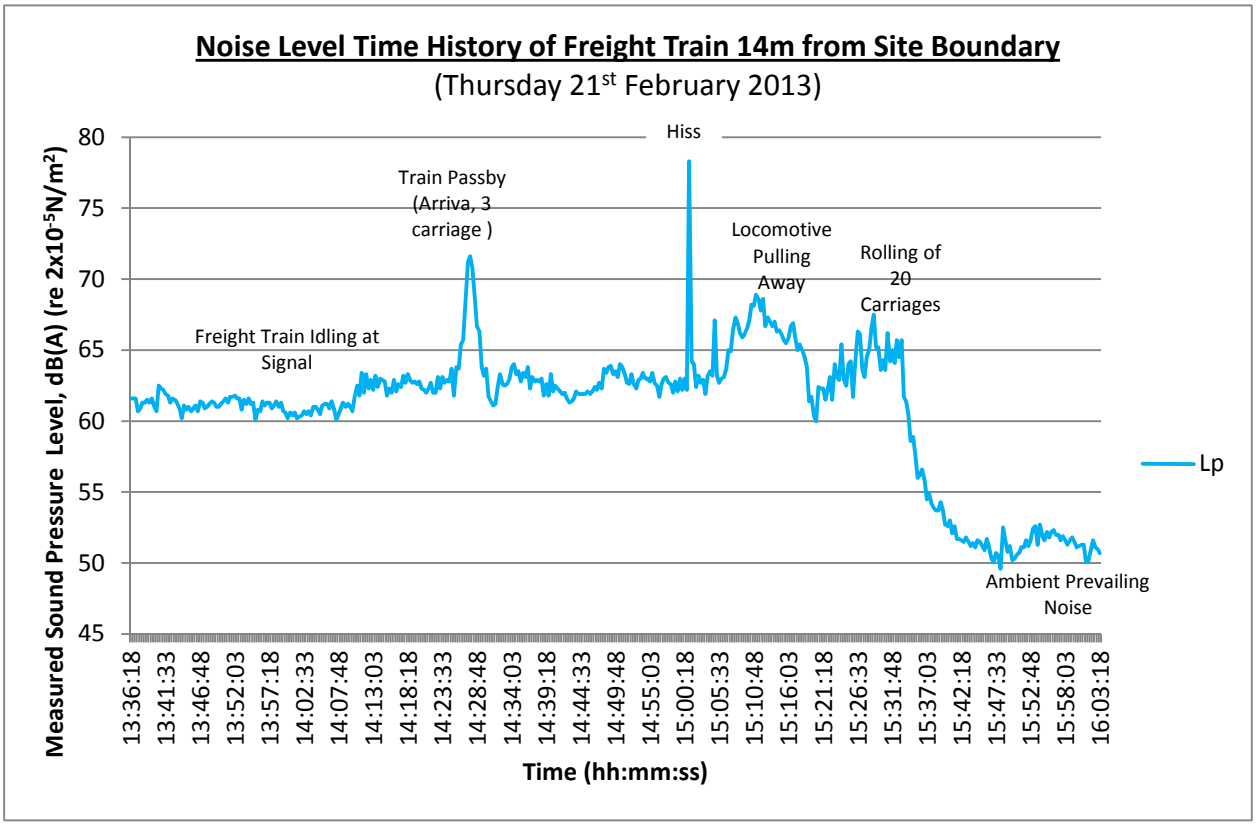
Four engine jet aircraft at 100m	120 dB
Riveting of steel plate at 10m	105 dB
Pneumatic drill at 10m	90 dB
Circular wood saw at 10m	80 dB
Heavy road traffic at 10m	5 dB
Telephone bell at 10m	65 dB
Male speech, average at 10m	50 dB
Whisper at 10m	25 dB
Threshold of hearing, 1000 Hz	0 dB

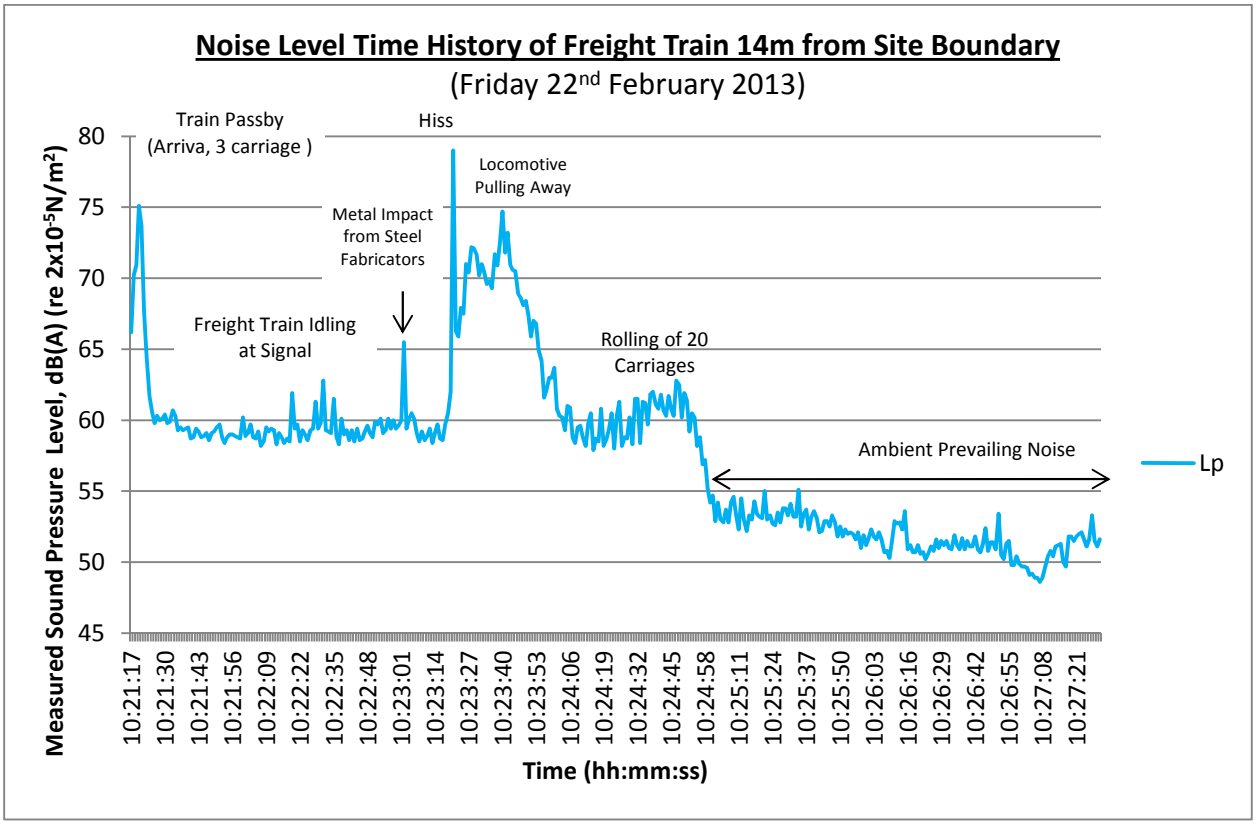
Appendix B Baseline Monitoring Data



							LAFmax	
	Date	Time	Duration	Leq	L10	L90	Max	90pc
ST1	21-Feb	11:00	35min	57	58	49	84	83
	21-Feb	15:00	20min	53	55	49	67	66
	22-Feb	09:50	10min	58	64	54	90	76
				56	**59**	**49**	**90**	**75**
ST2	21-Feb	11:35	30min	52	53	49	68	64
	21-Feb	15:28	30min	53	55	51	70	68
	22-Feb	10:07	10min	53	54	51	60	59
				53	**54**	**49**	**70**	**64**
ST3	21-Feb	12:10	1hr 15min	57	58	51	74	71
	21-Feb	15:45	30min	54	55	52	59	58
	22-Feb	09:20	20min	55	57	52	67	66
				55	**57**	**51**	**74**	**65**

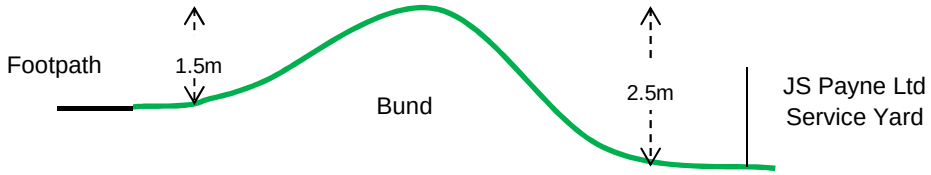

Noise Level Time History at ST1 - Payne Steel Fabrication
(Thursday 21st February 2013)
Measured Sound Pressure Level, dB(A) (re 2x10-5N/m2)
80
75
70
65
60
55
50
45
40
11:00:05
11:01:08
11:02:11
11:03:14
11:04:17
11:05:20
11:06:23
11:07:26
11:08:29
11:09:32
11:10:35
11:11:38
11:12:41
11:13:44
11:14:47
11:15:50
11:16:53
11:17:56
11:18:59
11:20:02
11:21:05
11:22:08
11:23:11
11:24:14
11:25:17
11:26:20
11:27:23
11:28:26
11:29:29
Time (hh:mm:ss)
Lp


Noise Level Time History of Freight Train 14m from Site Boundary
(Thursday 21st February 2013)
Measured Sound Pressure Level, dB(A) (re 2x10-5N/m2)
80
75
70
65
60
55
50
45
Hiss
Train Passby (Arriva, 3 carriage)
Locomotive Pulling Away
Rolling of 20 Carriages
Freight Train Idling at Signal
Ambient Prevailing Noise
13:36:18
13:41:33
13:46:48
13:52:03
13:57:18
14:02:33
14:07:48
14:13:03
14:18:18
14:23:33
14:28:48
14:34:03
14:39:18
14:44:33
14:49:48
14:55:03
15:00:18
15:05:33
15:10:48
15:16:03
15:21:18
15:26:33
15:31:48
15:37:03
15:42:18
15:47:33
15:52:48
15:58:03
16:03:18
Time (hh:mm:ss)
Lp


Noise Level Time History of Freight Train 14m from Site Boundary
(Friday 22nd February 2013)
Train Passby
(Arriva, 3 carriage)
Hiss
Locomotive
Pulling Away
Metal Impact
from Steel
Fabricators
Freight Train Idling
at Signal
Rolling of 20
Carriages
Ambient Prevailing Noise
Lp
Measured Sound Pressure Level, dB(A) (re 2x10-5N/m2)
80
75
70
65
60
55
50
45
10:21:17
10:21:30
10:21:43
10:21:56
10:22:09
10:22:22
10:22:35
10:22:48
10:23:01
10:23:14
10:23:27
10:23:40
10:23:53
10:24:06
10:24:19
10:24:32
10:24:45
10:24:58
10:25:11
10:25:24
10:25:37
10:25:50
10:26:03
10:26:16
10:26:29
10:26:42
10:26:55
10:27:08
10:27:21
Time (hh:mm:ss)

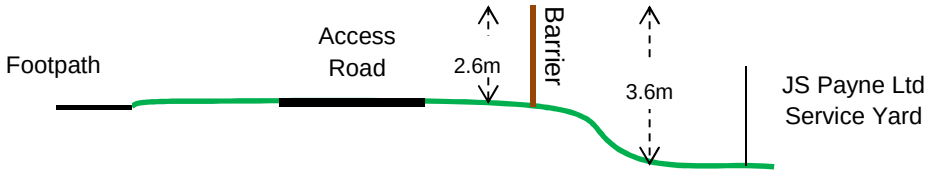
Appendix C Acoustic Calculations

Estimation of current intervening ground levels to the rear of JS Payne Ltd:



It is expected that the development would require the intervening bund between the existing footpath and the service yard of JS Payne Ltd to be removed to make way for the main access road from Collier Street. As such it is estimated that a height difference of 1m would remain between ground level of the service yard and ground level at the nearest proposed dwelling. The 2.6m barrier should be constructed on the raised ground level to ensure optimum noise attenuation to the yard activities.

Estimation of proposed intervening ground levels to the rear of JS Payne Ltd:

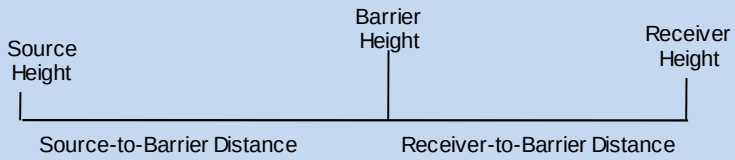


BASIC BARRIER ATTENUATION

(Based on Maekaw a or CRTN)

Project: Herbert Road Newport

Source: JS Payne Ltd **Receiver:** Nearest proposed residential dwelling



Ground height at:		Height above ground level:	
Source	0 m	Source	0.5 m
Receiver	1 m	Receiver	1.5 m
Barrier	1 m	Barrier	2.6 m

Source-to-Barrier Distance	15.0 m	Path Difference	0.236 m
Receiver-to-Barrier Distance	20.0 m	Shadow or Illumunated?	Shadow

Frequency (Hz)	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation (dB)	**6.7**	**8.1**	**9.9**	**12.2**	**14.8**	**17.6**	**20.5**	**23.5**	**11.2**

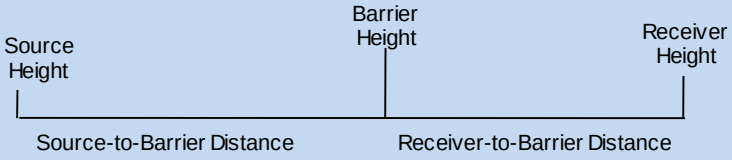
BASIC BARRIER ATTENUATION

(Based on Maekaw a or CRTN)

Project: Herbert Road Newport - Night

Source: Js Payne Ltd

Receiver: Nearest proposed residential dwelling



Ground height at:		
	Source	0 m
	Receiver	1 m
	Barrier	1 m

Height above ground level:		
	Source	0.5 m
	Receiver	4.5 m
	Barrier	2.6 m

Source-to-Barrier Distance	15.0 m
Receiver-to-Barrier Distance	20.0 m

Path Difference	0.025 m
Shadow or Illumunated?	Shadow

Frequency (Hz)	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation (dB)	**6.7**	**8.1**	**9.9**	**12.2**	**14.8**	**17.6**	**20.5**	**23.5**	**7.3**

BS8233 Calculation of Noise Breakin

Project Number: EED13478-100

Description: Proposed Flats Adjacent to JS Payne Ltd

Consultant: JL

Term	Term Description	Value
S_f	Façade area (incl. window) (m^2)	13.0
S_{wi}	Area of the windows (m^2)	3.0
S_{rr}	Area of the ceiling (m^2)	0.0
S_{ew}	Area of the external wall (m^2)	7.8
S	Area of facade and roof	13.0
x	Room Dimension x	5.0
y	Room Dimension y	4.0
z	Room Dimension z	2.4
RT	Receiving Room RT	0.5
K	Façade correction	0.0

SRI of ceiling/roof not present in calculation

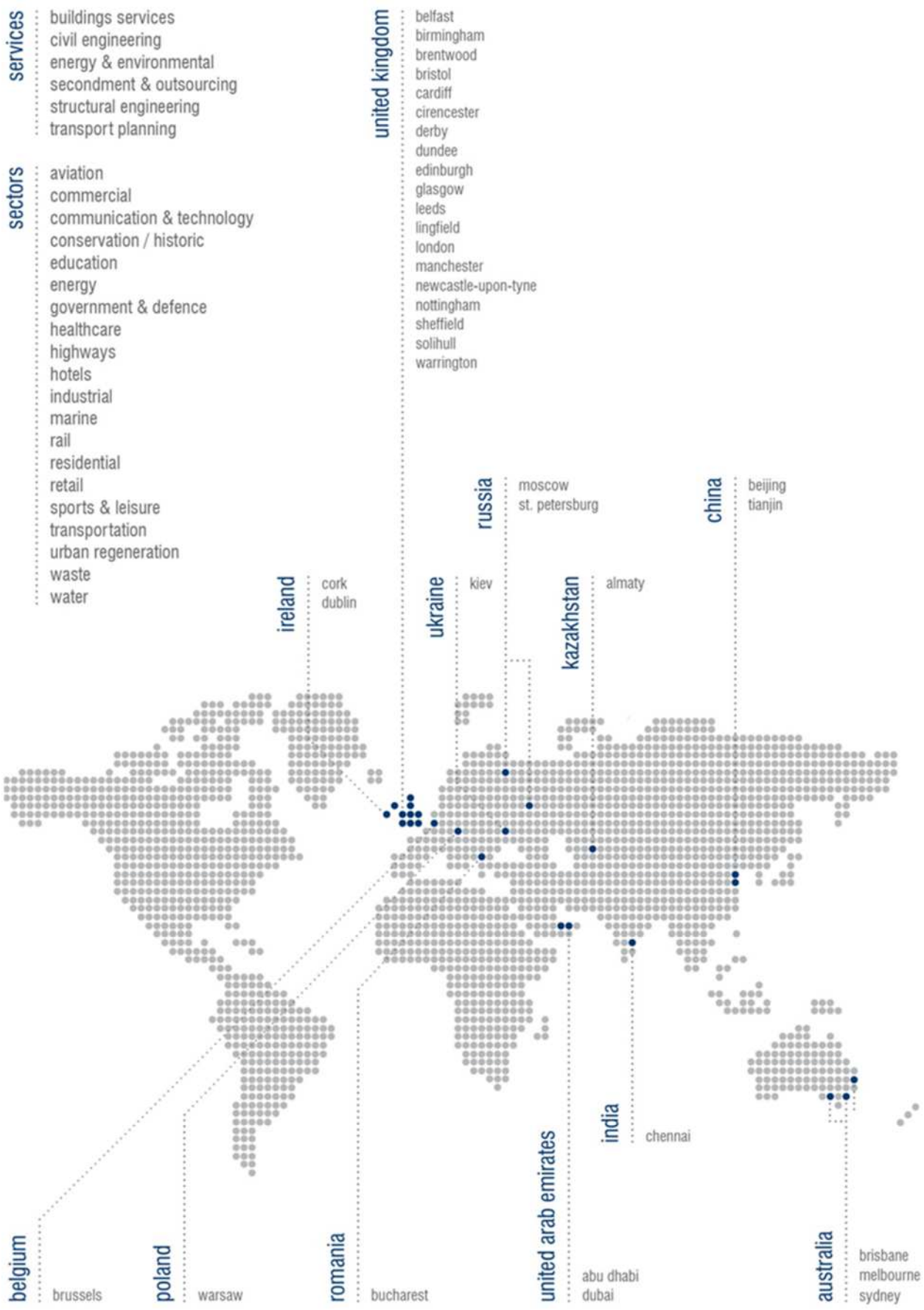
BS8233 Result 49 dB(A)

	Term	Term Description	Description	Octave Band Centre Frequency 63	125	250	500	1000	2000	4000	8000	Broadband
A	Leq,ff	Free-field Leq outside room	Enter the Octave Band LAmax Data	71	65	65	75	83	74	67	54	84
	Dn,e	Insulation of the trickle vent	Hit and miss trickle vent (from Draft Part E)	29	34	39	34	41	31	28	24	
B		$\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}}$										
	Rwi	SRI of the window	10:12:6 mm	21	26	27	34	40	38	46	46	
C		$\frac{S_{wi}}{S} 10^{\frac{-Rwi}{10}}$										
	Rew	SRI of the external wall	BS8233 Example - Brick and block external wall	100	40	44	45	51	56	100	100	
D		$\frac{S_{ew}}{S} 10^{\frac{-Rew}{10}}$										
	Rrr	SRI of roof/ceiling										
E		$\frac{S_{rr}}{S} 10^{\frac{-Rrr}{10}}$										
F		10log(B + C + D + E)		-24	-29	-30	-33	-40	-32	-29	-25	
	A	Equivalent Absorption Area	$\frac{0.161\ V}{RT}$ (Includes RT rise at low frequency)	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	
G		10log(S/A)		-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	

L_{eq} Results

Term	Term Description	Octave Band Centre Frequency 63	125	250	500	1000	2000	4000	8000	Broadband
$L_{eq,2}$	Level in the receiver room (includes façade correction +3dB - K)	49	39	37	44	45	45	40	31	**53**
	A-weighting	-26	-16	-9	-3	0	1	1	-1	
$L_{Aeq,2}$	A-weighted Level in the receiver room	23	23	28	41	45	46	41	30	**50**

waterman


services
buildings services
civil engineering
energy & environmental
secondment & outsourcing
structural engineering
transport planning
sectors
aviation
commercial
communication & technology
conservation / historic
education
energy
government & defence
healthcare
highways
hotels
industrial
marine
rail
residential
retail
sports & leisure
transportation
urban regeneration
waste
water
united kingdom
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brentwood
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