Assessment of industrial sound impact from proposed shear at EMR Tyne Dock, South Shields, NE34 9PL on residential dwellings

Provided by MAS Environmental Ltd

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2.0 Introduction and Background

2.1 MAS were commissioned by European Metal Recycling Ltd ("EMR") to independently undertake a noise impact assessment for the proposed installation of fixed industrial plant at EMR Tyne Dock, South Shields. The proposed industrial plant comprises of a metal shear powered by a diesel generator (enclosed within plant casing).

2.2 MAS were asked specifically to consider the impact of noise from the shear on existing dwellings within the locality. The site operates and exists as a Scrap Metal Export site where noise from tipping, loading and reloading metals is expected. The site currently stores metals in preparation for ship loading at the dockside.

2.3 All scrap metal currently handled at the site has been processed elsewhere. I understand the intention of the planning application is to allow the sorting and processing of mixed scrap metal on part of the site. The application also seeks the instillation of a shear.

2.4 The proposed shear acts as a guillotine to cut and compress metals to produce internationally recognised grades of metal. The installation of the shear has the potential to intensify activity and generate additional noise from preparation and loading of the shear. This report considers the potential for new activity associated with the shear to affect residential amenity.

2.5 Noise measurements were undertaken adjacent the eastern boundary with the residential street Temple Town on two separate occasions. Measurements were targeted between 10am and 2pm outside of busier road transport periods. The measurements were conducted to acquire ambient/residual[1] and background sounds

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[1] A glossary of acoustic terms is provided in appendix 1.

levels including sound from existing operations at EMR Tyne Dock. Attended noise measurements were undertaken to characterise and identify different sources of ambient sound.

2.6 Noise modelling has been undertaken to predict impact on noise sensitive receptors on Temple Town to the east and Dock Street to the south east at ground, first, second and third floor level[2].

2.7 Mitigation measures have been considered using internationally recognised noise modelling software and incorporated into the development to ensure an acceptable acoustic environment / soundscape for existing residents. The mitigation measures primarily minimise industrial noise impact from the shear but also general metals handling within parts of the site towards the western boundary (i.e. provides acoustic planning gain).

2.8 Noise mitigation concentrates on maximising distance attenuation (air absorption and geometrical spreading over distance) to the nearest dwellings, localised screening adjacent the shear and existing close proximity to large industrial buildings to provide additional screening to the south east.

2.9 This report summarises the findings of noise surveys by MAS, noise modelling methodology including derivation of specific sound levels and necessity for noise mitigation measures. The MAS noise surveys assist the formulation of an appropriate noise prediction model and determine the level of noise mitigation for the proposed shear plant on existing dwellings. The noise mitigation scheme is shown by fig 7-1 within section 7.

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[2] Dock Street only.

3.0 Objectives

3.1 The main objective is to establish the existing sound climate at existing noise sensitive receptors (dwellings) including the A-weighted (dBA) Leq[3] and L90[4] (background environment) sound levels. This process is complete based on two visits/surveys by MAS in 2015 and historic noise monitoring of shear activity at other EMR sites.

3.2 A secondary objective is to establish a representative prediction of the likely typical worst case noise levels from the operation of the shear.

3.3 The report aims to:

- Establish a representative snapshot of existing ambient and background sound levels adjacent the closest residential dwellings
- Establish a representative snapshot of 'typical worst case' specific sound levels from EMR (based on predictions using measurements of fixed plant at other EMR sites measured by MAS)
- Predict sound levels from EMR at ground and first floor level at the nearest noise sensitive receptors using recognised noise modelling software based on international (ISO) standards
- Identify mitigation measures required to achieve acceptable industrial sound levels at existing residential dwellings in the context of national government planning and noise policy

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[3] Average equivalent sound energy levels.

[4] Statistical value used to reflect background noise, it is the quietest 10% of sound.

4.0 Planning policy and guidance

4.1 National planning (and noise) policy is evolving with a range of terms used to help define impact. The terms are open to interpretation and the relevant criteria will vary based on the characteristics of the acoustic environment and locality. This is true for assessing noise impact from industrial sound (i.e. site specific industrial noise with character) where background sound levels, and industrial sound character, can vary considerably and affect assessments of noise perceptibility and, invariably, acceptability.

4.2 Transport related noise is assessed applying a different methodology to industrial noise and typically through the application of fixed or absolute noise limits (i.e. longer term LAeq,T and short term LAmax) considered appropriate to avoid health effects. It is recognised by the World Health Organisation (WHO) that the impact of equal levels of anonymous transportation noise and site specific industrial noise with character (neighbourhood noise), result in unequal levels of impact. The main phrases from planning policy and guidance are used below and summarised in table 1 later in this section.

4.3 National planning policy framework

4.4 Regarding noise, the NPPF confirms at paragraph 123 planning decisions should aim to:

- 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[5].

4.5 The first and second sentences in paragraph 123 of the NPPF above refer to the explanatory note to the Noise Policy Statement for England 2010 (NPSE) by DEFRA which is considered below.

4.6 Noise Policy Statement for England[6]

4.7 The Noise Policy Statement for England (NPSE) applies to all noise apart from workplace (occupational) noise. The vision contains the following aims:

- avoid significant adverse impacts on health and quality of life from noise,

- mitigate and minimise adverse impacts on health and quality of life from noise and

- where possible contribute to the improvement of health and quality of life.

[5] Department for Communities and Local Government, 2012. National Planning Policy Framework. DCLG: London. Page 29.

[6] Department for Environment, Food and Rural Affairs, 2010. Noise Policy Statement for England (NPSE). DEFRA: London.

4.8 The NPSE introduces concepts from toxicology that have been applied to noise impact. These are described on page 8 and 9 of the NPSE as:

- **NOEL / No Observed Effect Level** - this is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

- **LOAEL / Lowest Observed Adverse Effect Level** - this is the level above which adverse effects on health and quality of life can be detected.

4.9 Extending these concepts for the purpose of this NPSE then leads to the concept of a significant observed adverse effect level.

4.10 **SOAEL / Significant Observed Adverse Effect Level** - this is the level above which significant adverse effects on health and quality of life occur.

4.11 The following explanatory points are taken directly from page 9 of the NPSE.

4.12 "The first aim of the Noise Policy Statement for England

4.13 Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

4.14 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development (paragraph 1.8).

4.15 "The second aim of the Noise Policy Statement for England

4.16 Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

4.17 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.

4.18 "The third aim of the Noise Policy Statement for England

4.19 Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

4.20 This aim seeks, where possible, to positively improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development (paragraph 1.8), recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

4.21 The aims of the NPSE are directly referenced within the planning practice guidance notes for noise.

4.22 Planning practice guidance for noise[7]

4.23 The PPG for noise outlines a number of considerations relevant to the assessment of noise impact from development. This includes new development affecting existing dwellings or new dwellings that are affected by existing sources of noise. Paragraph 002 of the guidance note identifies LPAs' should consider:

- *"whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved."*

4.24 The PPG refers to observed effect levels which are taken from the NPSE. These are described in paragraph 004 of the guidance note below:

4.25 "Observed Effect Levels

4.26 **Significant observed adverse effect level**: This is the level of noise exposure above which significant adverse effects on health and quality of life occur.

4.27 **Lowest observed adverse effect level**: this is the level of noise exposure above which adverse effects on health and quality of life can be detected.

4.28 **No observed effect level**: this is the level of noise exposure below which no effect at all on health or quality of life can be detected."

4.29 The PPG (paragraph 005) describes how to recognise when noise could be a concern. Reference is made to a scale with the lowest

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[7] Department for Communities and Local Government, 2014. Accessed at http://planningguidance.planningportal.gov.uk/blog/guidance/noise/noise-guidance/

point being noise that is not noticeable causing any effect. The extreme of the scale is noise exposure that is noticeable and very disruptive and would cause extensive and sustained changes in behaviour without an ability to mitigate the effect of noise. There are then three additional perceptions of noise impact which are noticeable and not intrusive, noticeable and intrusive and noticeable and disruptive.

4.30 Table 1[8] below shows a summary of the noise exposure hierarchy based on the likely average response:

Table 1 Noise exposure hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

4.31 Paragraph 006 of the PPG outlines the factors that influence an assessment of whether or not noise could be a concern. The guidance correctly identifies the subjective nature of noise means

8 Paragraph 005 of the NPPG. Accessed at http://planningguidance.planningportal.gov.uk/blog/guidance/noise/noise-guidance/

there is not a simple relationship between noise levels and impact on those affected. In summary, the factors include:

- The source and absolute level of noise together with the time of day it occurs
- For non-continuous noise, the number of noise events, and the frequency and pattern of occurrence of the noise
- The spectral content of the noise and the general character of the noise

4.32 The PPG provides specific guidance on noise that should be considered for new development and relates observed effects to perception and changes in attitudes and behaviour. Such considerations are consistent with the assessment of statutory nuisance[9] and identify how absolute decibel levels do not directly relate to impact. The character of noise is considered important by the PPG.

4.33 Noise impact assessment

4.34 The Guidelines for Environmental Noise Impact Assessment 2014[10] (IEMA) outline the key principles of noise impact assessment and how a noise impact assessment contributes within the environmental impact assessment process. At an early stage all potential noise sources that may arise from the development should be identified. Characterisation and understanding of the existing (baseline) noise environment should be achieved before assessing the impact of proposed noise sources.

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[9] When applied to site specific noise and not anonymous transportation noise.

[10] Institute of Environmental Management and Assessment (IEMA) *Guidelines for Environmental Noise Impact Assessment.* Lincoln: IEMA.

4.35 The guidelines note that noise impact can rarely be determined simply by the numerical difference in the value of a noise indicator and that other factors such as the type of noise source and the nature of the change should be considered. There is also discussion on use of the appropriate indicators to describe the noise source, for example an LA10 might increase only slightly but the LA90 (background noise level) might increase significantly. This indicates a change that would most likely be noticed by residents and could have an adverse effect.

4.36 The noise impact caused by development can be both adverse and beneficial. The EIA process requires the magnitude and significance of impact to be assessed and this is summarised in table 7-7 of the IEMA guidelines and is abbreviated in the table below.

4.37 Table 7-7 Generic relationship between noise impact (magnitude) and noise effect (magnitude + sensitivity) including the evaluation of effect significance

Magnitude (nature of impact)		Description of effect	Significance
Substantial	Beneficial	Marked change - Quality of life enhanced due to change in character of area.	More likely to be significant
Moderate	Beneficial	Noticeable improvement - Improved noise climate resulting in small changes in behaviour and attitude.	
Slight	Beneficial	Just noticeable improvements - Noise impact can be heard but does not result in any change.	Less likely to be significant
Negligible		No discernible effect on receptor.	Not significant
Slight	Adverse	Non-intrusive - Noise impact can be heard but does not cause any change in behaviour or perceived quality of life.	Less likely to be significant
Moderate	Adverse	Intrusive - Noise impact causes small changes in behaviour - potential for non awakening sleep disturbance, perceived change in quality of life.	
Substantial	Adverse	Disruptive - Material change in behaviour e.g. avoidance behaviours, potential for sleep disturbance, quality of life diminished due to change in character of area.	More likely to be significant
Severe	Adverse	Physically harmful - Significant changes in behaviour, psychological stress, physiological effects.	Significant

4.38 There are overlaps between table 7-7 above and the noise exposure hierarchy from the NPPG. The NPPG concentrates only on the adverse magnitude of impact. The IEMA guidelines also refer to the beneficial changes in noise impact and effect.

4.39 Noise impact may be assessed with reference to the above table, in part, enabling an understanding of the suitability of the area for development to be determined. However, before any detailed assessment of the development can be considered, impact using other indices and procedures under relevant guidance is required.

4.40 Industrial noise

4.41 Details of noise guidance used to assess industrial noise was previously outlined in PPG24[11] and BS4142 1997 Method for rating industrial noise affecting mixed residential and industrial areas. In the absence of specific planning policy guidance on industrial noise, I consider the principles established in the former PPG24 remain a useful aide to assess and determine noise acceptability in this case.

4.42 Former Planning Policy Guidance 24: Planning and Noise

4.43 Planning Policy Guidance 24 (PPG24) was withdrawn in 2012 and replaced with the NPPF. PPG24 outlined the considerations to be taken into account when determining planning applications both for noise-sensitive developments and those which generate noise. The concept remains valid.

4.44 PPG24 described how the planning system could be used to minimise the adverse impact of noise without placing unreasonable restrictions on development and business. The concept remains valid.

4.45 For industrial noise, PPG24 advised the NEC[12] noise levels should not be used for assessing the impact of existing industrial noise on proposed residential development apart from where the industrial noise was not dominant. However, the NEC levels are / were not applicable to these sources of industrial noise that are, at times, noticeable in comparison to the residual sound environment.

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[11] Policy Guidance 24: Planning and Noise (PPG24)

[12] Noise Exposure Categories

4.46 In addition, PPG24 stated that "the likelihood of complaints about noise from industrial development can be assessed, where the Standard is appropriate, using guidance in BS4142:1990". It also directs the assessor to BS8233 1999 but this standard advises BS4142 1997 should be used for assessing industrial noise, which remains valid albeit both British Standards were updated in 2014.

4.47 The quote from PPG24, taken from Annex 3 paragraph 19, is confusing to many and has been misinterpreted by some to imply BS4142 1997 may only be used to assess the impact of new commercial and industrial activity on existing dwellings. This is considered inappropriate by MAS and the assessment methodology is applicable to new dwellings near to existing sources of industrial noise. This is also confirmed within the scope to BS4142 2014 Methods for rating and assessing industrial and commercial sound (BS4142 2014).

4.48 BS4142 2014 Methods for rating and assessing industrial and commercial sound

4.49 The standard relates to the assessment of sound of an industrial or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling (or dwellings used for residential purposes). The standard is applicable for the determination of rating levels (specific sound plus penalties for inherent acoustic features), ambient, background and residual sound levels.

4.50 The standard is used, in this case, to assess predicted sound levels at proposed dwellings upon which industrial sound is incident. Given the character of sound from the coal yard and proposed residential use of the development, the standard is directly applicable to the circumstances of this case.

4.51 In summary BS4142 2014:

- Compares the specific sound averaged over an hour during the day and 15 minutes at night to the background sound level in the area (obtained in the absence of the specific sound source).

- Identifies this (relative) comparison method as a recognised way of evaluating intrusive sound generally and not just from industrial sources.

- Applies different decibel penalties (see table 2 below) to sound which has inherent features / characteristics. This supports the importance of character in the assessment of noise perceptibility i.e. likely annoyance response.

- Identifies methods for measuring sources of industrial sound and calculating their level. It also identifies methods for measuring and determining the ambient, residual and background sound level.

- Identifies at initial assessment that a positive indication of an adverse impact is likely when the rating sound level exceeds the background sound level by around 5dB (depending on the context - see table 3 below)

- Identifies at initial assessment that a positive indication of significant adverse impact is likely when the rating sound level exceeds the background sound level by around +10dB (depending on the context).

- Advises an initial estimate of impact should be modified due to the context and take all pertinent factors into consideration including the absolute level of sound, character and level of the residual sound compared to the character and level of the specific sound and consider the sensitivity of the receptor and the incorporation of design measures that secure good internal and/or outdoor conditions.

4.52 Table 4-1 below provides an overview of the possible acoustic penalties to be applied to the specific sound level (where applicable).

Table 4-1 Acoustic feature corrections

Acoustic features	Perception of audibility			Correction applied
	Just	Clearly	Highly	
Impulsivity	+3	+6	+9	**0, +3, +6 or +9dB**
Tonality	+2	+4	+6	**0, +2, +4 or +6dB**
- - - - - - - - - - OR - - - - - - - - - -				
Other sound characteristics	+3dB			**0 or +3dB**
Intermittency	+3dB			**0 or +3dB**

4.53 Penalties for impulsivity and/or tonality are applied to the specific sound level. Where the specific sound does not contain impulsive or tonal features, a penalty for other sound characteristics and/or intermittency may be applied. I understand it is technically incorrect to add all the penalties cumulatively to a single source of industrial sound i.e. the maximum penalty = +15 for highly impulsive and tonal noise or +3dB for other sound characteristics and/or +3dB for intermittency (total = +6dB). The penalties applicable will vary in each case depending on the prominence of the acoustic features present within the sound.

4.54 Table 4-2 below provides an overview of the assessment of impacts and initial estimate of impacts following the subtraction of the background sound level from the rating level (specific sound + acoustic penalties).

Table 4-2 Assessment of impacts	
Rating level minus background sound level	**Estimate of impact**
Typically the greater this difference the greater the magnitude of impact	
Difference of around +10dB or more	Indication of significant adverse impact, depending on context
Difference of around +5dB	Indication of an adverse impact, depending on context
The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound sources will have an adverse impact or significant adverse impact. A rating level below the background sound level indicates low impact depending on context	

4.55 Acceptable planning criteria for industrial noise

4.56 Historically, a large proportion of local authorities based acceptable noise criteria for industrial noise impact at dwellings on a BS4142 1997 excess of rating level over background noise level. Neither national planning guidance nor BS4142 1997 set a definitive noise level for this type of development but most local planning authorities set a rating level[13] limit equal to the background noise level or up to 5dB above that point. Commonly a complaint prediction level of between 0-3dB above the background noise level was applied which was consistent with the level applied by the Environment Agency (EA) in their horizontal guidance from 2002.

4.57 The evolution of planning guidance and update to BS4142 (2014) has arguably changed the limits of acceptability in some cases but not others depending on the context and inherent acoustics features of different types of industrial noise i.e. some situations will now be shown to be acceptable and some unacceptable compared to the previous standard. In this case the assessment, using worst case predicted sound levels against typical worst case background sound levels, shows the initial assessment levels fall below a point of adverse impact (i.e. below an excess of rating level of background sound level of +5dB). This is equivalent to a complaint prediction level of 0dB when compared to BS4142 1997[14]. This is up to 3dB lower than a commonly applied, albeit now historic, limit applied by local authorities and the EA.

4.58 Note, the penalty for impulsivity applied to all assessments assumes the acoustic feature will be highly audible at existing dwellings. This is considered conservative as the perceptibility within dwellings will be lower than externally. However, the principle of BS4142 historically is to consider the impact internally through the assessment of noise externally. The impulsive characteristics from metals handling and associated impacts are the dominant acoustic feature here. Sound from HGV engines can be tonal but of less significance to the highly perceptible features of impulsive noise. No penalty for tonality is considered necessary[15]. The inclusion of penalties for impulsivity effectively excludes the application of

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[13] Rating level is the average ('specific') noise source decibel level plus the 5dB character penalty, applicable in this case.

[14] **EXAMPLE BS4142 2014**. Specific sound (31-47) + 9dB penalty applied in this case = (40-56) - 52-59 = **-**19 to **+4dB**. **EXAMPLE BS4142 1997** Specific noise + 5dB penalty applied in this case = (31-47) + 5 - 52-59 = -23 to **0dB**.

[15] See also BS4142 2014 section 9.2 note 2 on the use of rating level penalties.

penalties for other sound characteristics and intermittency which could apply to the specific sound source in this case.

4.59 Note, the objective measure of impulsivity is dependant on the onset rate and level difference. As impulsive sound propagates away from the shear and towards dwellings the sound energy reduces due to distance and air absorption. The level difference (difference between residual sound and impulsive sound peak) also reduces meaning it is unlikely to be perceived as highly impulsive at a distance of over 450m. The application of penalties explained further in section 8.

4.60 The criteria adopted by MAS is considered reasonable and provides a robust approach to the assessment of noise exposure over a typical worst case hour of industrial sound relative to the perceptibility and likely acceptability of existing residents in the context of a home environment in an area where metals handling is established within the soundscape.

5.0 Site description

5.1 The EMR site is located within the Port of Tyne approximately 500m south of the River Tyne. The EMR site is located centrally within the dock and surrounded on all sides by industrial and commercial uses. The storage and distribution of coal, storage of shipping containers and other local uses are reflective of a working dock.

5.2 An aerial view of the site is provided within fig 5-1 below.

Fig 5-1 Indicative EMR layout/footprint

5.3 Fig 5-1 shows an indicative layout of the EMR site relative to the locality. The access road splits the site in two. The red line shows the indicative outline of part of the site to which the application relates.

5.4 The nearest residential dwellings are located approximately 190m from the eastern boundary of the existing EMR site along Temple Town and Devonshire Street. A number of dwellings along Temple Town have first and second floor windows facing towards the EMR site, albeit screened by existing industrial buildings within the Port of Tyne. Note, the proposed shear is located a further distance of

260m to the west giving a total separation distance of around 450m+.

5.5 To the south east, the nearest residential dwellings are located approximately 250m from the south eastern boundary of EMR. The dwellings overlook the A194 which appears to have a steady flow of heavy traffic generating high levels of noise even outside of rush hour. There are a number of apartment buildings on Dock Street elevated above the ground and up to second and third storey level. These have been considered within the assessment of industrial sound impact by MAS. Note, the proposed shear is located a further 300m to the north west giving a total separation distance of around 555m.

5.6 Two visits have been made to the locality by MAS in 2015. The dominant source of noise along Temple Town and Dock Street is road traffic noise. Noise monitoring has been completed within the Tyne Dock boundary close to Temple Town. Existing metals handling noise is audible close to the boundary near a gap between the large 2m+ boundary wall. A variety of other residual industrial/commercial sounds arise within the locality including the movement of delivery vehicles, loading and unloading, shunter and heavy goods vehicle movements, waste carriage, fork lift trucks and occasional plant.

6.0 Summary of noise monitoring

6.1 Attended noise measurements were undertaken on Friday 30/01/15 between 10:40 and 11:35hrs and Thursday 21/05/15 between 10:50 and 11:55hrs. Noise monitoring on 21/05/15 followed a short site meeting with Kevin Burrell from South Tyneside Council Environmental Health department. The dates were chosen to ensure suitable meteorological conditions to satisfy the requirements of BS7445 (parts 1-3) and BS4142 2014.

6.2 Short term measurements were taken to reflect general levels of ambient/residual noise at the closest residential dwellings in the absence of sound from the shear. Residual sound levels varied due primarily to the presence of road traffic noise along Temple Town and general industrial sound from operations within the dock and commercial uses on Mitre Place.

6.3 Measurements of various acoustic parameters were recorded including A-weighted (dBA) Leq and L90. For both noise monitoring visits the microphone was located approximately 1.2m above ground level. A Type 1 Norsonic 140 sound level meter was used for all measurements. The instrument was calibrated before and after monitoring. No significant drift was recorded[16].

6.4 The noise monitoring location is illustrated in Fig 6-1 below.

16 Significant drift taken as being over +/-0.5dB compared to the calibrated noise level.

Fig 6-1 Noise monitoring location

6.5 The photographs below show the position of the sound level meter in relation to the boundary with Temple Town (location A). The meter was moved further from the boundary (location B) to reduce measured levels of road traffic noise i.e. increase separation distance and increase level of screening from 2m+ brick wall running along boundary with Temple Town. Higher road traffic noise levels would be expected at the façade of the closest dwellings facing onto Temple Town.


Noise monitoring location A - 30/01/15

6.6 Noise monitoring 30/01/15

6.7 A site visit was undertaken in January to initially assess the site layout and surrounding area in terms of location, topography, proximity of noise sensitive premises and to assess the soundscape.

Spot measurements were undertaken at location A then moved approximately 10m further into the industrial estate at location B to reduce the influence of road traffic noise (approx 15m from the road).

6.8 The noise monitoring conditions were cool (0-2 degrees Celsius) with 20% cloud cover. Steady westerly breeze from the EMR site towards monitoring location at Temple Town below 5 metres per second. Conditions were considered in compliance with BS7445-1 2003 and BS4142 2014.

6.9 Noise monitoring 21/05/15

6.10 Monitoring conditions were mild around 8-10°C with a breeze from a westerly and west south westerly direction below 5 metres per second. The meteorological conditions were considered suitable for obtaining representative measurement results under a 'worst case' positive wind direction e.g. from the proposed EMR shear towards Temple Town with minimal screening features.

6.11 Overall, background sound measurements were conducted at both locations during the main daytime working hours but at times when the contribution from road transport sources would be lower (i.e. between 10am and 2pm). Typical background sound levels varied between 52-59dB LA90,T on 30/01/15. A range of 54-55dB LA90,T were obtained in the same location on 21/05/15.

6.12 Noise monitoring results

6.13 The results are presented in the noise monitoring graphs in Appendix 3 and 4. The graphs provide a visual indication of the temporal distribution of noise over time.

6.14 Appendix 3 shows noise monitoring graphs 1 to 10 from 30/01/15 and plot the LAeq,5min and LA90,5min. An example graph is shown overleaf. The graph shows 5 minutes of noise monitoring data. The solid red line shows the LAeq,5min (average ambient sound) and solid blue line the LA90,5min (background sound level). The larger peaks are generated by road traffic passing on Temple Town. Other large and also smaller peaks are labelled including metal impacts and gulls overhead. Generally the higher noise events are labelled and the sound energy contribution from different sources (peaks) to the overall LAeq,T varies between graphs. However, road traffic noise is the primary contributor to noise levels overall.

6.15 Appendix 4 shows graphs from 21/05/15. The graphs are similar except they relate to periods of around 10 to 15 minutes. Typically a LA90,5min value will be lower than an equivalent LA90,15min period. The quietest 10% of noise in 5 minutes is 30 seconds whereas the quietest 10% of 15 minutes is 90 seconds i.e. using a 5 minute period is more conservative within the acoustic environment.

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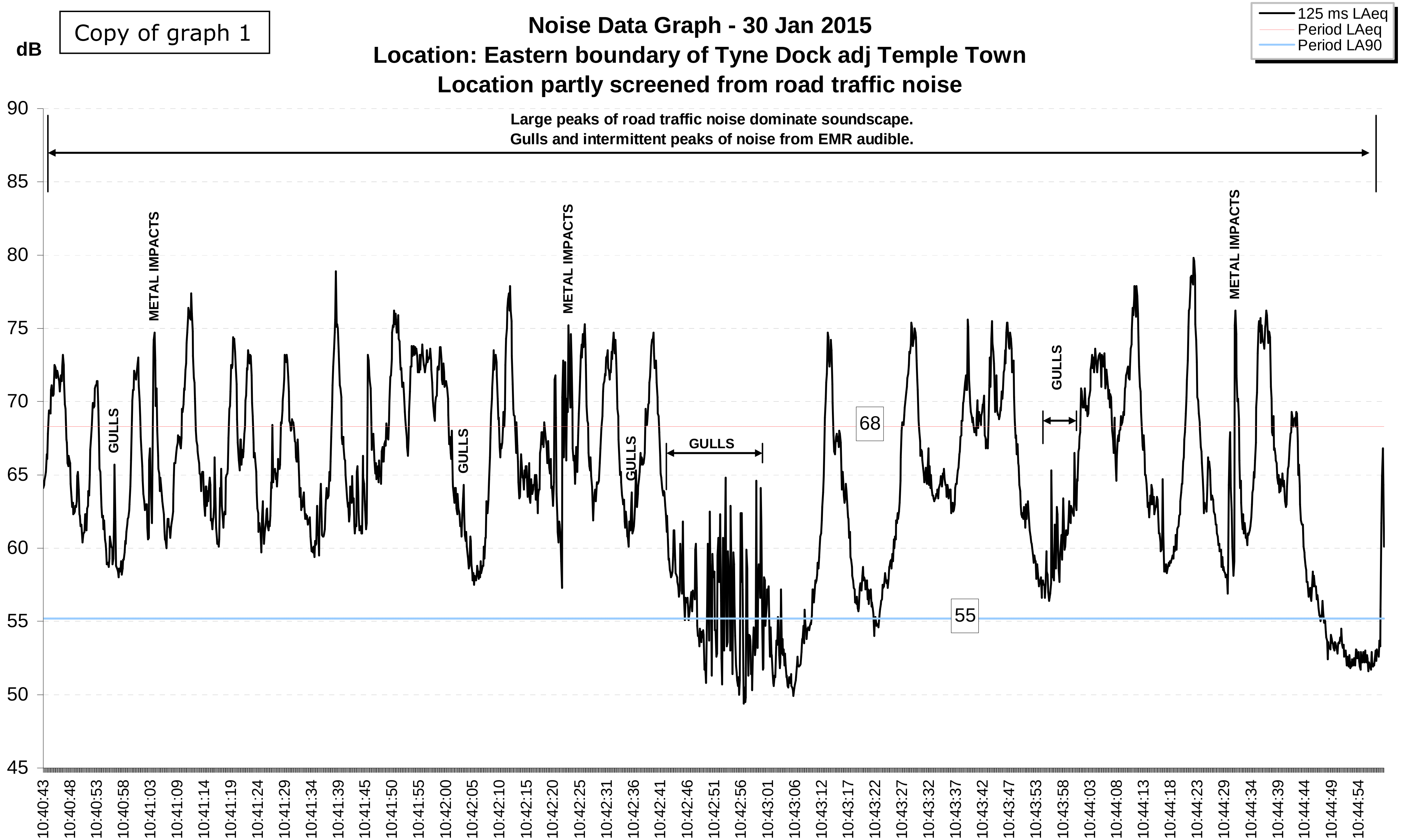
Copy of graph 1

Noise Data Graph - 30 Jan 2015
Location: Eastern boundary of Tyne Dock adj Temple Town
Location partly screened from road traffic noise



6.16 The period measurements obtained from the noise monitoring on 30/01/15 are presented in table 6-1 and from 21/05/15 in table 6-2 below.

Table 6-1 Noise monitoring results 30/01/15

Location	Start time	Duration	LAeq	LA90	LA10	Highest LAmax for period	Source of highest LAmax	Highest LAmax from existing metals handling for period
A - adjacent boundary with Temple Town	10:40:43	00:04:16	68	55	73	80	Road traffic noise	75
	10:45:02	00:04:57	70	59	73	87	HGV RTN	77
	10:50:02	00:04:57	68	56	72	79	RTN and Metals handling	78
	10:55:01	00:04:58	69	58	73	81	Road traffic noise	72
	11:00:02	00:04:57	68	52	73	81	Metal clatters	81
B - 10m further in from boundary with Temple Town	11:10:01	00:04:58	61	54	64	75	Impact (MOT test centre with vehicle repair)	66
	11:15:02	00:04:57	61	56	64	73	RTN and Metals handling	73
	11:20:01	00:04:58	64	55	66	86	Forklift tipping waste	77
	11:25:02	00:04:57	64	56	66	83	Metal clatters	83
	11:30:01	00:04:58	63	56	65	73	Metal impacts	73

6.17 At location A closer to Temple Town, table 6-1 shows consistent LAeq,5min noise levels between 68-70dB. At location B 10m further from the road, the LAeq,5min remains consistent between 61-64dB. The highest LAmax noise events arise from a mixture industrial and road traffic sources. Typical background sound levels varied between 52-59dB LA90,T on 30/01/15. The lowest LA90,5min was 52dB at location A.

6.18 Table 6-2 below again shows consistent LAeq,T noise levels between 61-63dB. These are also similar to measurements at location B on 30/01/15. A range of 54-55dB LA90,T were obtained in the same location on 21/05/15.

Table 6-2 Noise monitoring results 21/05/15									
Location	**Graph ref**	**Start time**	**Duration**	**LAeq**	**LA90**	**LA10**	**Highest LAmax for period**	**Source of highest LAmax**	**Highest LAmax from existing metals handling for period**
B - 10m from boundary with Temple Town	11	10:51:29	00:08:30	63	55	66	76	Loud vehicle exhaust TT*	75
	12-14	11:00:02	00:14:57	63	55	66	82	Road traffic noise	74
	15-17	11:15:02	00:14:57	61	54	65	79	Road traffic noise	64
	18-20	11:30:02	00:14:57	62	54	66	78	Road traffic noise	70
	21	11:45:03	00:09:12	61	54	65	74	Road traffic noise	66

*TT shorthand for Temple Town

6.19 Table 6-3 below shows the same noise data split into shorter periods between 5-9[17] minutes. When split into shorter periods the LAeq,T levels show consistency between 61-63dB. This is reflective of the frequency traffic movements along Temple Town.

Table 6-3 Noise monitoring results 21/05/15 split into shorter periods									
Location	**Graph ref**	**Start time**	**Duration**	**LAeq**	**LA90**	**LA10**	**Highest LAmax for period**	**Source of highest LAmax**	**Highest LAmax from existing metals handling for period**
B - 10m from boundary with Temple Town	11	10:51:29	00:08:30	63	55	66	76	Loud vehicle exhaust TT*	75
	12	11:00:02	00:05:00	62	55	66	76	Road traffic noise	70
	13	11:05:00	00:05:00	63	55	66	78	HGV TT	74
	14	11:10:00	00:05:00	63	55	66	82	Road traffic noise	58
	15	11:15:02	00:05:00	61	54	65	73	HGV TT	64
	16	11:20:00	00:05:00	62	54	65	79	Road traffic noise	60
	17	11:25:00	00:05:00	61	54	65	74	Road traffic noise	64
	18	11:30:02	00:05:00	62	54	66	74	Road traffic noise	70
	19	11:35:00	00:05:00	62	54	66	78	Road traffic noise	64
	20	11:40:00	00:05:00	62	54	66	76	Road traffic noise	67

[17] Graphs 11 and 21 show periods of 8min 30s and 9min 12s respectively, the remaining graphs are all 5 minutes.

	21	11:45:03	00:09:12	61	54	65	74	Road traffic noise	66

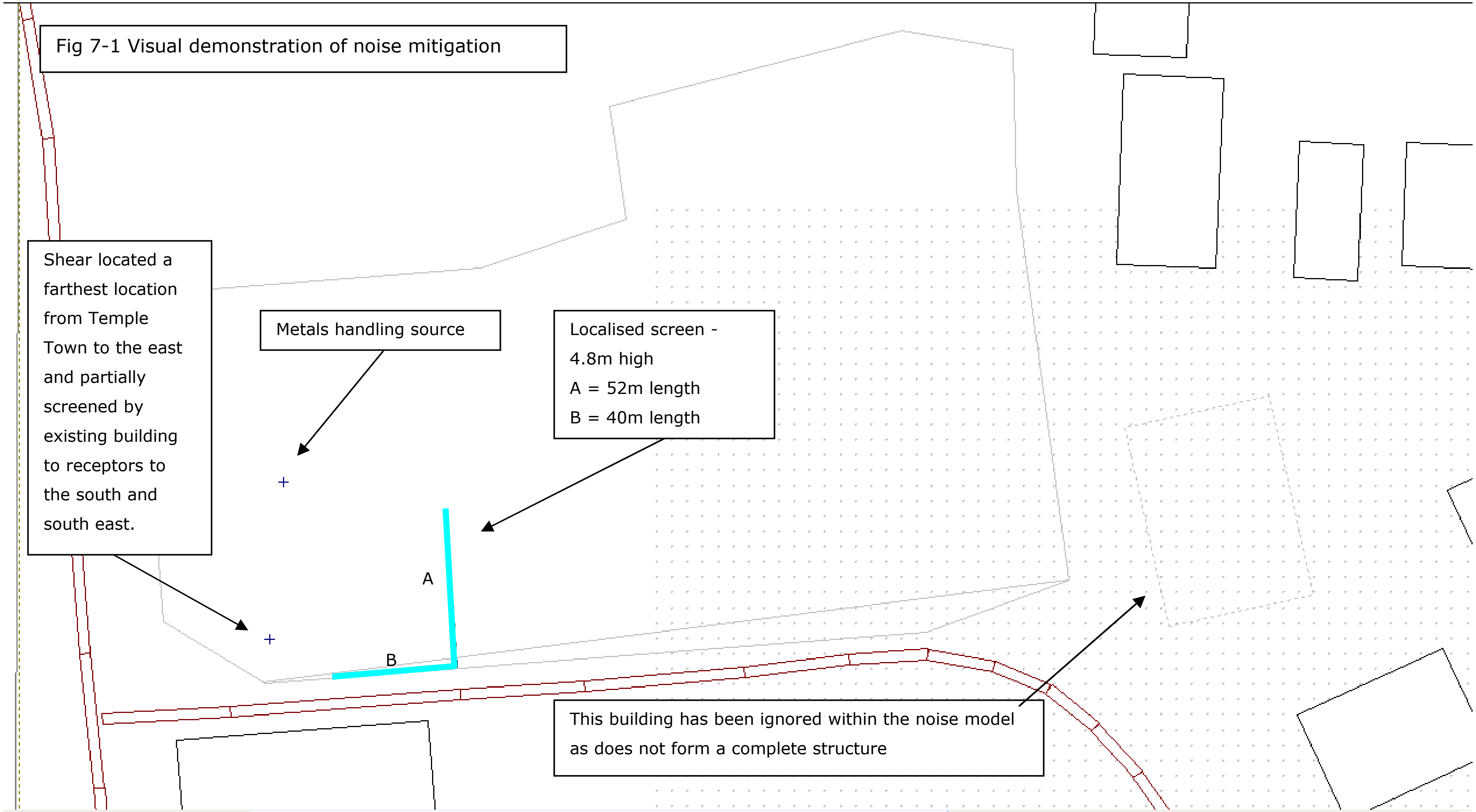
*TT shorthand for Temple Town

7.0 Noise mitigation measures

7.1 The principles of noise control consider the noise source, its location and height, propagation pathway, receptor conditions and receptor type. For the introduction of fixed plant at the EMR site, a number of measures have been implemented to mitigate impact at sensitive receptors including positioning the shear at the farthest point from receptors, position to south west to maximise the acoustic screening provided by existing industrial building heights to act as screening and localised screening to break the line of sight. The incorporation of mitigation measures significantly reduces industrial sound levels at the closest noise sensitive receptors.

7.2 EMR have no control over mitigation at noise sensitive dwellings. Therefore, it is important to maximise noise reduction through location, positioning and localised screening to provide an acceptable acoustic environment post development. The localised screening positions/dimensions are provided in fig 3 below. The mitigation measures have all been incorporated for noise modelling predictions and the assessment in section 8.

Fig 7-1 Visual demonstration of noise mitigation



7.3 Summary of mitigation measures:

- Physical screening provided by shipping containers stacked two high to a minimum height of 4.8m and minimum (total) length of 92m (see section A and B lengths and position above). Provides screening to shear and associated surrounding metals handling.

- Strategic placement to the south western corner of the EMR site to provide partial screening to dwellings to the south and south east.

- Strategic placement at the farthest point of the site from the closest dwellings to the east along Temple Town. Increasing distance increases natural attenuation from geometrical spreading, air absorption and ground effects.

8.0 Assessment of industrial noise impact

8.1 This section contains the noise impact assessment completed by MAS relating to the closest dwellings following the revision to planning noise guidance and BS4142. The noise impact assessment concentrates on the use of the proposed shear and associated metals handling sources of noise likely to generate the highest noise levels for the longest duration.

8.2 Measurement and prediction of noise from the shear

8.3 The operation of new fixed plant is a noise producing activity that has the potential to impact existing residents and includes:

- Loading metal hopper - new activity and included within MAS noise modelling
- Preparatory metals handling - an established activity at the site but concentrated towards the western boundary (i.e. at increased separation distance than existing metals handling activity)
- Movement of finished metal grade - again metals handling is established at the site, finished metal grades are smaller and produce less noise on impact
- Metals tipping - already an established activity at the site
- HGV movements and pneumatic brakes hissing - already an established activity at the site

8.4 In practice there is no 'new' noise occurring from shear activity that doesn't already occur on site. The difference is an intensification of metals handling and loading the shear within the farthest and most screened area of the existing site.

8.5 The shearing process acts as a guillotine and press to physically reduce the size and weight of a metal grade. The shearing process is relatively quiet in comparison to the relatively high levels produced by tipping, loading the shear and preparatory handling. The shear diesel engine and shearing action will be inaudible at residential dwellings. This is found at the majority of EMR sites that benefit from boundary screening but with reduced separation distances to residential dwellings.

8.6 The noise maps are produced using software Cadna, developed by Datakustik and applying ISO9613-2. The objective is to show average (LAeq) noise levels predicted under downwind conditions and the effect of mitigation measures. They ignore all other sources of noise, allowing a direct comparison of the proposed source with background noise levels. The noise contour maps in appendix 5 show predicted levels of the hourly LAeq from metals recycling noise and excludes all other sources in the locality.

8.7 As discussed, prediction has been undertaken using data from other metals recycling sites, taking a worst case level of noise, assuming continuous handling and loading of the shear. In practice this intense level of activity will not occur and levels should be lower.

8.8 Some of the data relied upon in the predictions was used in the High Court[18] (metals handling) in a case relating to the same type of metals recycling noise and agreed between the experts and thus is considered a reasonable representation of metals handling noise.

8.9 The assessment of industrial sound is based on the assumption the noise control and mitigation measures set out in this report have been fully implemented.

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18 Thornhill and Others v NMR Ltd 2010

8.10 Shear and metals handling noise modelling

8.11 The source sound power levels for metals handling and shear loading are presented in table 8-1 below.

Table 8-1 Sound power levels of metals handling and shear sources

SHEAR											
Source	**Octave Spectrum (dB)**										
Continuous shear loading and operation	**Weighting**	31.5	63	125	250	500	1k	2k	4k	8k	A	lin
	A	0	88	93	98	103	104	104	100	90	109.1	109.5
METALS HANDLING											
Source	**Octave Spectrum (dB)**										
Continuous crane metal movement of alloy	**Weighting**	31.5	63	125	250	500	1k	2k	4k	8k	A	lin
	A	0	85	90	95	100	101	101	97	87	106.1	106.5

8.12 Noise modelling has been undertaken to assume a worst case of noise impact with a source height for metals handling of 5 metres[19] and shear loading at 4.1 metres (hopper height).

8.13 The MAS noise modelling uses topography data to reflect sound propagation within the locality i.e. taking into account ground contours and changes in ground level. The location of each source is shown in Figure 3 above.

8.14 The analysis and assessment also assumes the site is empty, removing any additional screening and absorptive effects from onsite metals piles.

8.15 A summary of the noise modelling inputs is provided for reference below.

[19] Based on the assumption of 10 metals piles around the shear. For the majority of time handling will occur below 5 metres.

Noise Contour Assessment - EMR Tyne Dock Shear

Source:

1 - Shear [SWL(A) = 109.5dB]
2 - Metals handling [SWL(A) = 106.1dB]

Predictions made according to IS0 9613.

Ground absorption = 0.0
2nd order reflections included
Noise contours at 2m

Shear source height = 4.1m (hopper height)
Metals handling = 5m

Receiver heights
Ground floor = 1.5m (noise models 1 and 1a)
First floor = 4.5m (noise model 2)
Second floor = 7m (noise model 3)
Third floor = 9.5m (noise model 4 - relevant to dwellings located to the south east only)

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8.16 A summary of the noise modelling results are provided in table 5 and 6 below.

8.17 Assessment of noise impact at dwellings

8.18 Table 8-2 below shows predicted noise levels at the facades (1m) of the closest residential dwellings.

Table 8-2 Prediction of sound from metals handling and shear loading with 4.8m screen around shear

Reference noise model		**1**	**2**	**3**	**4**
Receiver height (m)		**1.5**	**4.5**	**7**	**9.5**
Location	**Receiver ref no.**	**dB level (LAeq,1hr)**			
Temple Town	1	47	44	n/a	n/a
Temple Town	2	43	45	n/a	n/a
Temple Town	3	43	46	n/a	n/a
Temple Town	4	43	46	n/a	n/a
Temple Town	5	42	45	n/a	n/a
Temple Town	6	41	44	n/a	n/a
Temple Town	7	40	43	n/a	n/a
Temple Town	8	37	42	43	n/a
Temple Town	9	31	37	41	n/a
Temple Town	10	31	36	41	n/a
Temple Town	11	35	39	42	n/a
Temple Town	12	35	38	42	n/a
Temple Town	13	37	39	42	n/a
Temple Town	14	37	39	42	n/a
Temple Town	15	37	39	42	n/a
Temple Town	16	37	39	41	n/a
Temple Town	17	39	41	42	n/a
Temple Town	18	38	41	42	n/a
Temple Town	19	38	40	40	n/a
Devonshire Street	20	37	40	n/a	n/a
Devonshire Street	21	31	34	n/a	n/a
Devonshire Street	22	31	31	n/a	n/a
Devonshire Street	23	31	33	n/a	n/a
Devonshire Street	24	32	35	n/a	n/a
Devonshire Street	25	32	36	n/a	n/a
Devonshire Street	26	33	37	n/a	n/a
Devonshire Street	27	32	36	n/a	n/a
Dock Street	28	37	38	37	37
Dock Street	29	37	38	37	37
Dock Street	30	37	37	37	38
Dock Street	31	36	37	37	38
Dock Street	32	36	38	37	38
Dock Street	33	35	37	37	38
Dock Street	34	35	37	38	38
Dock Street	35	36	38	38	38
Dock Street	36	36	38	38	38
Dock Street	37	37	38	38	39
Dock Street	38	40	38	39	39
Dock Street	39	38	38	39	39
Dock Street	40	38	39	39	37
Dock Street	41	38	40	38	40
Dock Street	42	36	36	38	39

8.19 Temple Town refers to facades facing towards EMR at ground, first and second floor[20]. Devonshire street runs to the rear of Temple Town and also has some windows at second floor level. The apartment buildings on Dock Street have glazed areas facing towards EMR up to third floor level.

8.20 In summary, noise models 1, 2, 3 and 4 show predicted noise levels with localised screening around the shear. The predicted noise levels vary between 31-47dB LAeq,1hr depending on location. Noise model 1a shows predicted noise levels without any localised screening at EMR. The differences between predicted noise levels with and without localised screening at 1.5m are shown in table 8-3 below.

Table 8-3 Comparison of predicted sound levels at 1.5m with and without mitigation

Reference noise model		1	1a	Difference with and without mitigation (dB)
Receiver height (m)		1.5	1.5	
Location	Receiver ref no.	dB level (LAeq,1hr)		
Temple Town	1	47	50	**3**
Temple Town	2	43	45	**2**
Temple Town	3	43	45	**2**
Temple Town	4	43	44	**1**
Temple Town	5	42	44	**1**
Temple Town	6	41	42	**1**
Temple Town	7	40	41	**1**
Temple Town	8	37	37	**0**
Temple Town	9	31	32	**1**
Temple Town	10	31	33	**3**
Temple Town	11	35	36	**1**
Temple Town	12	35	37	**1**
Temple Town	13	37	38	**1**
Temple Town	14	37	38	**1**
Temple Town	15	37	38	**1**
Temple Town	16	37	37	**1**
Temple Town	17	39	40	**1**
Temple Town	18	38	40	**2**
Temple Town	19	38	38	**0**
Devonshire Street	20	37	41	**4**
Devonshire Street	21	31	40	**8**
Devonshire Street	22	31	32	**1**
Devonshire Street	23	31	31	**0**
Devonshire Street	24	32	32	**0**
Devonshire Street	25	32	32	**0**
Devonshire Street	26	33	33	**0**
Devonshire Street	27	32	32	**0**
Dock Street	28	37	39	**3**
Dock Street	29	37	40	**3**
Dock Street	30	37	44	**7**
Dock Street	31	36	40	**4**

[20] A limited number along one block have windows at second floor level.

Dock Street	32	36	39	**3**
Dock Street	33	35	38	**3**
Dock Street	34	35	38	**3**
Dock Street	35	36	38	**2**
Dock Street	36	36	38	**2**
Dock Street	37	37	38	**2**
Dock Street	38	40	42	**2**
Dock Street	39	38	43	**5**
Dock Street	40	38	44	**6**
Dock Street	41	38	39	**0**
Dock Street	42	36	36	**0**

8.21 The table shows reductions due to the presence of localised screening between 0 and 8dB. Generally reductions up to 3dB are shown which is a noticeable reduction to most people.

8.22 BS4142 2014 assessments

8.23 Outlined below are a series of BS4142 assessments concentrating on the following noise sensitive residential dwellings:

- Temple Town at 1.5, 4.5 and 7m (noise models 1, 2 and 3)
- Devonshire Street at 1.5 and 4.5m (noise models 1 and 2)
- Dock Street at 1.5, 4.5, 7 and 9.5m (noise models 1, 2, 3 & 4)

8.24 Noise impact is based on the assumption there is continued industrial sound for the entire hour with continuous metals handling activity and shear loading.

8.25 Detailed considerations of the BS4142 2014 assessments are provided in appendix 6. The appendix is consistent with BS4142 2014 section 12 - information to be reported.

8.26 BS4142 2014 assessment at Temple Town

8.27 A typical worst case BS4142 2014 assessment for dwellings along Temple Town and incorporating ALL mitigation measures gives:

i.	Predicted specific sound level =	31-47dB[21]
ii.	Rating penalty[22] for impulsivity =	+9dB
iii.	Rating penalty for tonality =	0dB
iv.	Rating level = (31-47) + 9 =	40-56dB
v.	Background sound level[23] =	52-59dB
vi.	Initial estimate of impact = (40-56)-(52-59) =	**-19 to +4dB**

8.28 The assessment indicates noise levels with mitigation when considering the highest predicted noise levels, highest penalty for highly impulsive acoustic features and the lowest background sound level are up to 4dB indicating adverse impact, depending on the context. This is 6dB below a point that could be considered a significant adverse impact.

8.29 The BS4142 2014 assessment at Temple Town is summarised overleaf.

[21] Receiver points 1 to 19 from table 8-2 with ALL mitigation.

[22] Sound from EMR qualifies for the acoustic feature correction for impulsive character. This assumes industrial noise will be audible at all residential premises and impulsive characters from metal impacts from the shear and associated metals handling will be highly perceptible. ALL BS4142 2014 ASSESSMENTS ASSUME A WORST CASE OF +9dB FOR EMR ACOUSTIC FEATURES. This is considered a conservative adjustment when applied to the closest affected dwellings that do not have traditional garden areas facing towards EMR.

[23] Takes the typical range of background sound levels of 52-59dB LA90,T from spot measurements outside of heavier traffic periods on 31/01/15. The background sound level of 52dB is still considered a typical worst case as this was the lowest recorded LA90,T. From looking at the noise graphs, LAeq,T levels do not generally drop below 50dB.

Table 8-4 BS4142 2014 assessment for industrial sound with impulsive features (Temple Town)

A		B		C		D1 & D2				E		F		G	
Predicted sound level (LAeq,T)		Correction for residual sound		Specific sound level (Ls = LAeq,Tr)		Corrections for sound with tonal and/or impulsive characteristics (dB)				Rating level - for sound with tonal and/or impulsive characteristics (LAr,Tr)		Background sound level (LA90,T)		Initial estimate of impact (E - F)	
						D1 Correction for tonality 0 2 4 or 6		D2 Correction for impulsivity 0 3 6 or 9							
Day (1hr) or night (15min)		upper	lower	(A - B)						(C + D1 + D2)		lower	upper	lower	upper
31	47	0	0	31	47	0	0	9	9	40	56	52	59	-19	4

BS4142 2014 acoustic feature penalties

Acoustic features	Perception of audibility: Just	Clearly	Highly
Impulsivity	3	6	9
Tonality	2	4	6
- - - - - - - OR - - - - - - -			
Other sound characteristics		+3dB	
Intermittency		+3dB	

Column	key to table inputs
A	Measured sound level
B	Residual sound correction
D1	Correction for tonality
D2	Correction for impulsivity
F	Background sound level

Initial upper estimate of impact shows:

Difference of around 10dB or more	4	indication of significant adverse impact, depending on the context (red)
Difference of around +5dB		indication of adverse impact, depending on the context (orange)
Decreasing difference at +3dB and below		less likely of adverse impact or significant adverse impact (green)
Difference below 0 (rating level below background sound level)		indication of low impact, depending on the context (green)

Initial lower estimate of impact shows:

Difference of around 10dB or more	-19	indication of significant adverse impact, depending on the context (red)
Difference of around +5dB		indication of adverse impact, depending on the context (orange)
Decreasing difference		less likely of adverse impact or significant adverse impact (green)
Difference below 0 (rating level below background sound level)		indication of low impact, depending on the context (green)

8.30 BS4142 2014 assessment at Devonshire Street

8.31 A typical worst case BS4142 2014 assessment at Devonshire Street incorporating ALL mitigation measures gives:

i. Predicted specific sound level = 31-40dB[24]
ii. Rating penalty for impulsivity = +9dB
iii. Rating penalty for tonality = 0dB
iv. Rating level = (31-40) + 9 = 40-49dB
v. Background sound level = 52-59dB
vi. Initial estimate of impact = (31-40)-(52-59) = **-19 to -3dB**

8.32 The assessment indicates noise levels with mitigation when considering the highest predicted noise levels, highest penalty for highly impulsive acoustic features and the lowest background sound level are between -19 to -3dB. The highest rating level is 3dB below the lowest measured background sound level indicating low impact.

8.33 The BS4142 2014 assessment at Devonshire Street is summarised overleaf.

[24] Receiver points 20 to 27 from table 8-2 with ALL mitigation.

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Table 8-5 - BS4142 2014 assessment for industrial sound with impulsive features (Devonshire Street)

A		B		C		D1 & D2		E		F		G	
Predicted sound level (LAeq,T)		Correction for residual sound		Specific sound level (Ls = LAeq,Tr)		Corrections for sound with tonal and/or impulsive characteristics (dB)		Rating level - for sound with tonal and/or impulsive characteristics (LAr,Tr)		Background sound level (LA90,T)		Initial estimate of impact	
Day (1hr) or night (15min)				(A - B)		D1 Correction for tonality 0 2 4 or 6	D2 Correction for impulsivity 0 3 6 or 9	(C + D1 + D2)				(E - F)	
		upper	lower							lower	upper	lower	upper
31	40	0	0	31	40	0	0	9	9	40	49	52	59	-19	-3

BS4142 2014 acoustic feature penalties

Acoustic features	Perception of audibility: Just	Clearly	Highly
Impulsivity	3	6	9
Tonality	2	4	6
- - - - - - - - - - - - - - - OR - - - - - - - - - - - - - - -			
Other sound characteristics	+3dB		
Intermittency	+3dB		

Column	key to table inputs
A	Measured sound level
B	Residual sound correction
D1	Correction for tonality
D2	Correction for impulsivity
F	Background sound level

Initial upper estimate of impact shows:

Difference	Estimate	Indication
Difference of around 10dB or more	-3	indication of significant adverse impact, depending on the context (red)
Difference of around +5dB		indication of adverse impact, depending on the context (orange)
Decreasing difference at +3dB and below		less likely of adverse impact or significant adverse impact (green)
Difference below 0 (rating level below background sound level)		indication of low impact, depending on the context (green)

Initial lower estimate of impact shows:

Difference	Estimate	Indication
Difference of around 10dB or more	-19	indication of significant adverse impact, depending on the context (red)
Difference of around +5dB		indication of adverse impact, depending on the context (orange)
Decreasing difference		less likely of adverse impact or significant adverse impact (green)
Difference below 0 (rating level below background sound level)		indication of low impact, depending on the context (green)

8.34 BS4142 2014 assessment at Dock Street

8.35 A typical worst case BS4142 2014 assessment at Dock Street incorporating ALL mitigation measures gives:

i. Predicted specific sound level = 35-40dB[25]
ii. Rating penalty for impulsivity = +9dB
iii. Rating penalty for tonality = 0dB
iv. Rating level = (35-40) + 9 = 44-49dB
v. Background sound level = 52-59dB
vi. Initial estimate of impact = (44-49)-(52-59) = **-15 to -3dB**

8.36 The assessment indicates noise levels with mitigation when considering the highest predicted noise levels, highest penalty for highly impulsive acoustic features and the lowest background sound level are between -15 to -3dB. Again, like Devonshire Street the highest rating level is 3dB below the lowest measured background sound level indicating low impact.

8.37 The BS4142 2014 assessment at Dock Street is summarised overleaf.

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[25] Receiver points 28 to 42 from table 8-2 with ALL mitigation.

Table 8-6 BS4142 2014 assessment for industrial sound with impulsive features (Dock Street)

A	B		C	D1 & D2		E	F		G	
Predicted sound level (LAeq,T)	Correction for residual sound		Specific sound level (Ls = LAeq,Tr)	Corrections for sound with tonal and/or impulsive characteristics (dB)		Rating level - for sound with tonal and/or impulsive characteristics (LAr,Tr)	Background sound level (LA90,T)		Initial estimate of impact (E - F)	
				D1 Correction for tonality 0 2 4 or 6	D2 Correction for impulsivity 0 3 6 or 9					
Day (1hr) or night (15min)	upper	lower	(A - B)			(C + D1 + D2)	lower	upper	lower	upper
35 40	0	0	35 40	0 0	9 9	44 49	52	59	-15	-3

BS4142 2014 acoustic feature penalties

Acoustic features	Perception of audibility: Just	Clearly	Highly
Impulsivity	3	6	9
Tonality	2	4	6
- - - - - - - - - - - - - - OR - - - - - - - - - - - - - -			
Other sound characteristics		+3dB	
Intermittency		+3dB	

Column	key to table inputs
A	Measured sound level
B	Residual sound correction
D1	Correction for tonality
D2	Correction for impulsivity
F	Background sound level

Initial upper estimate of impact shows:

Difference of around 10dB or more	-3	indication of significant adverse impact, depending on the context (red)
Difference of around +5dB		indication of adverse impact, depending on the context (orange)
Decreasing difference at +3dB and below		less likely of adverse impact or significant adverse impact (green)
Difference below 0 (rating level below background sound level)		indication of low impact, depending on the context (green)

Initial lower estimate of impact shows:

Difference of around 10dB or more	-15	indication of significant adverse impact, depending on the context (red)
Difference of around +5dB		indication of adverse impact, depending on the context (orange)
Decreasing difference		less likely of adverse impact or significant adverse impact (green)
Difference below 0 (rating level below background sound level)		indication of low impact, depending on the context (green)

8.38 The initial estimate of impact should be adjusted to consider the context of the assessment. This is addressed later in this section.

8.39 All assessments show acceptable noise levels below the point that indicates adverse impact. However, an indication approaching adverse impact is indicated only when the highest predicted sound levels are compared with the lowest measured background sound levels at a location screened from road traffic noise. Façade predictions are also compared to free field background sound levels indicating the initial assessment will be lower. Furthermore, when compared to BS4142 1997 the equivalent complaint prediction level would range between -16 and 0dB[26].

8.40 Context of BS4142 2014 assessment

8.41 The context includes the relationships between a person, activity and place at a point in space and time. The context may influence the soundscape through auditory sensation, interpretation of that auditory sensation and the responses to the acoustic environment. There are, therefore, many factors that influence whether a sound is perceived to be noise.

8.42 The foreword to BS4142 2014 states:

8.43 "Response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its impact, for example, can depend on such factors as the margin by which a sound exceeds the background environment, as well as local attitudes to the source of the sound and the character of the neighbourhood. This edition recognizes the importance of the context in which a sound occurs. Great care has, therefore, been

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[26] Takes the entire range of predicted specific sound levels of 31-47dB + 5dB character penalty minus 52dB LA90,T = -16 to 01dB excess of rating level over background.

taken in the use of the words "sound" and "noise". Sound can be measured by a sound level meter or other measuring system. Noise is related to a human response and is routinely described as unwanted sound, or sound that is considered undesirable or disruptive".

8.44 Therefore, any assessment of context should consider acoustic and non-acoustic factors associated with the sound source and resultant perception. Three of the many factors that influence perception in context are described within Section 11 - Assessment of the impacts of BS4142 2014 which states:

8.45 "The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."

8.46 This is consistent with the factors that influence the assessment of nuisance (statutory and private) and is a welcome addition to the BS4142 2014 assessment methodology. The context describes the setting, circumstances or state of affairs in which the impact is received and evaluates the level by which environmental sounds mask noise.

8.47 The BS4142 2014 assessment of impacts requires consideration of context to include the absolute level of sound, the character and level of the residual sound compared to the character and level of the specific sound and the sensitivity of receptor and whether dwellings will already incorporate design measures that secure good internal and/or outdoor acoustic conditions. 'Good' acoustic conditions are not defined.

8.48 The context is considered through reference to the frequency of occurrence, duration of occurrence over the day, periods of the day when it occurs and the number of days per week/month/year it arises, the character of the area, any economic tie to the source of noise, respite from noise, control over the source etc. It has long been established that there is not a set level of noise below which sounds become acceptable and in many cases of frequent noise impact, audibility is relevant.[27]

8.49 Some factors relevant to the context of impact at existing dwellings (with all mitigation) from the proposed shear includes considerations of the absolute level of sound. Predicted specific sound levels from EMR vary between 31 and 47dB LAeq,1hr compared to measured residual sound levels of 61 to 70dB LAeq,T. Improved confidence is provided that noise from the shear will be acceptable as specific sound levels are 14 to 30dB below the lowest measured residual sound levels but also 5 to 21dB below the lowest measured background sound level of 52dB LA90,T.

8.50 The specific sound from EMR is distinguishable from other residual sounds because of the inherent acoustic features present. However, Tyne Dock is a working dock and industrial sounds are expected within the locality. Metals handling, tipping, loading, HGV movements, reverse bleepers etc. are established industrial sounds. The character of the 'new' noise is congruous and compatible with the current soundscape albeit at a lower level as demonstrated by the BS4142 2014 assessment and comparison with residual sound levels.

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[27] A common example of this is music noise.

8.51 Other factors include frequency and duration of impact. The site currently operates 6 days per week (0700-1700hrs) including Saturday morning (0700-1200hrs). The site is not open on Sundays or Bank Holidays. However, the movement of heavier metal grades to the quay and ship loading have no formal restrictions and may operate, in line with other port activities, on a 24 hour basis. Agreement exists between EMR and the Port that there is no handling of plate and girder[28] material after 10pm or prior to 7am. There are no restrictions on other metal grades.

8.52 Metals handling noise can occur frequently through the week within increased duration during ship loading. Typically it may take 7-8 days to fill a ship with 30000 to 40000 tonnes of metals. I understand the shear will operate from 7am to 6pm Monday to Friday and 7am to 12pm on Saturday.

8.53 The level of activity is determined by market forces nationally and internationally and also varies relative to the economy i.e. increased development = greater demand for metals. The new noise may occur for long periods up to a maximum of 11 hours (the shear can run all day).

8.54 The character of the area is important when referring to the context of noise impact in this case. The area is predominantly commercial/industrial as a working dock. EMR is one of many heavy industries in the area handling minerals and other products. The noise generated (shear) is congruous with established types of noise already arising at the site. The character of noise from shear activity and the existing character of the residual sound are similar.

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[28] Heavier grade of metal e.g. structural steel girders.

8.55 Observations on BS4142 assessments

8.56 A number of BS4142 assessments are presented at the closest residential properties including all noise mitigation measures. A 9dB penalty for impulsivity (most prominent acoustic feature) is applied in all cases and a typical range of measured background sound levels between 52 and 59dB LA90,T applied.

8.57 In summary, post mitigation a negative excess of rating level over background sound level is predicted at the majority of residential locations except at those already exposed to high levels of environmental noise. An initial estimate with positive values above 0dB, and up to +4dB, is found using the highest predicted sound levels and the lowest measured background sound levels. This provides improved confidence that noise impact is not a reason for refusing planning permission.

8.58 Comparison with noise limits proposed by MAS

8.59 The noise limits considered reasonable for this type of development by MAS historically are consistent with those applied by many Local Authorities across England when applying BS4142 1997 (a rating level of 0-3dB above the background sound level) and more conservative when BS4142 2014 is applied (due to the increased decibel penalty and use of the same background sound levels).

8.60 In this case the assessment using typical worst case predicted sound levels against typical and a range[29] of background sound levels shows generated noise meets the +5dB rating level criteria at all existing dwellings and by a significant margin in many cases. This is the point adverse impacts are indicated but never arise even when the highest predicted sound levels and lowest measured background sound levels are considered. This offers a good level of protection as predictions are based on worst case levels. Noise modelling is considered robust and assumes downwind propagation conditions.

8.61 Comparison with NPPG on noise

8.62 With reference to the PPG note on noise I consider there are three main elements to the assessment. These include:

- Comparison and assessment of noise effects against noise exposure hierarchy
- Identification of acoustic/noise characteristics that influence whether or not noise could be a concern
- Conclusion based on all available evidence whether an adverse or significant adverse effect is occurring or likely to occur and whether or not a good standard of amenity can be achieved

8.63 In the absence of specific guidance on the interpretation of the PPG note on noise I have amended Table 1, noise exposure hierarchy, from the PPG note on noise. Table 9 below is an amended version of table 1 from the PPG note on noise. The table shows the five categories of perception from 'not noticeable' to 'noticeable and very disruptive'.

[29] Applicable to all BS4142 assessments.

Table 8-7 Noise exposure hierarchy amended for specific assessment of proposed shear and associated metals handling				
Perception	**Examples of Outcomes**	**Increasing Effect Level**	**Action**	**Conclusions on noise impact**
Not noticeable	No Effect	No Observed Effect	No specific measures required	On balance, I consider the development will not fall into the category of "not noticeable". There is no requirement that environmental noise should be "not noticeable" and existing dwellings adjacent a working dock should not perceive existing sources of noise as being unnoticeable and some proposed activity may be noticeable with peaks of noise from shear loading audible but not unreasonable and significantly lower than a point that could be considered a significant observed adverse effect. Industrial sound may be audible at some properties but acceptable when compared to recognised standards i.e. BS4142 2014.
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required	I consider post implementation of localised screening, noise from the proposed shear **falls into this category**. A comparison with noise guidance identifies noise levels fall below the point at which adverse impacts are indicated with localised screening around the shear. Assessments using BS4142 2014 and BS4142 1997 indicate an acceptable level of industrial noise at least 6dB below the point at which a significant adverse impacts are predicted to arise. The noise is characterised (given the large separation distances) by peaks of noise from tipping, handling and loading the shear. The same inherent acoustic features are already generated at the EMR site. These events are reduced significantly by localised screening, proposed location within the EMR site increasing separation distances and maximising screening effects from existing industrial buildings. Furthermore, there are no outdoor amenity areas at the closest dwellings. Higher peaks of noise from shear loading may be audible at existing dwellings externally that could be annoying to some and may cause a change in attitude or behaviour. However, the EMR is an established industrial use in the area and noise with the same inherent acoustic features is expected within the local environment in continuance of that business.

Lowest Observed Adverse Effect Level				
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum	When the highest predicted specific sound levels and lowest measured background sound levels are applied I consider impact does not fall into this category. I do not consider observed adverse effects from operation of the shear are likely to occur at existing residential dwellings. It is possible noise levels would be heard when the most intensive shearing activity is occurring which coincides with the lowest background sound levels but then only briefly. I do not consider this would cause small changes in behaviour or attitude or any change in the perception of quality of life in the area considered in the context of existing EMR operations and the character of the area as a working dock generally. There is no requirement that adverse effects cannot occur but these are not predicted to arise with reference to BS4142 2014. The assessment by MAS recommends localised screening to mitigate and reduce noise impact to a minimum.
Significant Observed Adverse Effect Level				
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid	On balance, the assessment by MAS provides no evidence predicted levels, post implementation of mitigation measures, would cause a material change in behaviour and/or attitude of existing residents. I consider it unlikely residents would have to employ coping mechanisms to deal with noise from the shear and associated activity. No traditional garden areas face directly towards the EMR site at the closest residential dwellings and significant screening is provided by localised screening and existing structures.
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent	On balance, the noise assessment provides no evidence predicted noise levels, post implementation of mitigation measures, would be noticeable and very disruptive. My findings indicate the predicted noise levels with mitigation would not result in extensive or regular changes in behaviour at residential dwellings.

8.64 In summary, a comparison with the PPG noise exposure hierarchy demonstrates that post implementation of engineering measures, noise levels are predicted to be significantly lower reducing noise impact below the lowest observed adverse effect level in all cases. Observed adverse effects from predicted daytime noise levels are unlikely when the absolute worst case scenario is applied. The use of a container wall provides the option to increase screen heights from 4.8 (2x containers) to 7.2m (3x containers) with additional bracing etc. This is not considered necessary or recommended but is a further option to mitigate noise from the shear if perceived problems of noise impact arise.

8.65 Noise from industry generally has psycho-acoustical characteristics and contains character that would likely attract attention and lead to annoyance. However, the proposed shear is compatible with the current soundscape and predicted to be much lower than existing ambient/residual sound levels and at least 5dB lower than existing background sound levels.

8.66 Any predicted adverse noise impacts have been mitigated and reduced to a minimum and there is, therefore, compliance with national guidance including the NPSE (aims), NPPF (para 123) and PPG on noise (para 003).

8.67 Uncertainty in the assessment

8.68 A full list of factors contributing to uncertainty can be provided but those factors of greatest potential significance to the assessment are described below.

8.69 **Noise modelling.** Whilst reasonably accurate and useful, all modelling methods have limitations. They are approximate tools based on average situations. ISO 9613-2 is no exception. The standard clearly states it considers situations with an assumed wind speed up to 5m/s OR inversion conditions but not both.

8.70 Table 5 from the standard indicates the accuracy of noise levels from modelling which for a distance between 0 and 1000 metres there may be a +/- 3dB difference[30] below 5m height. Therefore, average predicted noise levels may be 3dB higher or lower than those shown by modelling. Table 5 concedes this estimate is based on a situation where there are no effects from reflections or attenuation due to screening. This is clearly the case here. Therefore the error factor may be greater in this modelling scenario. Note 24 from ISO 9613-2 states the estimates of accuracy in Table 5 should not necessarily agree with the variation in measurements at a site on a given day. In short ISO 9613-2 is saying the error can be expected to be significantly larger than the values outlined in Table 5 of the standard[31] under atypical conditions.

8.71 **Use of background sound levels.** This may be considered a limitation of the assessment. However, the MAS noise surveys show road traffic noise from Temple Town (localised traffic movements) to be the main contributors to the background sound environment along with localised industrial sources. Road traffic noise is generally benign, not associated with a particular person or premises and homogenous within the acoustic environment. The residual sound levels indicate relatively steady noise level arising from a steady flow of traffic.

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[30] Relevant to a mean source and receiver height of between 0-5 metres. Reference ISO 9613-2:1996. Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. ISO. Table 5 – Estimated accuracy for broadband noise lf LAT(DW) calculate using equations (1) to (10). Page 14.

8.72 The background sound levels measured close to Temple Town have been assumed to be similar at first, second and third floor level at Temple Town, Devonshire Street and Dock Street. For Dock Street this is considered conservative based on the significant contribution of noise from the constant flow of traffic along the A194. Whilst further from the road than Temple Town, the apartments are elevated above ground level and do not benefit from ground absorption and screening effects experienced closer to the ground. Given the elevated position and façade effects the background sound levels will likely be higher at this location. This is supported by spot measurement visits to the area and observations of traffic flow.

8.73 In my experience, background sound levels typically increase by 1-2dB per increase in floor level (assuming equal levels of screening, line of sight to noise source etc.). The BS4142 2014 assessments at increased elevation are, therefore, considered conservative as a an allowance for an increase in height (1-2dB per floor) would not be unreasonable. This is generally consistent with an increase in specific sound levels of 1-2dB per increase in floor level.

8.74 **Use of free field background sound levels.** The assessment compares free field background sound levels with predicted façade noise levels. Arguably an adjustment downwards to the BS4142 assessments is appropriate. However, this adjustment has not been made providing a conservative assessment somewhat offsetting any uncertainty with noise modelling.

8.75 **Use of maximum penalty for impulsivity.** The BS4142 2014 assessment assumes the maximum penalty for impulsivity from operation of the shear and associated handling. However, at

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[31] Reference ISO 9613-2:1996. Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. ISO. Table 5 page 14 and Note 24 page 13.

separation distances of 450m+ it is unlikely peaks of metals handling would be 'highly perceptible' both subjectively or using the reference method from BS4142 2014 annex E. This provides further conservatism to the assessment and increased headroom noise will not be of concern.

8.76 **Absence of existing metal piles within the site.** The MAS noise modelling assumes an empty site with no existing piles. In reality, many metals piles up to 8m+ exist on the site for long periods providing additional screening and attenuation.

8.77 On balance, uncertainty could be important where the initial estimate of impact is just below +5dB. However, the use of free field background sound levels and conservative adjustment to background sound levels at 4.5m+ provides additional headroom to the assessment. Observations of the soundscape with attended snap-shot measurements provide confirmation that the specific sound and background sound environment has been sufficiently characterised and assessed. Thus overall uncertainty is not an issue as there is significant headroom and reliable procedures have been adopted.

9.0 Conclusions

9.1 The application for fixed plant (shear) is proposed within an established metals handling site within the working Tyne Dock is located within around 450m of existing residential dwellings. The operation of the shear and associated preparatory and handling activity contains inherent acoustic features that attract attention and increase annoyance to the listener, especially when received in a home environment.

9.2 The proposed shear is located in established area of industrial activity where relatively high levels of residual and background noise from road traffic and industrial uses is typical.

9.3 The separation distance between the proposed shear and existing residential dwellings presents the need for localised screening at a height of 4.8m such that there is no demonstrable harm to amenity and headroom to unacceptable criteria is provided. A conservative assessment is presented.

9.4 This assessment is based on the inclusion localised screening, appropriate location, separation distance and maximisation of screening from existing industrial buildings close to the EMR site. Noise impact is reduces below any point that could be considered a significant observed adverse effect level or adverse effect level.

9.5 The site is considered suitable for new shear plant with regards to noise impact. The noise measurements and predictions indicate this locality is acoustically acceptable for residential development. The character of the area is mixed industrial and residential with steady flows of road traffic noise. Existing industrial sound from EMR and other premises arises close to the most exposed dwellings (Nos 1 and 2 Temple Town).

9.6 The MAS assessment shows an acceptable acoustic environment would be created (relative to the existing character of the area in context), post implementation of mitigation options, at dwellings with headroom between predicted levels and unacceptable criteria.

9.7 A comparison with planning practice guidance on noise and BS4142 2014 shows no significant observed adverse effects are likely to occur at residential dwellings considering the context of the proposed development.

9.8 Using worst case propagation conditions, typical worst case predicted sound levels compared to the lowest daytime background sound levels indicates the potential for adverse impact does not occur. This impact is considered worst case combining all the worst case scenarios and it is mitigated/reduced to a minimum by the noise mitigation scheme as required by national noise policy and guidance (NPPF, NPPG and NPSE). In those circumstances it falls well within acceptable criteria.

9.9 The proposed mitigation options are shown to reduce noise a minimum of 5dB below a level considered to be of marginal significance and a minimum of 0-3dB below a commonly applied Local Authority noise limit under the previous BS4142 1997 at all existing dwellings.

9.10 The site is suitable for the implementation of a shear and there is no conflict with any national or local planning policy. I do not consider noise, when considered in the context of noise and planning guidance, a reason for refusal.

Report by

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Appendix 1 - Glossary of acoustic terms

This glossary is harmonised with relevant British and ISO standards which are referenced. Some definitions vary slightly due to updates since written and with other noise guidance documents.

A-Weighting - This is a function which attempts to simulate the characteristics of human hearing at lower levels. Hence a dB(A) reading is an estimate of what we actually hear for quieter sounds whereas dB(LIN), {dB(C) on simpler instruments}, is an objective reading of what is actually physically present. However, for louder and low frequency sounds dB(C) correlates better to the human ear.

Note, dB(A) has been proven not to be so effective in weighting for human hearing at low frequencies.

Acoustic environment – Sound at the receiver from all sounds as modified by the environment. The acoustic environment can be the actual environment or simulated, outdoors or inside, as experienced or in memory. [ref BS ISO 12913-1 2014]

Ambient sound – Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far. The ambient sound comprises the residual sound and the specific sound when present. [ref BS4142 2014]

Ambient sound level (La = LAeq,T) – Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far at the assessment location over a given time interval, T. [ref BS4142 2014]

Attenuation – The loss in energy level of the sound usually used in relation to the loss due to sound passing through a structure or enclosure.

Background sound level (LA90,T) – The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest number of decibels. It is the underlying level of noise in the absence of the source and normally excludes most short duration noises (depending on time interval relative to the presence of source noise) (see **Residual sound level**). [ref BS4142 2014]

Background sound level ("influenced") - In many situations the background sound level can be measured either when the source or premises from which sound emanates, or is associated with, is not operating. Alternatively the intermittency of the source means that it does not have any appreciable effect on the background level, which is a statistical level based mainly on sound that continues with limited breaks. Where this is not the case the measured sound level will be increased and thus influenced.

Background sound level ("uninfluenced") - This refers to any measurement of the background sound level that has not been increased due to noise associated with the source.

Broadband Noise – This is noise covering the whole of the audible frequency range. Compare to narrow band noise which is noise made up of only a very narrow band of frequencies. It will normally exhibit tonality.

Character (of the noise) - Noise character refers to specific features of a noise or sound that render it more intrusive and / or more likely to attract a listeners attention. Noise character can refer to distinguishable or discrete continuous tones (for example hums, whines, hissing or screeching), distinct impulsivity (bangs, clatters, thumps, clicks, pulses) or any other irregularity that attracts attention or makes the noise readily distinctive in relation to the pre-existing acoustic environment.

Context - This includes the interrelationships between person and activity and place, in space and time. The context may influence the soundscape through auditory sensation, interpretation of auditory sensation and the responses to the acoustic environment (see **Soundscape**). Context is also objectively measured using weightings for character and emergence of the sound above the background sound environment (loudness and relative character).

C-Weighting – see **A-Weighting** above.

Decibel (dB) - A unit or level, derived from the logarithm of the ratio between the value of a noise energy quantity and a reference value. For sound pressure level the reference quantity is 20μPa, the threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain / instantaneous damage. A change of 1 dB is only perceptible under special conditions.

dB(A): (see A-Weighting) - This is decibels measured on a sound level meter weighted by a scale which is designed to reflect the weighting placed on noise by the human ear. A noise meter incorporates a frequency weighting device to create this differentiation. The dB(A) scale is now widely accepted.

Measurements in dB(A) broadly agree with people's assessment of loudness for broadband noise. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background sound level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).

dB(Z): The Z-weighting is a flat frequency response of 10Hz to 20kHz ±1.5dB. This response replaces the older "Linear" or "Unweighted" responses as these did not define the frequency range over which the meter would be linear.

Equivalent continuous A-weighted sound pressure level (LAeq,T) - The sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period. LAeq is used to describe many types of noise and can be measured directly with an integrating sound level meter. It is obtained by continuously integrating ('adding up the energy of') a fluctuating sound signal and dividing by the elapsed time, to give the true mathematical average of any time varying signal. An LAeq reading must always be related to a measurement time interval and should not be read as an instantaneous value of sound pressure.

Façade level - Sound pressure level 1m in front of the façade. Façade level measurements are typically 1 to 2dB higher than corresponding free-field measurements because of the reflection from the façade in BS8233 2014 but 2-3dB in many other standards and guidance documents giving a range of 1-3dB.

FFT (Fast Fourier transform) Analysis – A method using digital signal processing to produce very rapid narrowband frequency analysis of acoustic signals. It can be used to equate audible sounds into decibel levels and / or enable a range of analysis of temporal sounds.

Filtering - Octaves & 1/3 Octaves - In general most noise is broad band i.e. it contains energy in virtually all the frequencies across the audio range in different combinations so that it has certain recognisable characteristics. To determine the frequencies at which most of the energy is concentrated, a sound signal is filtered into bands, commonly octave and 1/3 octave bands. Information from such filtering is widely used for diagnostic work and to determine noise control measures. (see **Octave band 1/1** and **Octave band 1/3**)

Free-field level - Sound pressure level away from reflecting surfaces. These are typically measurements made between 1.2 to 1.5m above the ground and at least 3.5m away from other reflecting surfaces. To minimize the effect of reflections the measuring position has to be at least 3.5m to the side of the reflecting surface (not 3.5m from the reflecting surface in the direction of the source). [ref BS8233 2014]

Frequency – This is the number of air vibrations or pressure fluctuations per second. The unit is the hertz (Hz).

Hertz (Hz) – See **Frequency** above.

Impulsivity - Used to describe an acoustic feature of single or repeated sound events of short duration such as a bang, shot or sudden impact of metal on metal etc. It is generally assessed subjectively as perceived by the listener and demonstrates rapid onset in the change in sound level and overall change in sound level. [ref BS4142 2014]

Lnight,outside - The long term equivalent outdoor A weighted sound pressure level established over a period of a year during night time hours (8 hours, typically 23:00 - 07:00). The Lnight,outside is a key parameter of the WHO 2009 Night Noise guidelines which was taken from the Environmental Noise Directive and is typically taken at the facade without reflections (free field level) rather than the facade level given for night time noise disturbance in the WHO 1999 guidelines. It is normally measured / calculated at a height of 4m.

Logarithmic – A scale where the exponent indicating the power to which a fixed number, the base, must be raised to produce a given number. The base used in acoustics is 10. Thus the logarithm of 10 = 1, the logarithm of 100 = 2 and the logarithm of 1000 = 3. In terms of sound energy, an increase of 10 decibels equates to a 10 fold increase. The human ear is sensitive to a very wide range of sound pressure levels (intensities). Measuring human response to sound with a linear scale would not be practical as the scale would be too large and hence a logarithmic scale, in the form of decibels, is used.

Loudness – An observer's auditory impression of the strength of a sound. It is a subjective effect which is a function of the ear and brain as well as the amplitude and frequency of the sound. Whilst loudness is a subjective perception, a value can be attributed to loudness, which is typically measured in phons. Loudness is related to sound intensity and takes account of the sensitivity of the human to ear to certain frequencies.

Low frequency noise – This is normally considered to be noise ranging from 20 Hertz (pressure fluctuations per second) to 200 Hertz. In music it is the bass region as opposed to alto and soprano.

Masking – The process by which the threshold of hearing of one sound is raised due to the presence of another.

Maximum (A weighted) sound level (LAmax) - The highest value A-weighted sound level with a specified time weighting that occurs during a given event. The time weighting (see below) used (F or S) should be stated. All measurements were 'fast' in this survey. [ref BS5228-1 2009+A1 2014[32]]

Measurement time interval (Tm) - Total time over which measurements are taken. [ref BS4142 2014]

Meter response and time weightings - Most practical sound sources cause fluctuating readings. If the level fluctuates too rapidly, an analogue pointer may move so erratically that it will not be possible to obtain a meaningful reading, or with impulsive sound the meter may not respond quickly enough to obtain an authentic reading. Sound level meters are therefore provided with a variable time response control with settings:-

[32] This edition of BS5228-1 2009 includes updates from February 2014.

'S' Slow - Meter response is over damped with a time constant of approx 1 second or 1000ms. The setting tends to average out fluctuations in the readings.

'F' Fast - Permits the instrument to follow and indicate levels that do not fluctuate too rapidly; the time constant response is 125ms.

'I' Impulse - Uses a special electrical circuit with a time constant of about 35ms (of the same order as the response time of the human ear) to permit a very rapid response for investigating very sudden, short duration, impulsive sounds. This setting incorporates a detector which in effect stores the signal for sufficient time to allow it to be displayed.

Also a slow decay rate is incorporated with time response of approx 1500ms to allow more easy reading of the maximum value as the indicator moves back relatively slowly.

'P' Peak - Higher grade meters often incorporate this setting which enables the absolute peak (as opposed to the rms) value of an impulsive waveform to be measured. A time constant of the order of 20 - 50 micro seconds is now involved to permit the following of very sharp impulsive events. Evidently electrical signal storage is also required to permit the meter to register the peak of such very fast events.

Noise - Sound perceived by the receiver to be unwanted.

Octave band 1/1 (single) - Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit. [ref BS4142 2014]

Octave band 1/3 (third)- Band of frequencies in which the upper limit of the band is 21/3 times the frequency of the lower limit. [ref BS4142 2014]

Percentile level (LAN,T) - A-weighted sound pressure level obtained using time-weighting "F" which is exceeded for N% of a specified time interval. Typically the percentile level can be changed on modern sound level meters e.g. LA90,T, LA10,T, LA50,T etc. [ref BS8233 2014].

Examples

LA90,T: The A-weighted sound pressure level exceeded for 90% of the specified measurement time interval. It is a statistical measurement. In BS4142 2014 (and generally) it is used to describe the background sound level. Thus for a measurement time interval of 1 minute it would equate to the quietest 6 seconds of sound. For a measurement time interval of one hour it would be the quietest sound for 10% of the time (or 6 minutes). If a machine runs continuously without a reduction in sound for 54 minutes and then stops it would represent the quietest 6 minutes of sound but if run for 55 minutes it would represent the quietest period of machine sound.

LA10,T: The A-weighted sound pressure level exceeded for 10% of the time. It represents the highest sound pressure levels within any measurement time interval. The LA10,18hour is typically used as a measure of road traffic noise.

Pitch – Frequency is an objective measure whereas the term pitch is subjective and although mainly dependent on frequency, is also affected by intensity. See also **Tonality**.

Rating level (LAr,Tr) – The specific sound level of a source plus any adjustment (penalty or weighting) for the characteristic features of the sound. It is used in BS4142 2014 for rating and assessing industrial and commercial sound. [ref BS4142 2014 and BS7445-1 2003 for tonal character and impulsiveness of sound]

Receiver - Person or group of persons who are or who are expected to be exposed to environmental noise.

Reference time interval (Tr) - Specific interval over which the specific sound is determined. For BS4142 2014 this is 1 hour during the day from

0700 to 2300hrs and a shorter period of 15 min at night from 2300 to 0700hrs. [ref BS4142 2014]

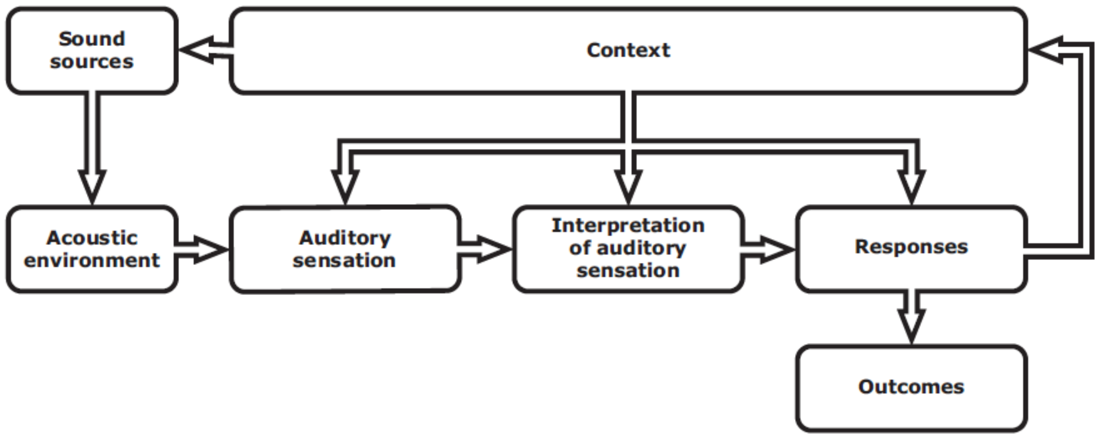
Residual sound level - Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T. [ref BS4142 2014]

Sound power level - Sound power is a measure of the flow of sound energy with reference to a unit of time measured in watts (W). The sound power level is an expression of this energy in a logarithmic scale. The sound power level, unlike the sound pressure level, is independent of room or environmental effects and distance.

Sound pressure level - Sound pressure is measured in pascals (Pa) and is created by fluctuations in air caused by sound. The sound pressure level is an expression of this pressure in decibels. The sound pressure level is variable depending on distance from the source and the interaction of the source with the environment (e.g. reflections).

Soundscape – The acoustic environment as perceived or experienced and/or understood by a person or people, in context (see **Acoustic environment** and **Context**). Figure 1 illustrates that soundscape is people's perceptions or experiences and/or understanding of an acoustic environment. The measurement, assessment or evaluation of soundscape is through the human perception of the acoustic environment.

Figure 1 - Elements in the perceptual construct of soundscape



[ref BS ISO 12913-1 2014]

Specific sound level (Ls = LAeq,Tr) - The equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given time interval, T. [ref BS4142 2014]

Tonality – Tonal sound gives a definite pitch sensation. It usually occurs where the sound energy in a narrow range of frequencies is greater than those either side of that narrow range. It will appear as a peak on a graph of sound energy shown in decibels versus the audible spectrum. It can often be shown by comparing adjoining octave band (1/3) spectra. A formal definition of tonality varies between standards. Where one 1/3rd octave band is more than 5dB above those either side, the noise contains a tone. [ref BS7445-2 1991 / ISO1996-2 1987]. In BS4142 2014 the level differences between adjacent 1/3rd octave bands that identify a tone are:

15dB in the lower frequencies (25Hz - 125Hz)

8dB in the mid frequencies (160Hz - 400Hz)

5dB in the higher frequencies (500Hz - 1000Hz)

Appendix 2 - Summary of qualifications and experience

My name is Daniel Baker and I am a fully qualified Senior Environmental Health Practitioner with additional qualifications in acoustics and noise. I have an MSc in Applied Acoustics and 14[33] years experience in this field. I have assessed a significant number of planning applications for local authorities and also assessed a considerable number of new developments.

I have a BSc (Hons) Environmental Health Degree and have undertaken a range of investigations[34] professionally for local authorities since 2004 as an Environmental Protection Officer and fully qualified as an Environmental Health Officer (EHO) in 2006. I registered with the Environmental Health Registration Board in 2006.

In addition to my EHO qualifications, I hold the Institute of Acoustics' Diploma in Acoustics and Noise Control (obtained 2008). I am a full member of both the Chartered Institute of Environmental Health (CIEH) and the Institute of Acoustics (IoA). I completed a Master of Science degree (MSc) in Applied Acoustics in 2013 (Merit).

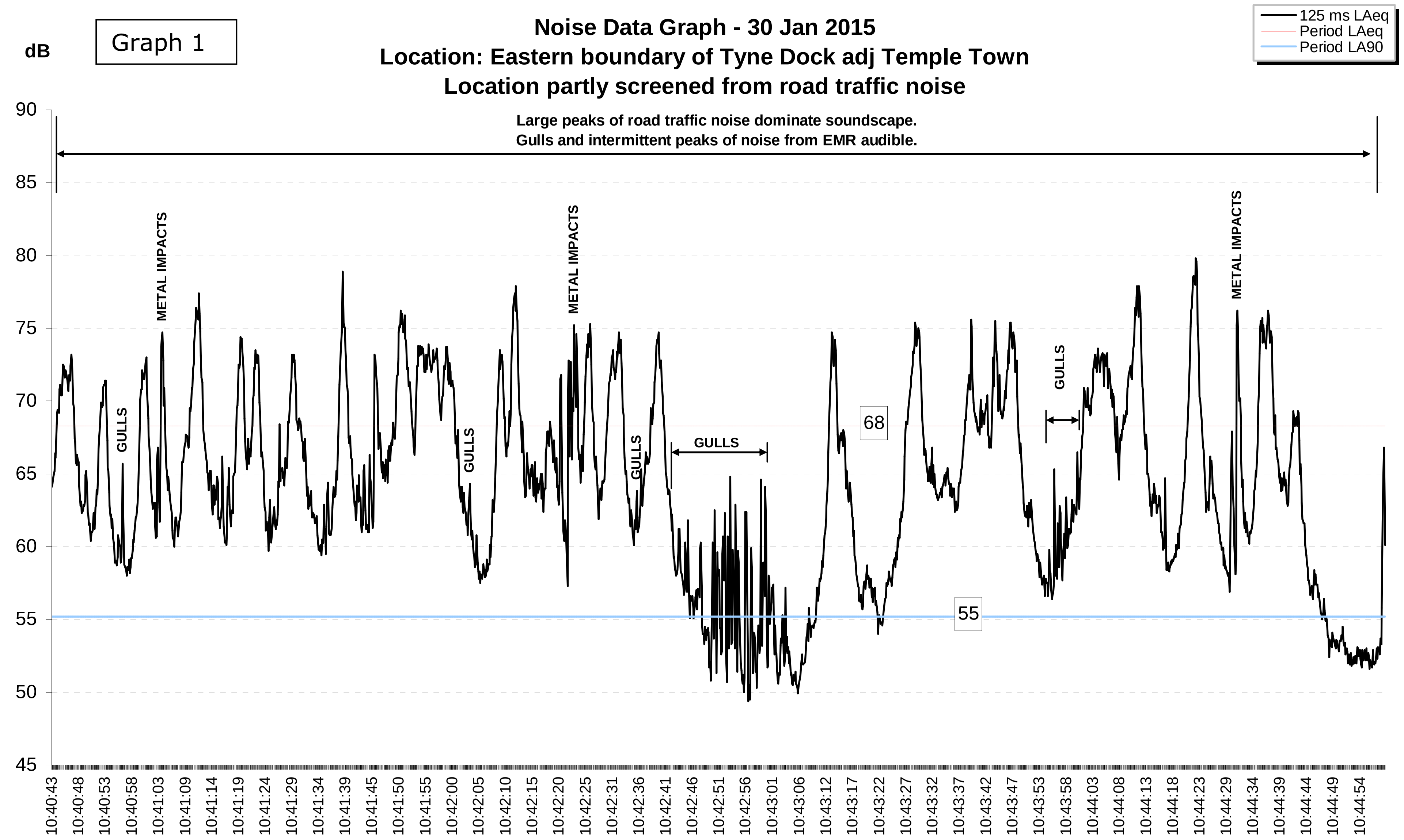
During my local government career I worked for two different local authorities between 2004 and 2010. Throughout that time I was heavily involved with and primarily specialised in nuisance issues, the use of statutory provisions and planning with associated noise issues. I have worked as a private consultant for MAS Environmental Ltd (MAS) since 2010 advising local authorities, private individuals and noise producers on a range of planning, nuisance and noise related issues. In February 2015 I published a technical note in a peer reviewed Journal titled "Application of noise guidance to the assessment of industrial noise with character on residential dwellings in the UK"[35].

[33] Including the study of Environmental Health at undergraduate level.

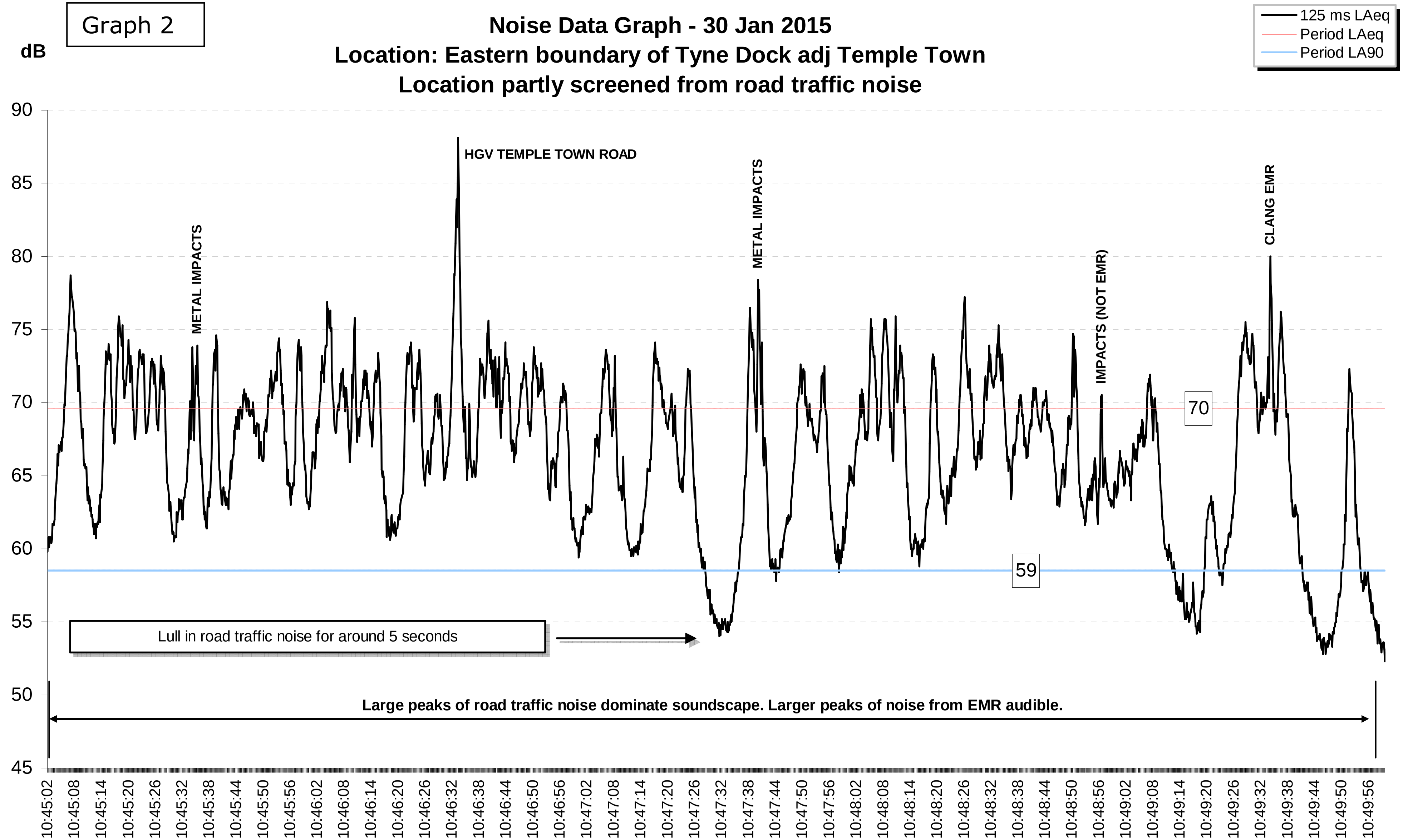
[34] Undertaking investigations for local authorities using a number of statutory provisions including the Environmental Protection Act 1990.

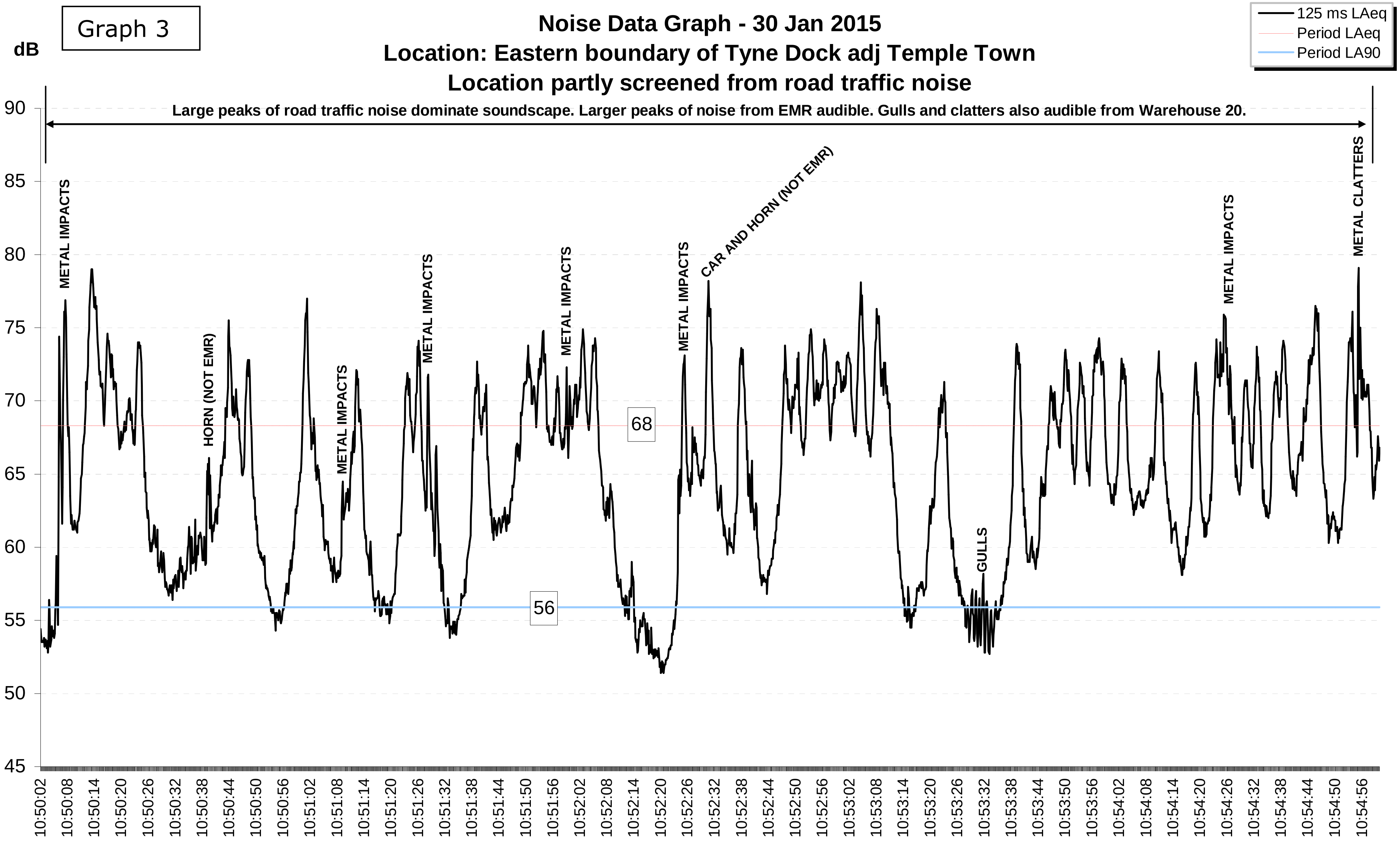
[35] Baker D. Application of noise guidance to the assessment of industrial noise with character on residential dwellings in the UK. Journal of Applied Acoustics 2015 Volume 93, Pages 88-96. Available at http://www.sciencedirect.com/science/article/pii/S0003682X15000298

Appendix 3 - Noise monitoring graphs 30/01/15

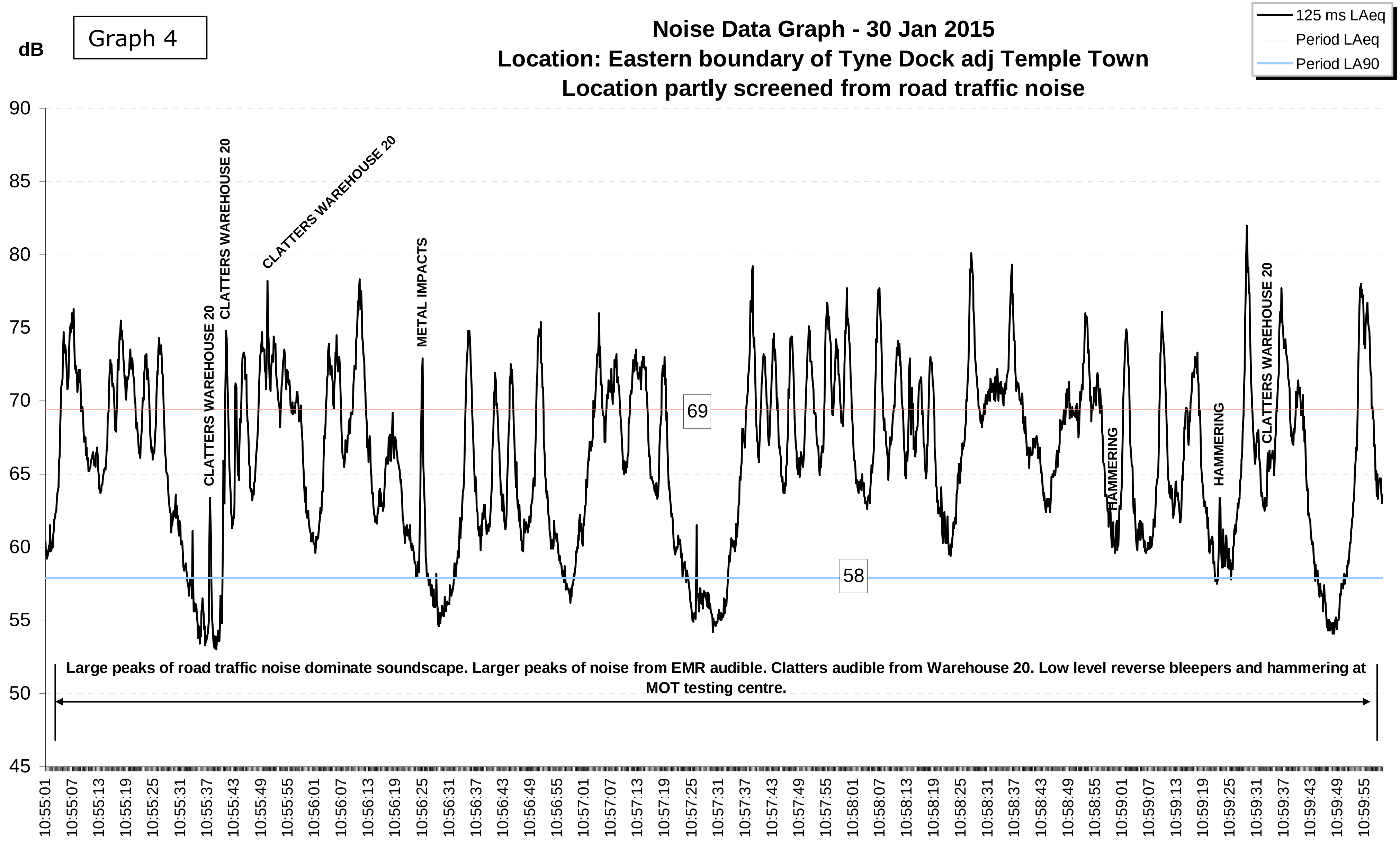


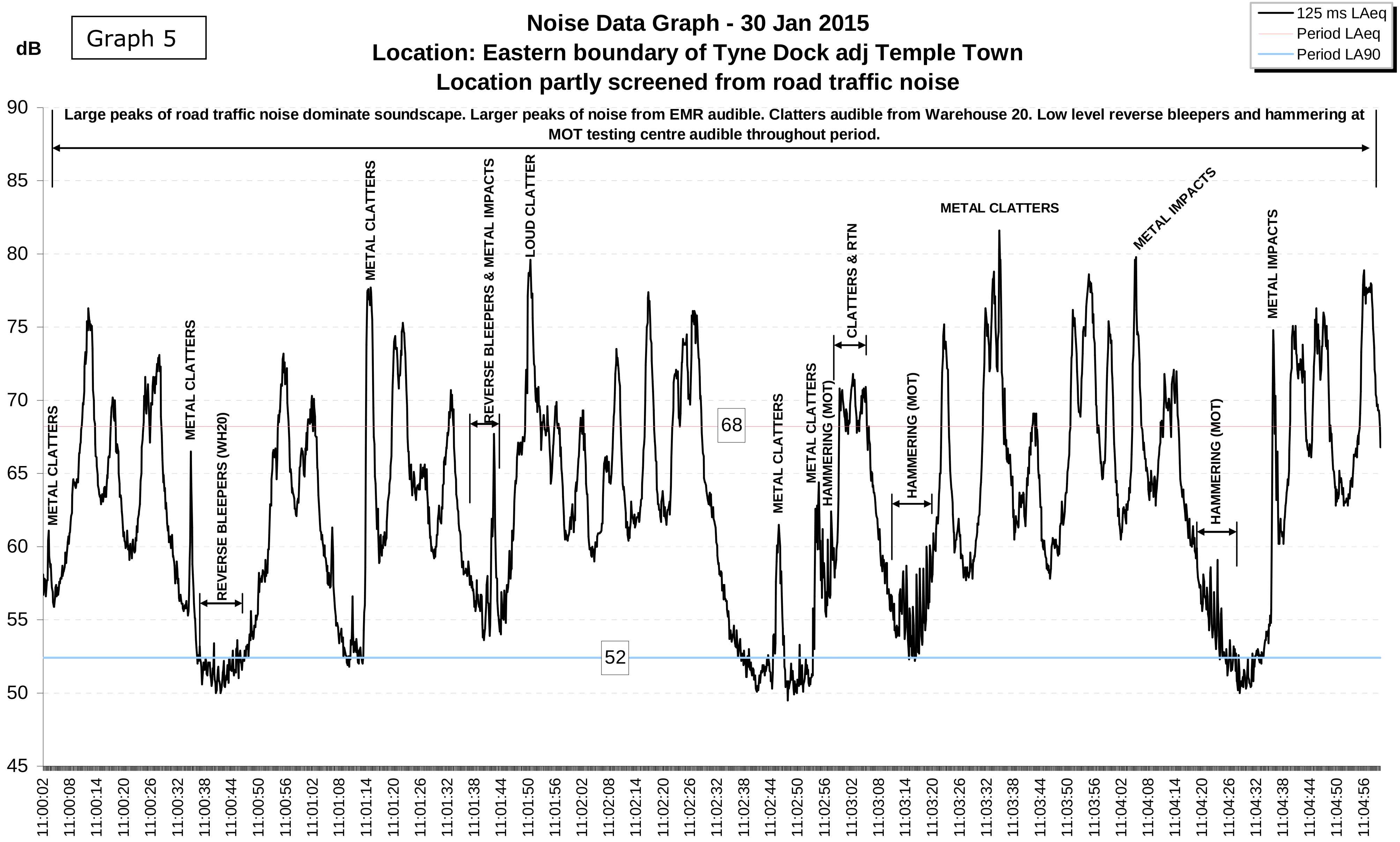
Graph 2


Noise Data Graph - 30 Jan 2015
Location: Eastern boundary of Tyne Dock adj Temple Town
Location partly screened from road traffic noise
dB
125 ms LAeq
Period LAeq
Period LA90
90
85
80
75
70
65
60
55
50
45
HGV TEMPLE TOWN ROAD
METAL IMPACTS
METAL IMPACTS
IMPACTS (NOT EMR)
CLANG EMR
70
59
Lull in road traffic noise for around 5 seconds
Large peaks of road traffic noise dominate soundscape. Larger peaks of noise from EMR audible.
10:45:02
10:45:08
10:45:14
10:45:20
10:45:26
10:45:32
10:45:38
10:45:44
10:45:50
10:45:56
10:46:02
10:46:08
10:46:14
10:46:20
10:46:26
10:46:32
10:46:38
10:46:44
10:46:50
10:46:56
10:47:02
10:47:08
10:47:14
10:47:20
10:47:26
10:47:32
10:47:38
10:47:44
10:47:50
10:47:56
10:48:02
10:48:08
10:48:14
10:48:20
10:48:26
10:48:32
10:48:38
10:48:44
10:48:50
10:48:56
10:49:02
10:49:08
10:49:14
10:49:20
10:49:26
10:49:32
10:49:38
10:49:44
10:49:50
10:49:56


Graph 3
dB
Noise Data Graph - 30 Jan 2015
Location: Eastern boundary of Tyne Dock adj Temple Town
Location partly screened from road traffic noise
125 ms LAeq
Period LAeq
Period LA90
Large peaks of road traffic noise dominate soundscape. Larger peaks of noise from EMR audible. Gulls and clatters also audible from Warehouse 20.
METAL IMPACTS
HORN (NOT EMR)
METAL IMPACTS
METAL IMPACTS
METAL IMPACTS
METAL IMPACTS
CAR AND HORN (NOT EMR)
GULLS
METAL IMPACTS
METAL CLATTERS
68
56
90
85
80
75
70
65
60
55
50
45
10:50:02
10:50:08
10:50:14
10:50:20
10:50:26
10:50:32
10:50:38
10:50:44
10:50:50
10:50:56
10:51:02
10:51:08
10:51:14
10:51:20
10:51:26
10:51:32
10:51:38
10:51:44
10:51:50
10:51:56
10:52:02
10:52:08
10:52:14
10:52:20
10:52:26
10:52:32
10:52:38
10:52:44
10:52:50
10:52:56
10:53:02
10:53:08
10:53:14
10:53:20
10:53:26
10:53:32
10:53:38
10:53:44
10:53:50
10:53:56
10:54:02
10:54:08
10:54:14
10:54:20
10:54:26
10:54:32
10:54:38
10:54:44
10:54:50
10:54:56

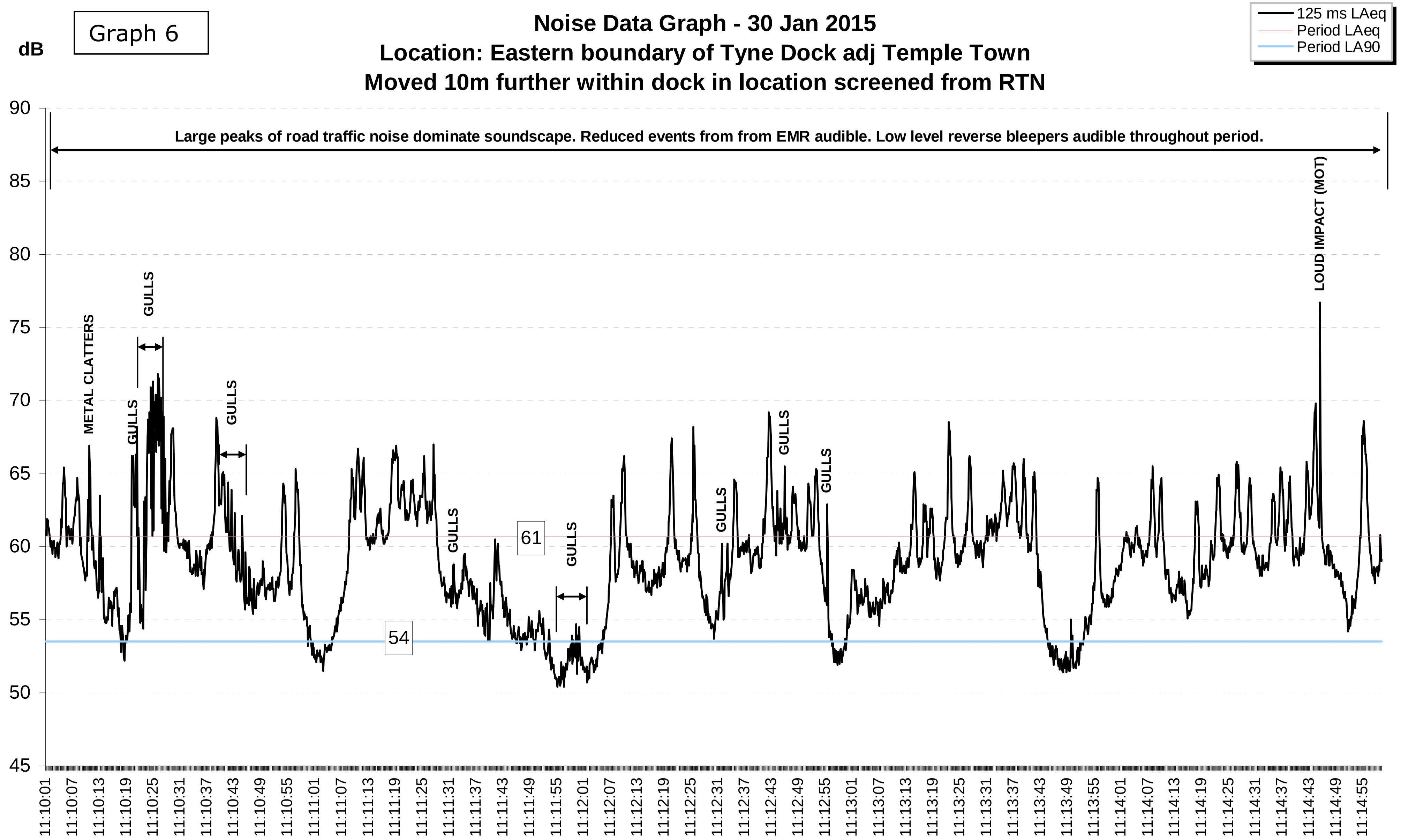
MAS ENVIRONMENTAL





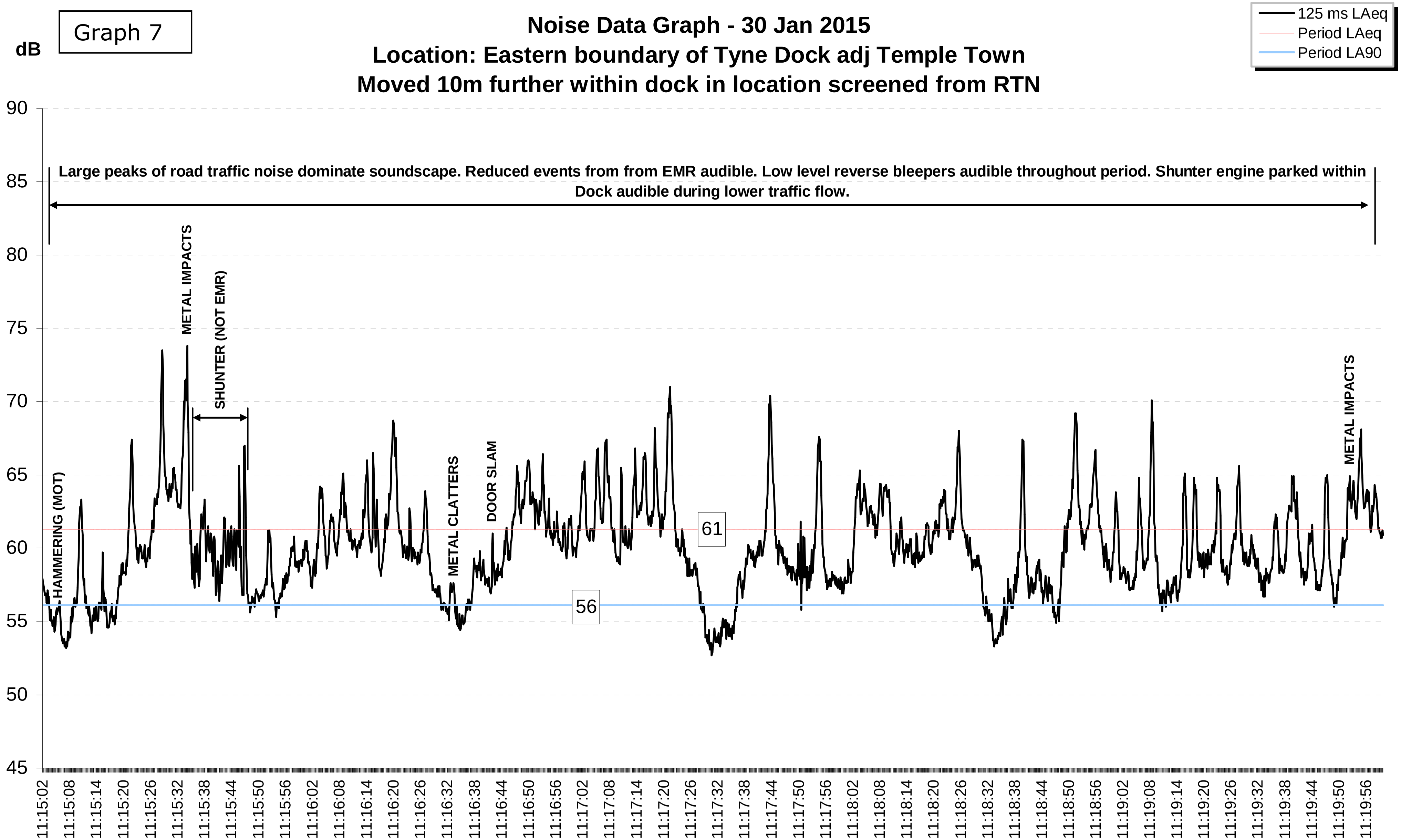
Graph 5
dB
Noise Data Graph - 30 Jan 2015
Location: Eastern boundary of Tyne Dock adj Temple Town
Location partly screened from road traffic noise
125 ms LAeq
Period LAeq
Period LA90
Large peaks of road traffic noise dominate soundscape. Larger peaks of noise from EMR audible. Clatters audible from Warehouse 20. Low level reverse bleepers and hammering at MOT testing centre audible throughout period.
METAL CLATTERS
METAL CLATTERS
REVERSE BLEEPERS (WH20)
METAL CLATTERS
REVERSE BLEEPERS & METAL IMPACTS
LOUD CLATTER
68
52
METAL CLATTERS
METAL CLATTERS
HAMMERING (MOT)
CLATTERS & RTN
HAMMERING (MOT)
METAL CLATTERS
METAL IMPACTS
HAMMERING (MOT)
METAL IMPACTS
90
85
80
75
70
65
60
55
50
45
11:00:02
11:00:08
11:00:14
11:00:20
11:00:26
11:00:32
11:00:38
11:00:44
11:00:50
11:00:56
11:01:02
11:01:08
11:01:14
11:01:20
11:01:26
11:01:32
11:01:38
11:01:44
11:01:50
11:01:56
11:02:02
11:02:08
11:02:14
11:02:20
11:02:26
11:02:32
11:02:38
11:02:44
11:02:50
11:02:56
11:03:02
11:03:08
11:03:14
11:03:20
11:03:26
11:03:32
11:03:38
11:03:44
11:03:50
11:03:56
11:04:02
11:04:08
11:04:14
11:04:20
11:04:26
11:04:32
11:04:38
11:04:44
11:04:50
11:04:56

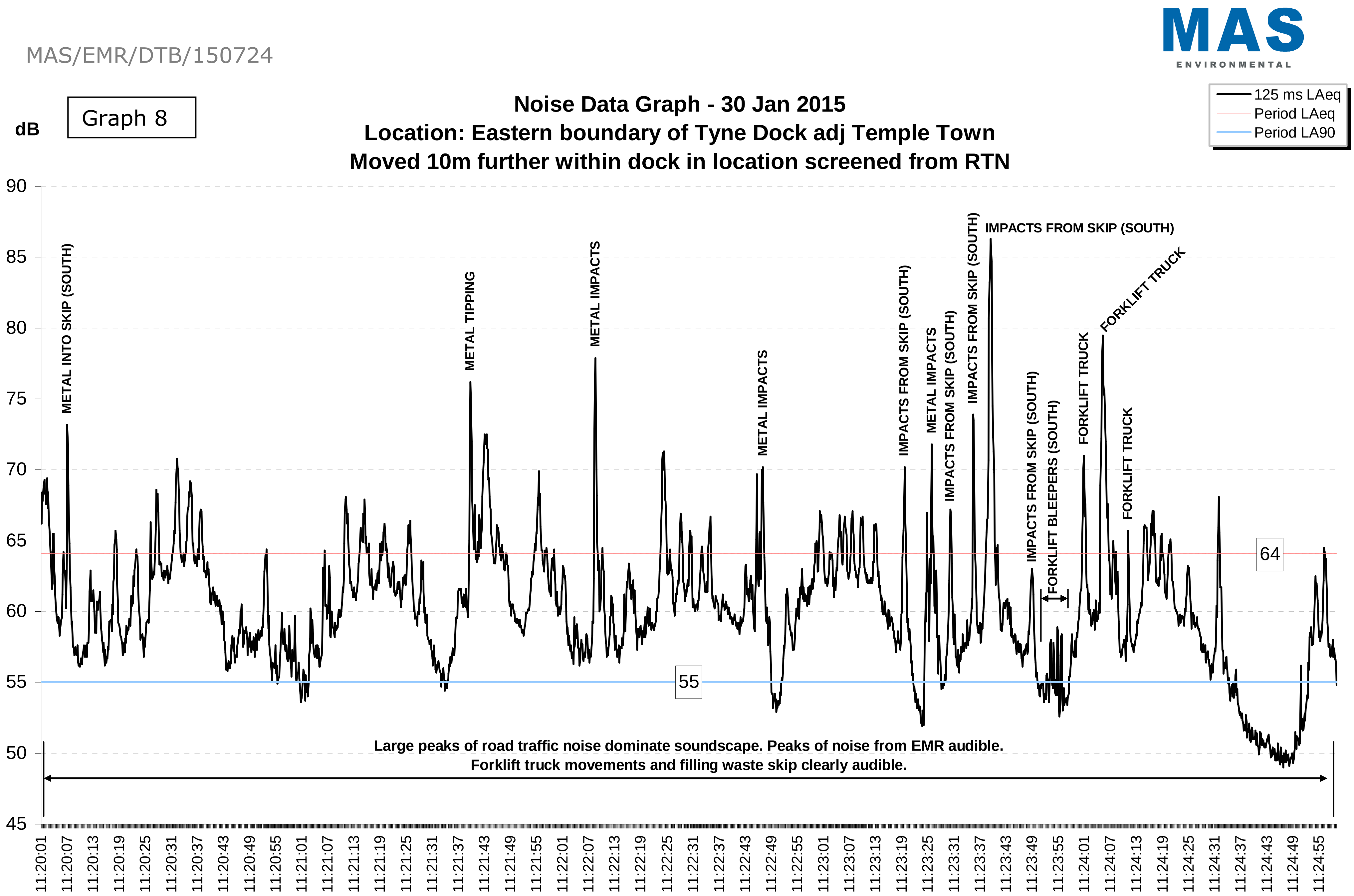
Graph 6



Noise Data Graph - 30 Jan 2015
Location: Eastern boundary of Tyne Dock adj Temple Town
Moved 10m further within dock in location screened from RTN
dB
125 ms LAeq
Period LAeq
Period LA90
Large peaks of road traffic noise dominate soundscape. Reduced events from from EMR audible. Low level reverse bleepers audible throughout period.
METAL CLATTERS
GULLS
GULLS
GULLS
GULLS
GULLS
GULLS
GULLS
GULLS
LOUD IMPACT (MOT)
54
61
90
85
80
75
70
65
60
55
50
45
11:10:01
11:10:07
11:10:13
11:10:19
11:10:25
11:10:31
11:10:37
11:10:43
11:10:49
11:10:55
11:11:01
11:11:07
11:11:13
11:11:19
11:11:25
11:11:31
11:11:37
11:11:43
11:11:49
11:11:55
11:12:01
11:12:07
11:12:13
11:12:19
11:12:25
11:12:31
11:12:37
11:12:43
11:12:49
11:12:55
11:13:01
11:13:07
11:13:13
11:13:19
11:13:25
11:13:31
11:13:37
11:13:43
11:13:49
11:13:55
11:14:01
11:14:07
11:14:13
11:14:19
11:14:25
11:14:31
11:14:37
11:14:43
11:14:49
11:14:55

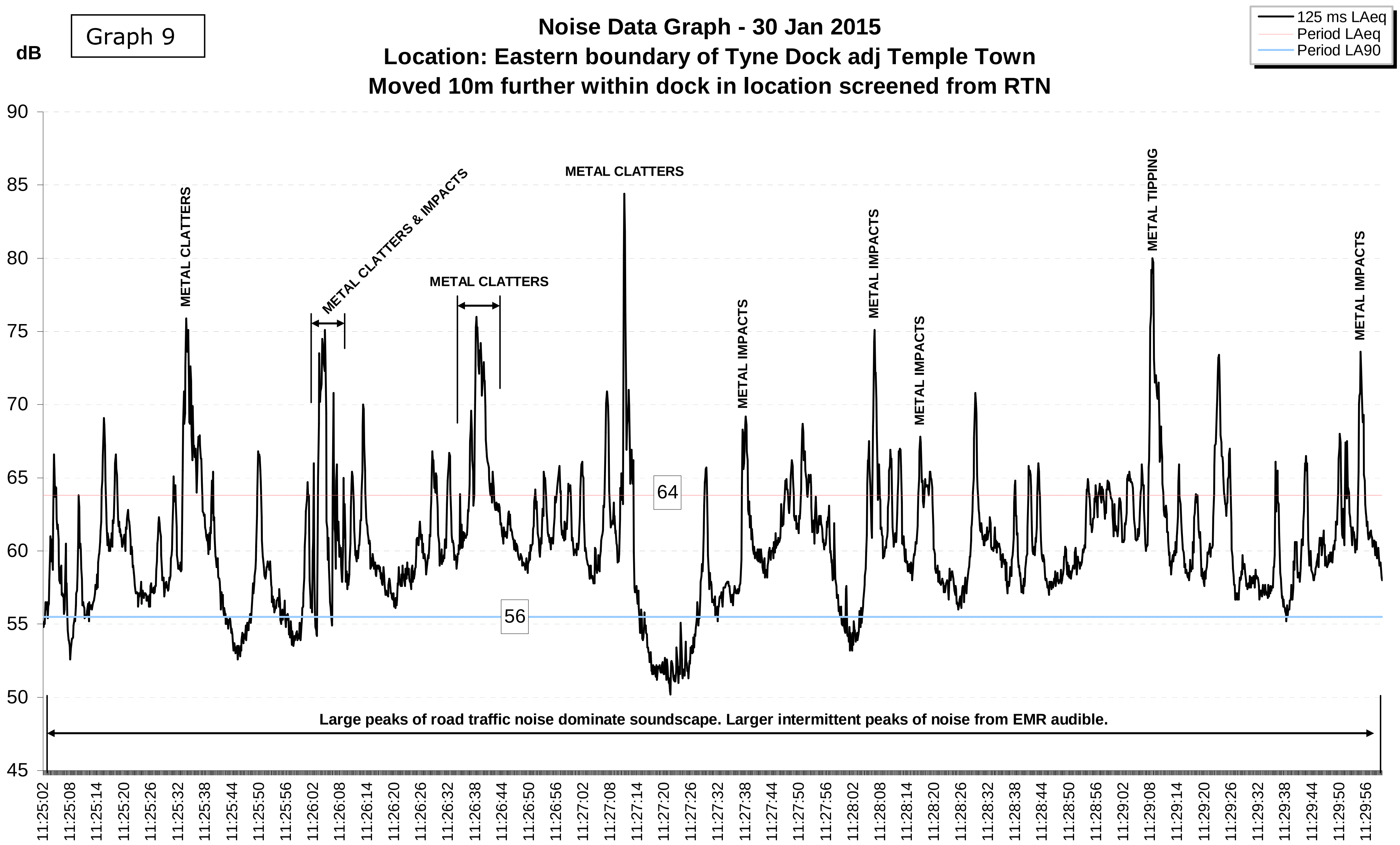
Graph 7


Noise Data Graph - 30 Jan 2015
Location: Eastern boundary of Tyne Dock adj Temple Town
Moved 10m further within dock in location screened from RTN
dB
125 ms LAeq
Period LAeq
Period LA90
Large peaks of road traffic noise dominate soundscape. Reduced events from from EMR audible. Low level reverse bleepers audible throughout period. Shunter engine parked within Dock audible during lower traffic flow.
HAMMERING (MOT)
METAL IMPACTS
SHUNTER (NOT EMR)
METAL CLATTERS
DOOR SLAM
METAL IMPACTS
61
56
90
85
80
75
70
65
60
55
50
45
11:15:02
11:15:08
11:15:14
11:15:20
11:15:26
11:15:32
11:15:38
11:15:44
11:15:50
11:15:56
11:16:02
11:16:08
11:16:14
11:16:20
11:16:26
11:16:32
11:16:38
11:16:44
11:16:50
11:16:56
11:17:02
11:17:08
11:17:14
11:17:20
11:17:26
11:17:32
11:17:38
11:17:44
11:17:50
11:17:56
11:18:02
11:18:08
11:18:14
11:18:20
11:18:26
11:18:32
11:18:38
11:18:44
11:18:50
11:18:56
11:19:02
11:19:08
11:19:14
11:19:20
11:19:26
11:19:32
11:19:38
11:19:44
11:19:50
11:19:56

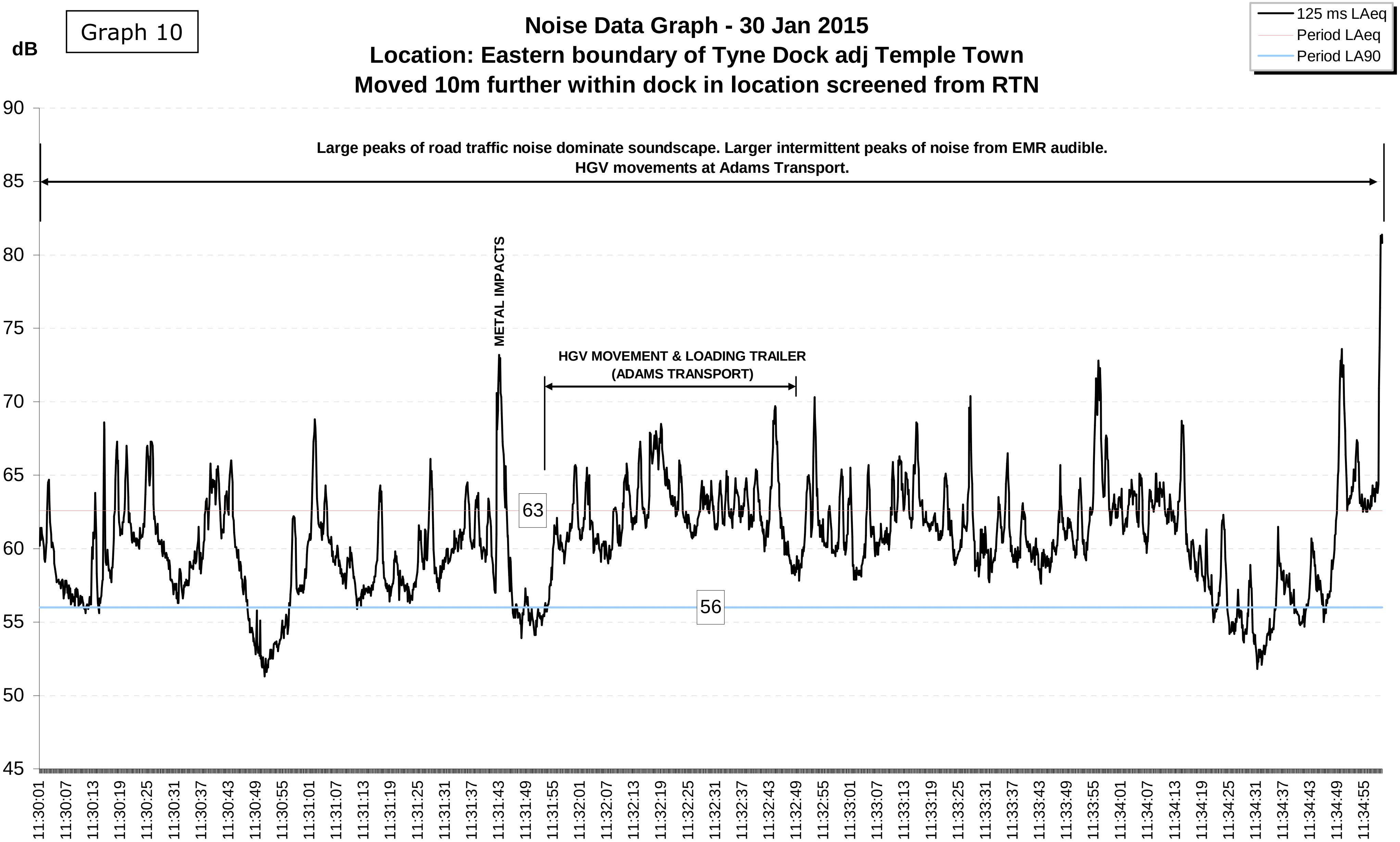

MAS
ENVIRONMENTAL
125 ms LAeq
Period LAeq
Period LA90
dB
Graph 8
Noise Data Graph - 30 Jan 2015
Location: Eastern boundary of Tyne Dock adj Temple Town
Moved 10m further within dock in location screened from RTN
METAL INTO SKIP (SOUTH)
METAL TIPPING
METAL IMPACTS
METAL IMPACTS
IMPACTS FROM SKIP (SOUTH)
METAL IMPACTS
IMPACTS FROM SKIP (SOUTH)
IMPACTS FROM SKIP (SOUTH)
IMPACTS FROM SKIP (SOUTH)
IMPACTS FROM SKIP (SOUTH)
FORKLIFT BLEEPERS (SOUTH)
FORKLIFT TRUCK
FORKLIFT TRUCK
FORKLIFT TRUCK
64
55
Large peaks of road traffic noise dominate soundscape. Peaks of noise from EMR audible.
Forklift truck movements and filling waste skip clearly audible.
90
85
80
75
70
65
60
55
50
45
11:20:01
11:20:07
11:20:13
11:20:19
11:20:25
11:20:31
11:20:37
11:20:43
11:20:49
11:20:55
11:21:01
11:21:07
11:21:13
11:21:19
11:21:25
11:21:31
11:21:37
11:21:43
11:21:49
11:21:55
11:22:01
11:22:07
11:22:13
11:22:19
11:22:25
11:22:31
11:22:37
11:22:43
11:22:49
11:22:55
11:23:01
11:23:07
11:23:13
11:23:19
11:23:25
11:23:31
11:23:37
11:23:43
11:23:49
11:23:55
11:24:01
11:24:07
11:24:13
11:24:19
11:24:25
11:24:31
11:24:37
11:24:43
11:24:49
11:24:55

MAS ENVIRONMENTAL

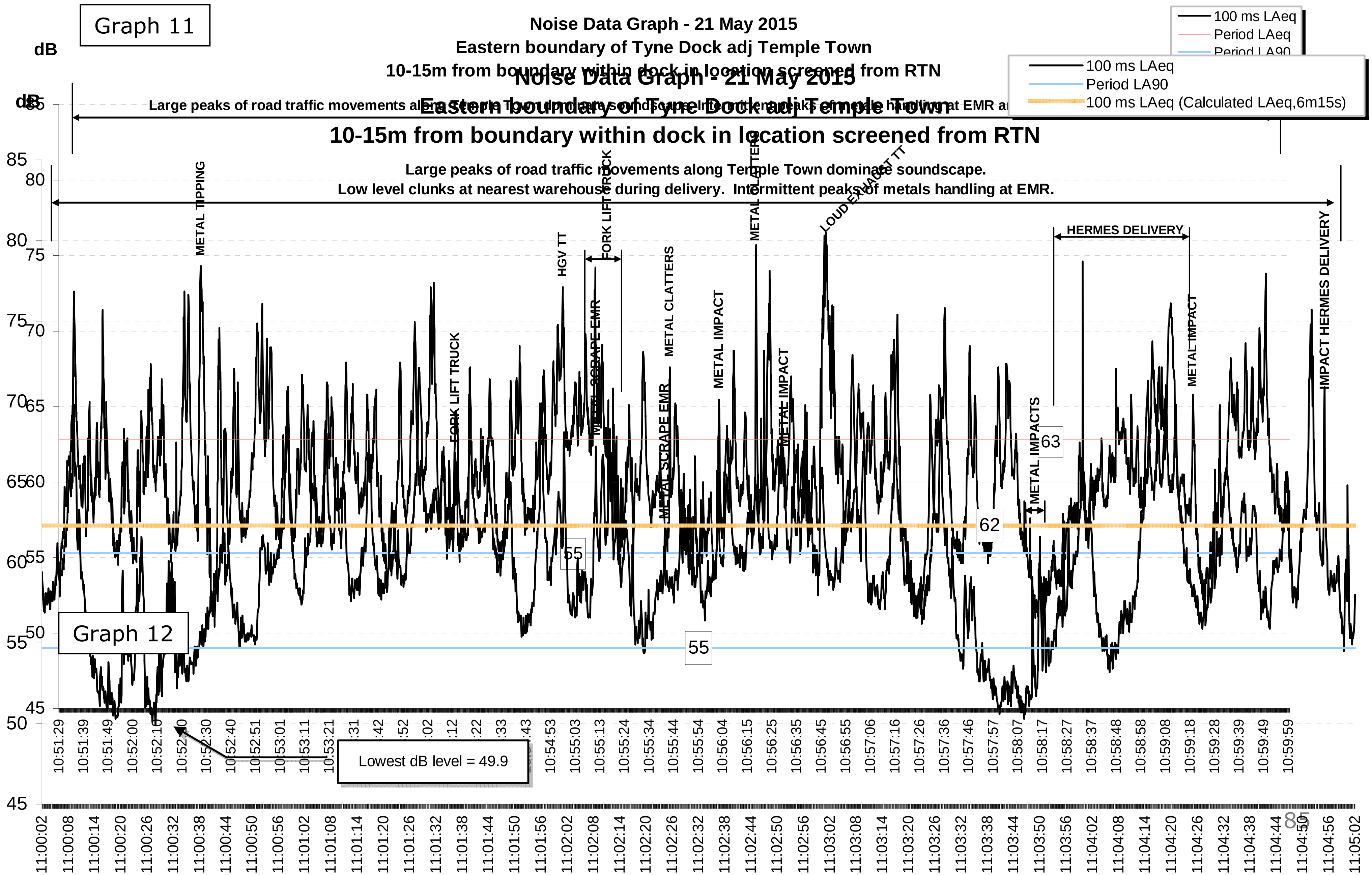
Graph 9



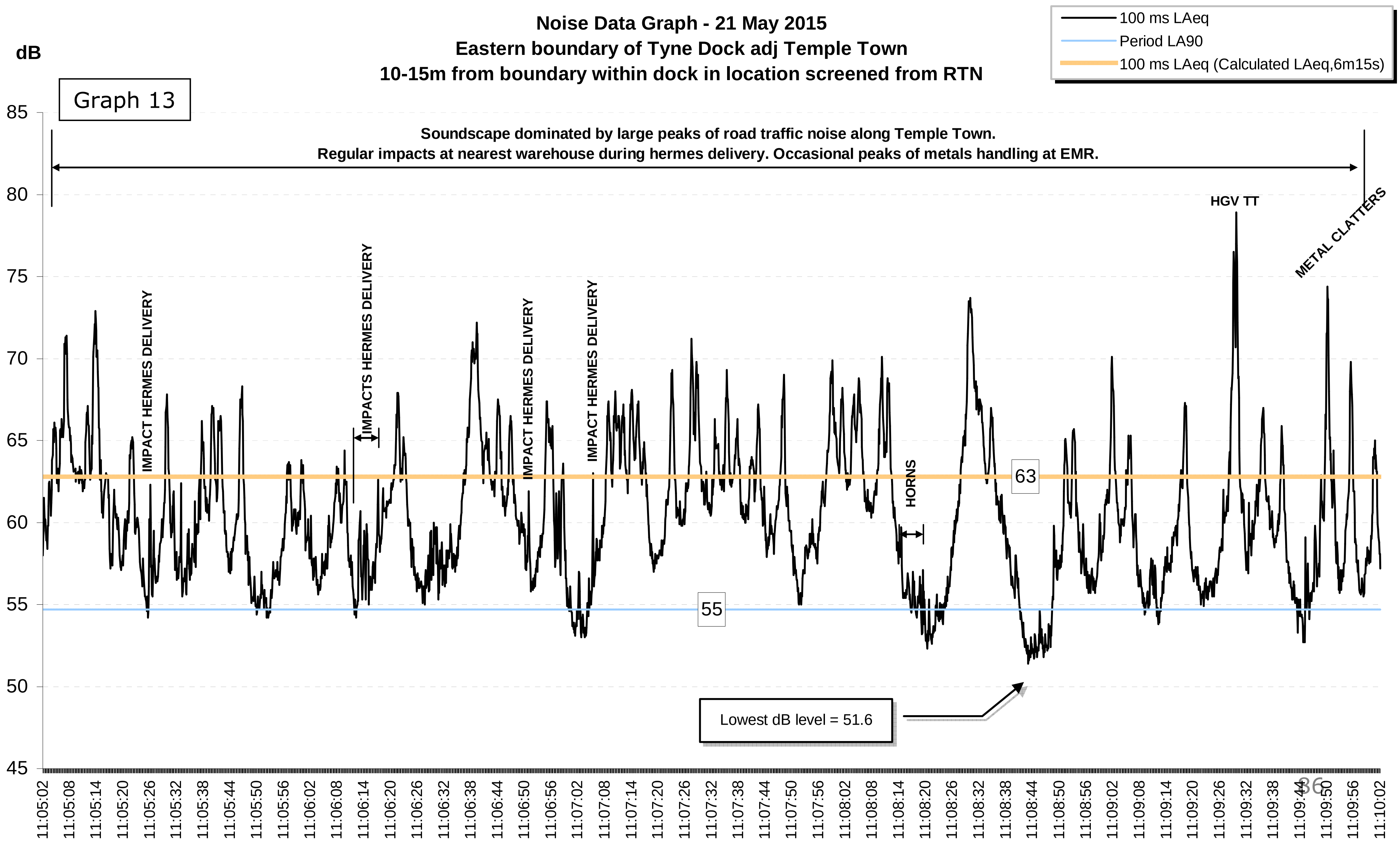
Graph 10


dB
Noise Data Graph - 30 Jan 2015
Location: Eastern boundary of Tyne Dock adj Temple Town
Moved 10m further within dock in location screened from RTN
125 ms LAeq
Period LAeq
Period LA90
Large peaks of road traffic noise dominate soundscape. Larger intermittent peaks of noise from EMR audible.
HGV movements at Adams Transport.
METAL IMPACTS
HGV MOVEMENT & LOADING TRAILER
(ADAMS TRANSPORT)
63
56
90
85
80
75
70
65
60
55
50
45
11:30:01
11:30:07
11:30:13
11:30:19
11:30:25
11:30:31
11:30:37
11:30:43
11:30:49
11:30:55
11:31:01
11:31:07
11:31:13
11:31:19
11:31:25
11:31:31
11:31:37
11:31:43
11:31:49
11:31:55
11:32:01
11:32:07
11:32:13
11:32:19
11:32:25
11:32:31
11:32:37
11:32:43
11:32:49
11:32:55
11:33:01
11:33:07
11:33:13
11:33:19
11:33:25
11:33:31
11:33:37
11:33:43
11:33:49
11:33:55
11:34:01
11:34:07
11:34:13
11:34:19
11:34:25
11:34:31
11:34:37
11:34:43
11:34:49
11:34:55

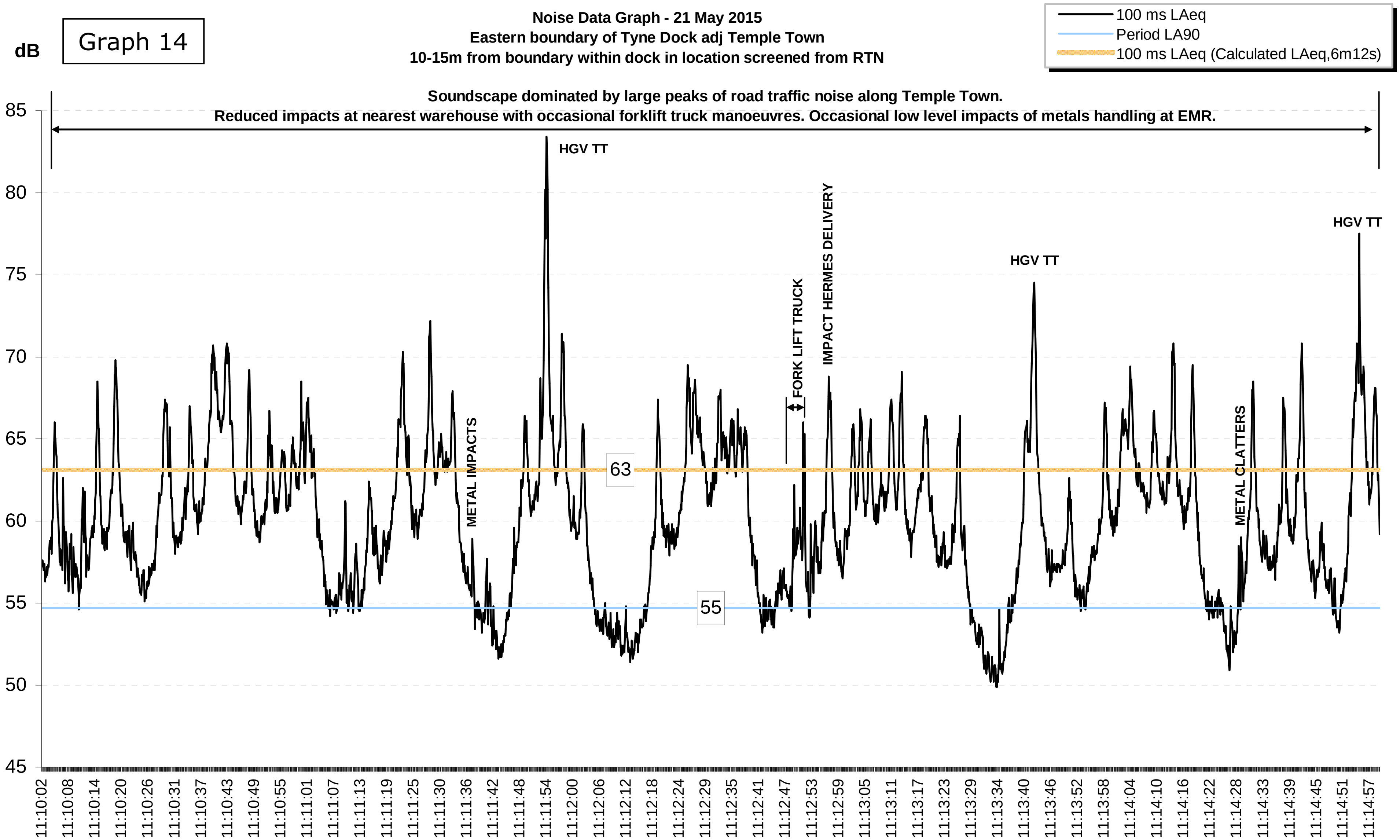
Appendix 4 - Noise monitoring graphs 21/05/15



MAS ENVIRONMENTAL



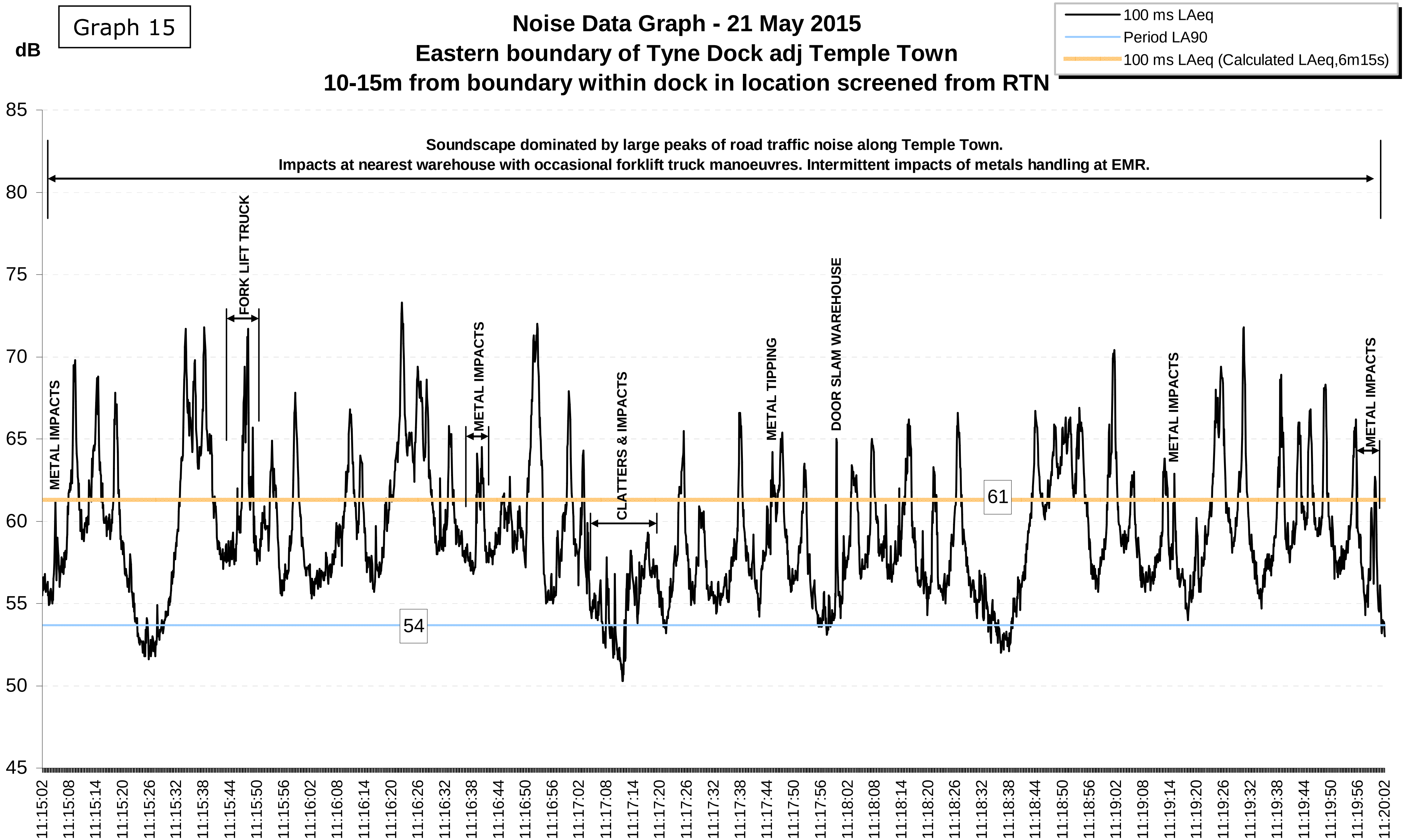
MAS ENVIRONMENTAL



MAS ENVIRONMENTAL

Graph 15

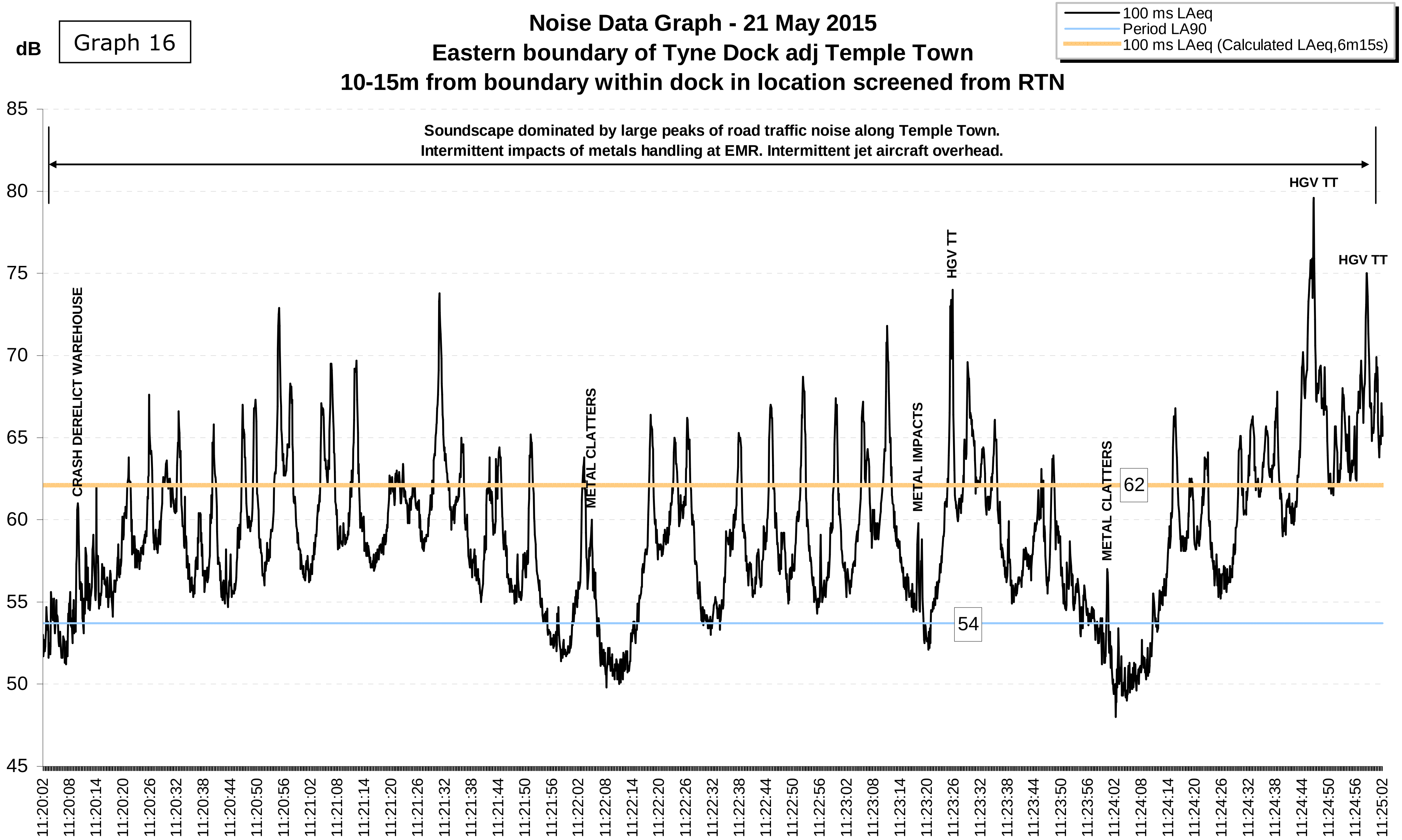
Noise Data Graph - 21 May 2015
Eastern boundary of Tyne Dock adj Temple Town
10-15m from boundary within dock in location screened from RTN



MAS ENVIRONMENTAL

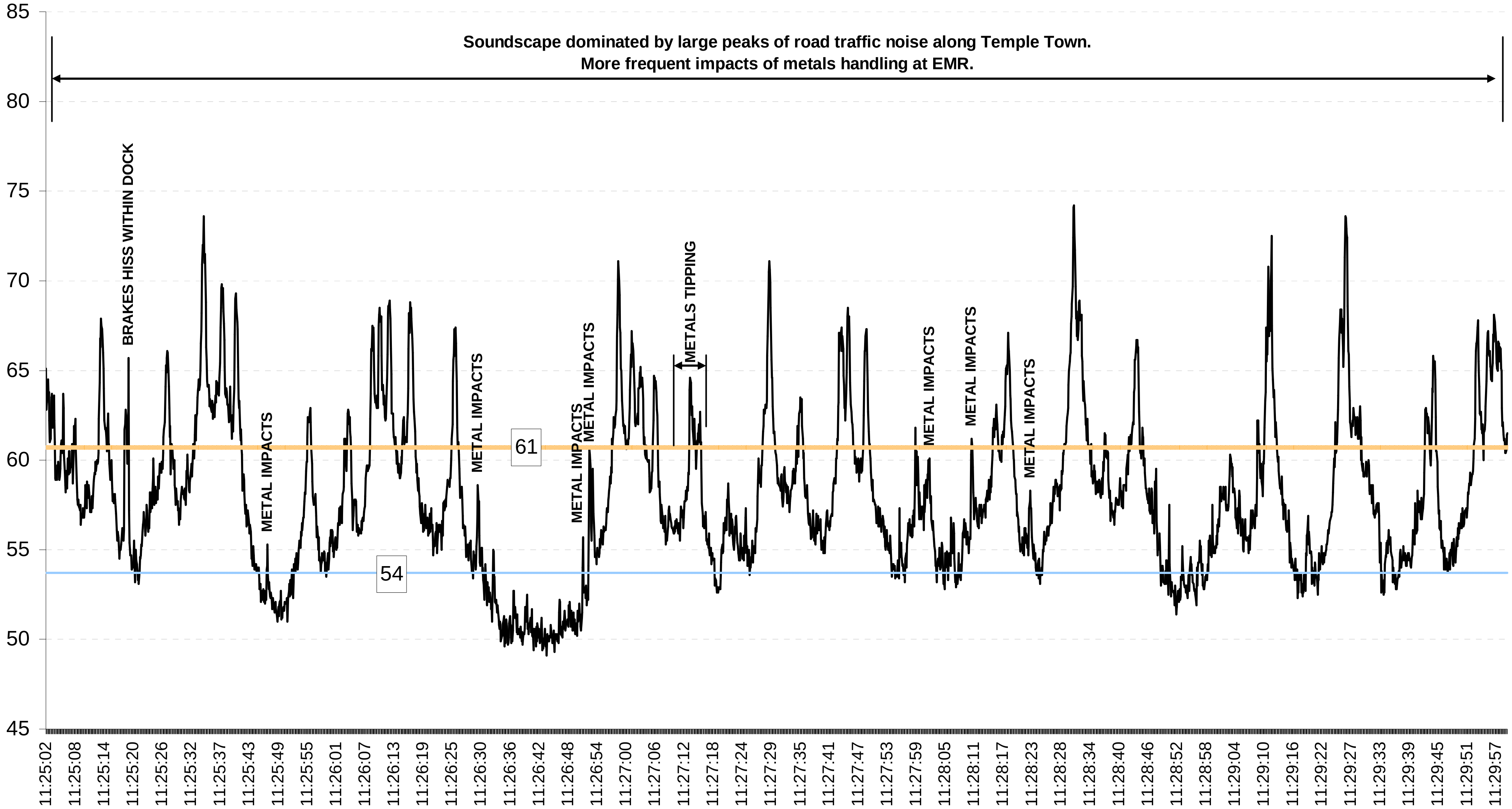
Graph 16

Noise Data Graph - 21 May 2015
Eastern boundary of Tyne Dock adj Temple Town
10-15m from boundary within dock in location screened from RTN



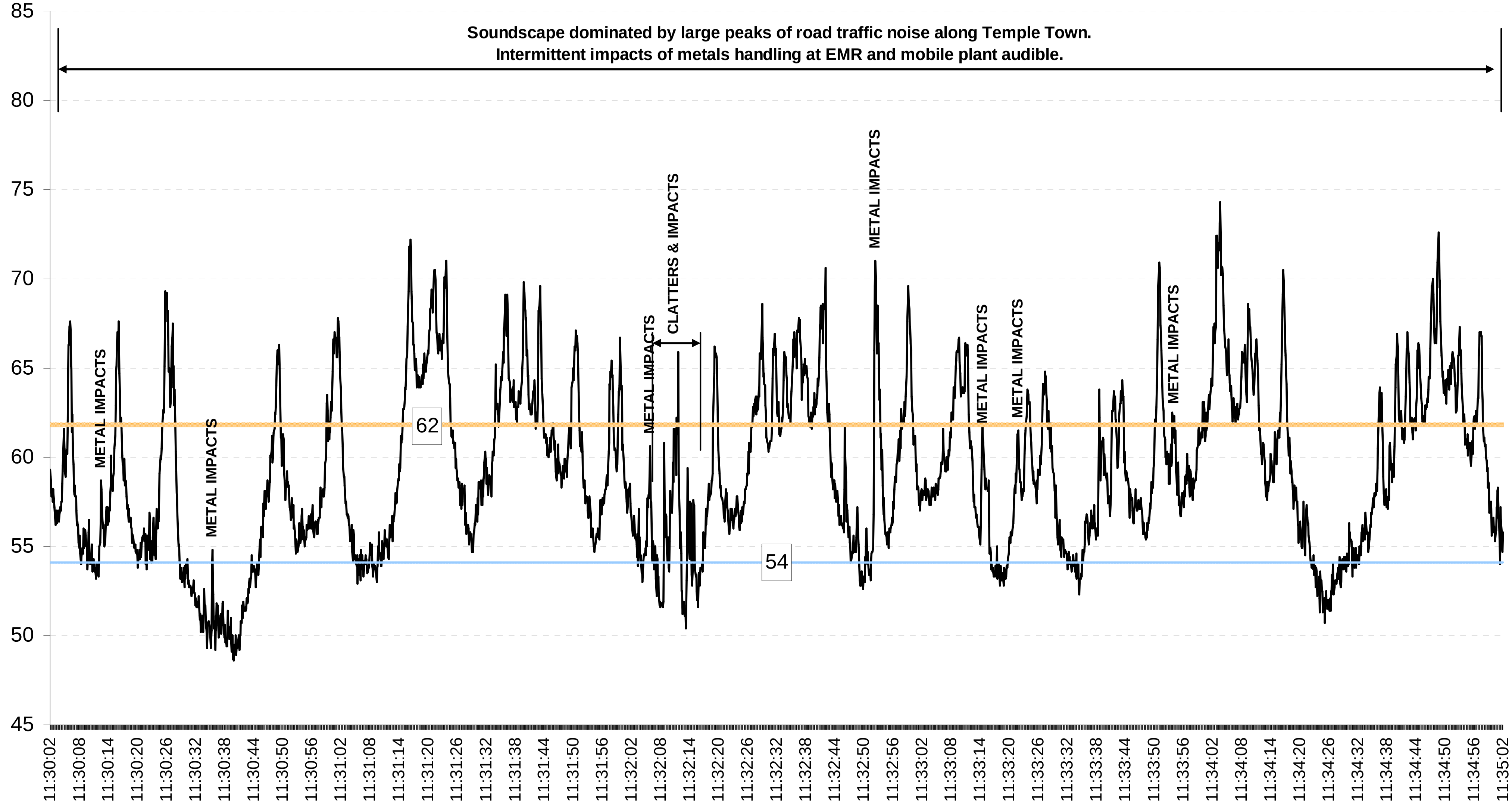
Graph 17

Noise Data Graph - 21 May 2015
Eastern boundary of Tyne Dock adj Temple Town
10-15m from boundary within dock in location screened from RTN



Graph 18

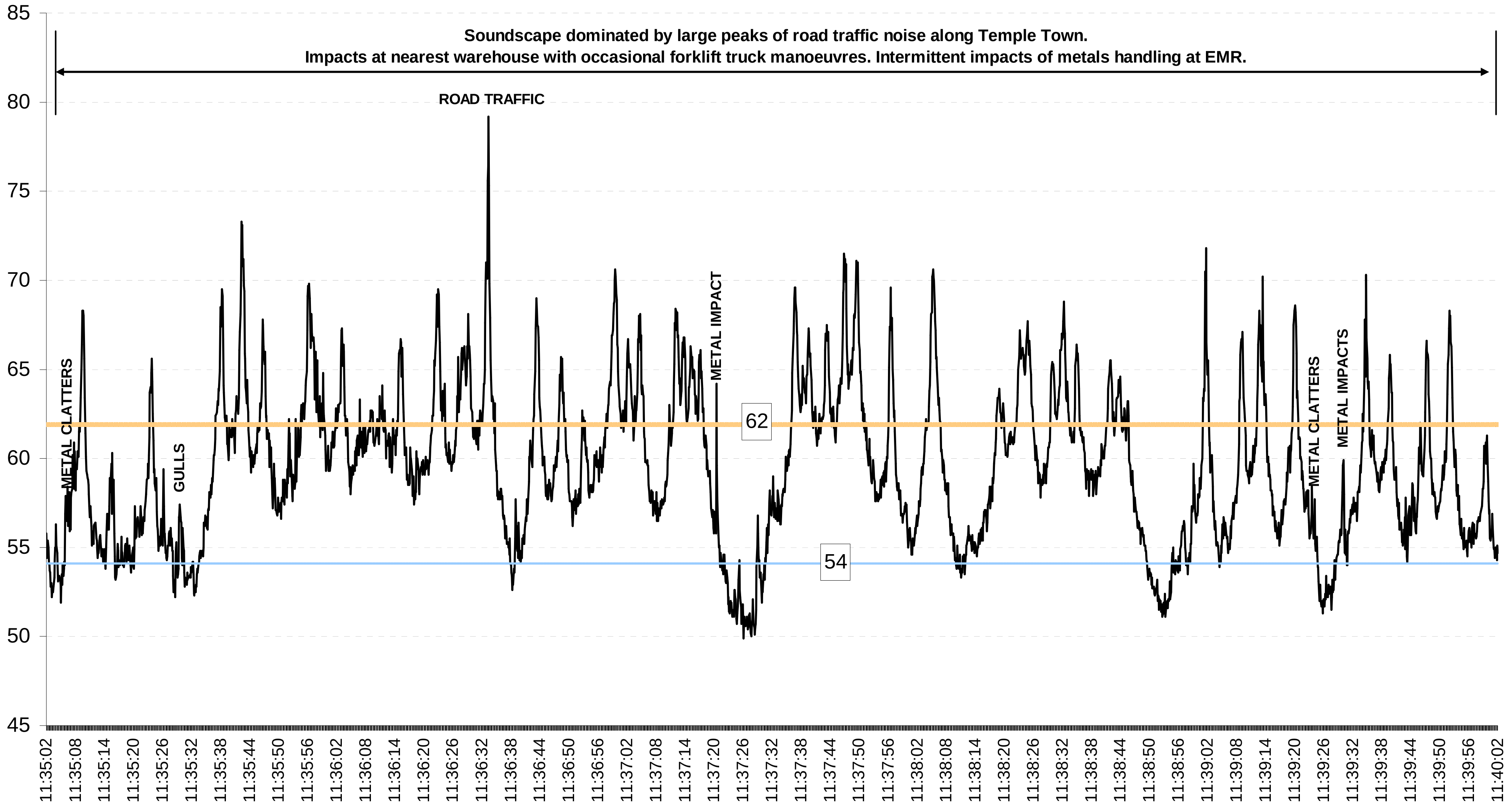
Noise Data Graph - 21 May 2015
Eastern boundary of Tyne Dock adj Temple Town
10-15m from boundary within dock in location screened from RTN



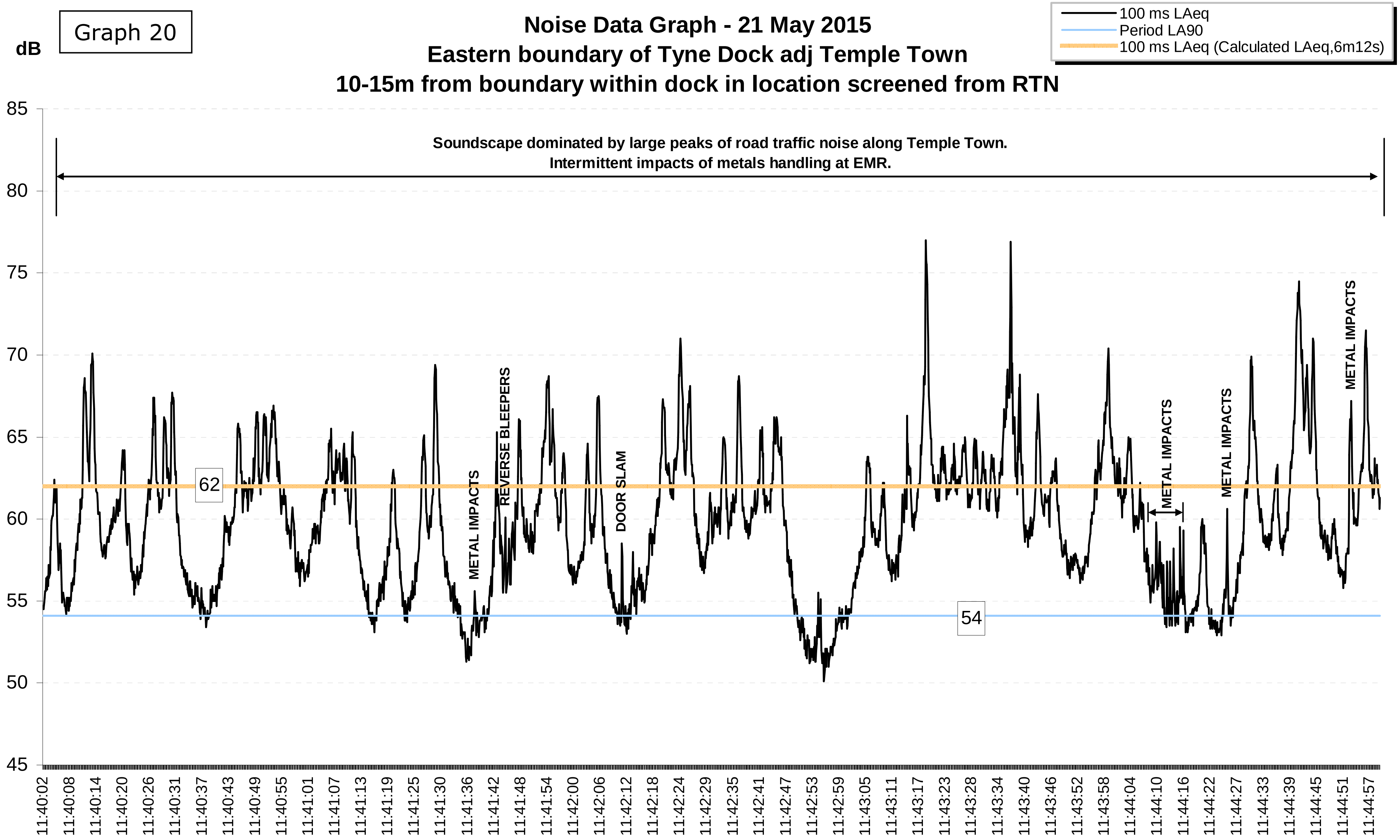
MAS ENVIRONMENTAL

Graph 19

Noise Data Graph - 21 May 2015
Eastern boundary of Tyne Dock adj Temple Town
10-15m from boundary within dock in location screened from RTN



Graph 20



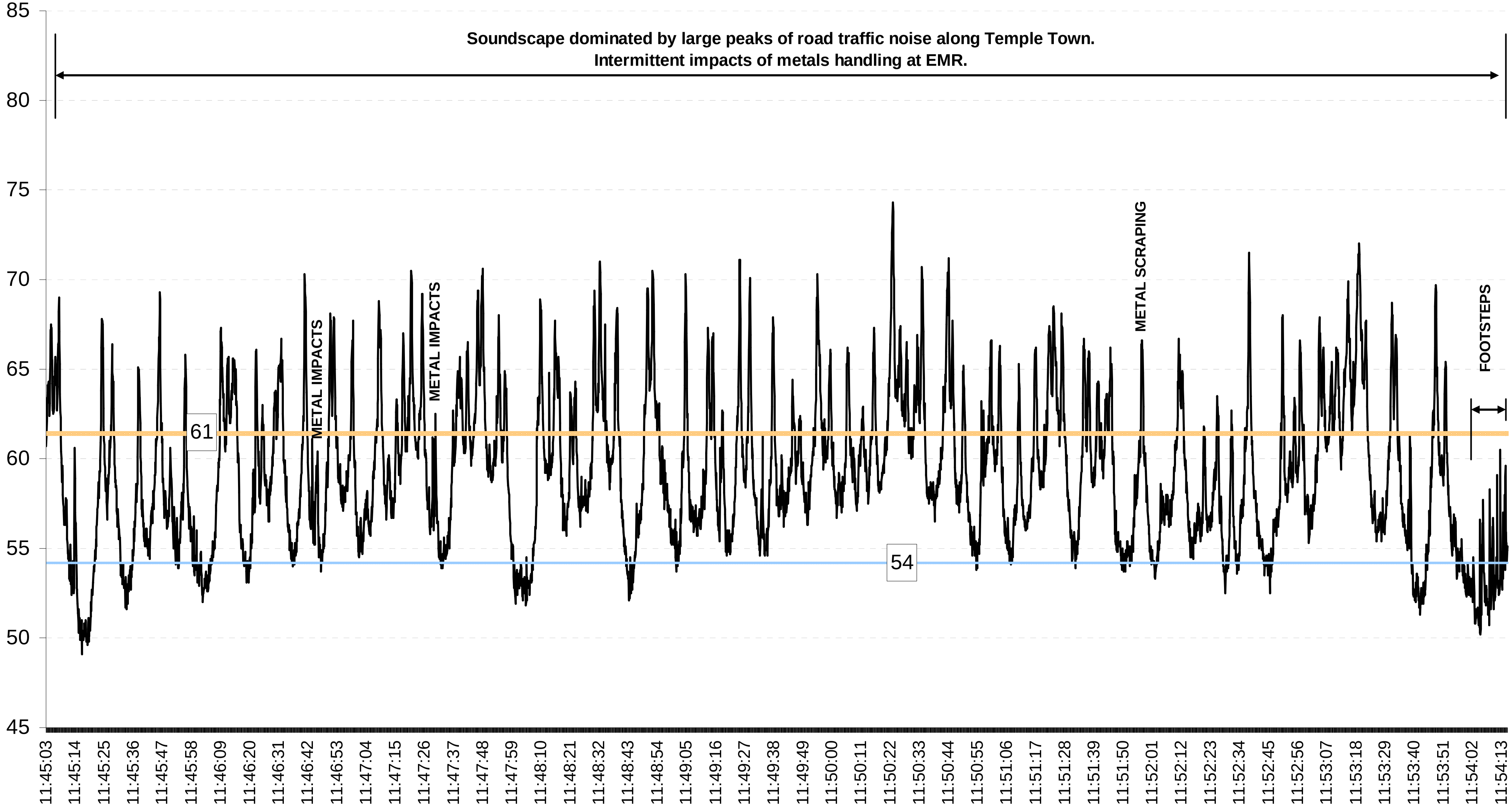
Noise Data Graph - 21 May 2015
Eastern boundary of Tyne Dock adj Temple Town
10-15m from boundary within dock in location screened from RTN
dB
100 ms LAeq
Period LA90
100 ms LAeq (Calculated LAeq,6m12s)
Soundscape dominated by large peaks of road traffic noise along Temple Town.
Intermittent impacts of metals handling at EMR.
85
80
75
70
65
60
55
50
45
62
54
METAL IMPACTS
REVERSE BLEEPERS
DOOR SLAM
METAL IMPACTS
METAL IMPACTS
METAL IMPACTS
11:40:02
11:40:08
11:40:14
11:40:20
11:40:26
11:40:31
11:40:37
11:40:43
11:40:49
11:40:55
11:41:01
11:41:07
11:41:13
11:41:19
11:41:25
11:41:30
11:41:36
11:41:42
11:41:48
11:41:54
11:42:00
11:42:06
11:42:12
11:42:18
11:42:24
11:42:29
11:42:35
11:42:41
11:42:47
11:42:53
11:42:59
11:43:05
11:43:11
11:43:17
11:43:23
11:43:28
11:43:34
11:43:40
11:43:46
11:43:52
11:43:58
11:44:04
11:44:10
11:44:16
11:44:22
11:44:27
11:44:33
11:44:39
11:44:45
11:44:51
11:44:57

MAS ENVIRONMENTAL

Graph 21

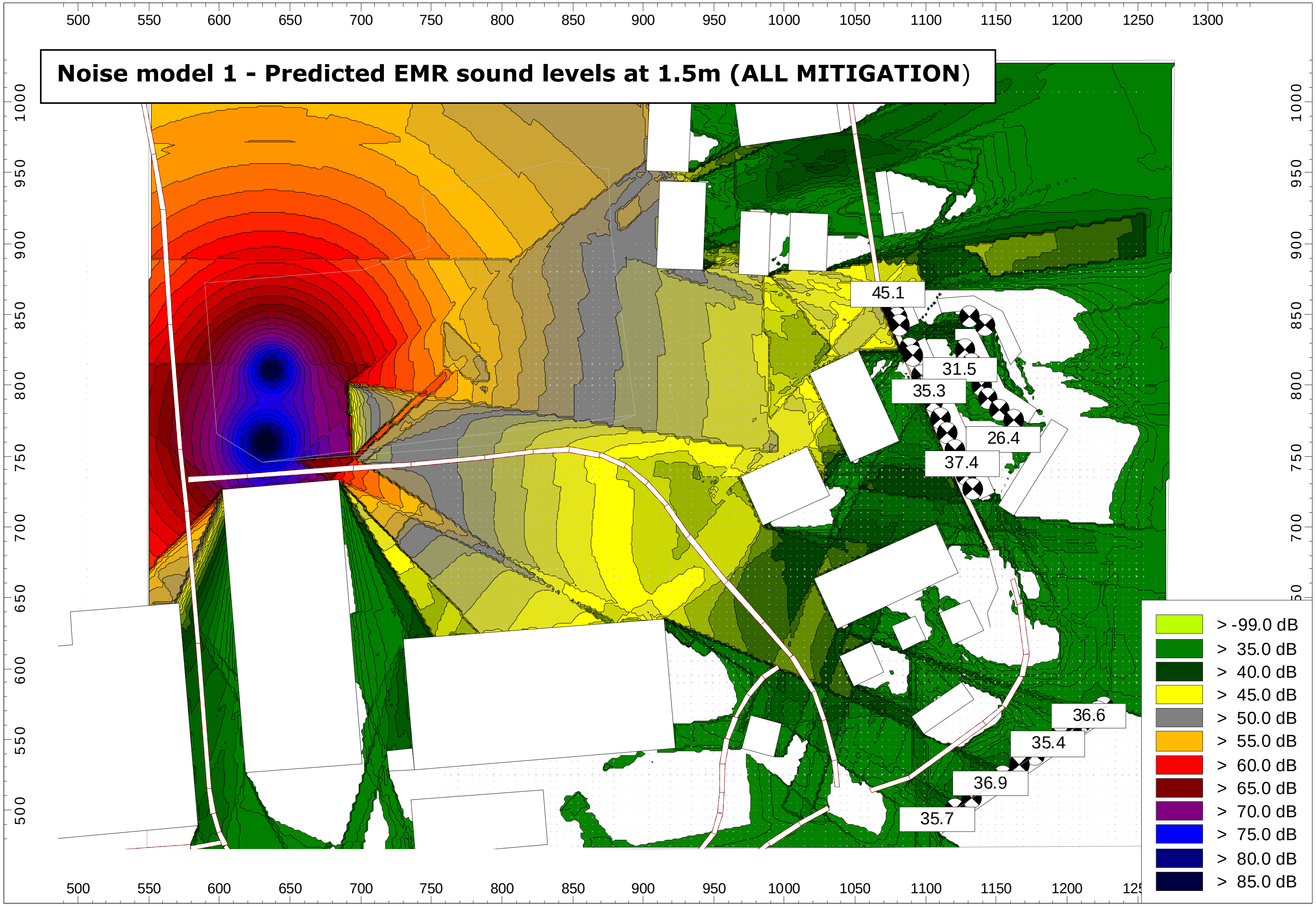
Noise Data Graph - 21 May 2015
Eastern boundary of Tyne Dock adj Temple Town
10-15m from boundary within dock in location screened from RTN

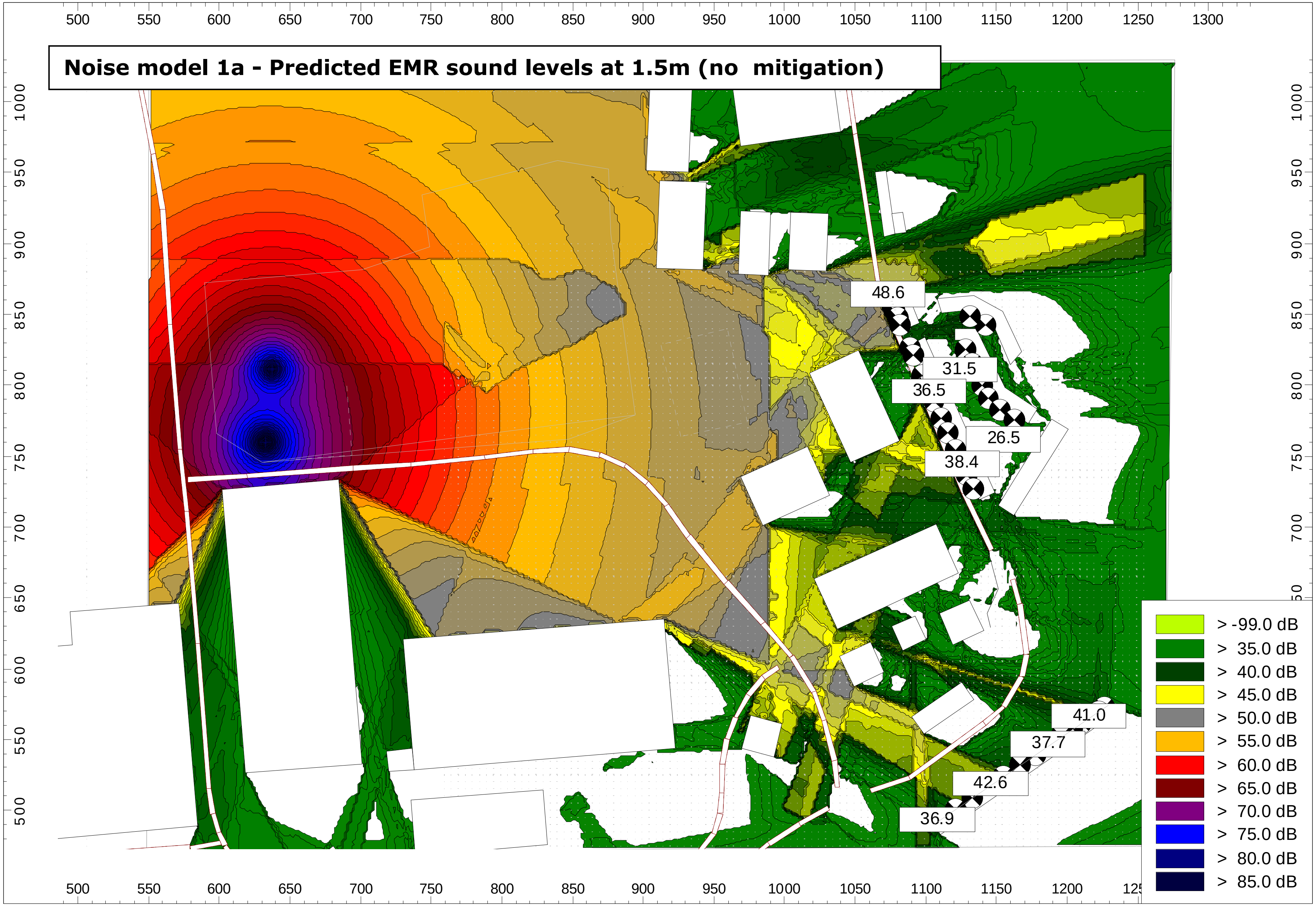
- 100 ms LAeq
- Period LA90
- 100 ms LAeq (Calculated LAeq,12m)



MAS ENVIRONMENTAL

Appendix 5 - Noise modelling




Noise model 1a - Predicted EMR sound levels at 1.5m (no mitigation)
48.6
31.5
36.5
26.5
38.4
41.0
37.7
42.6
36.9
> -99.0 dB
> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB
> 85.0 dB

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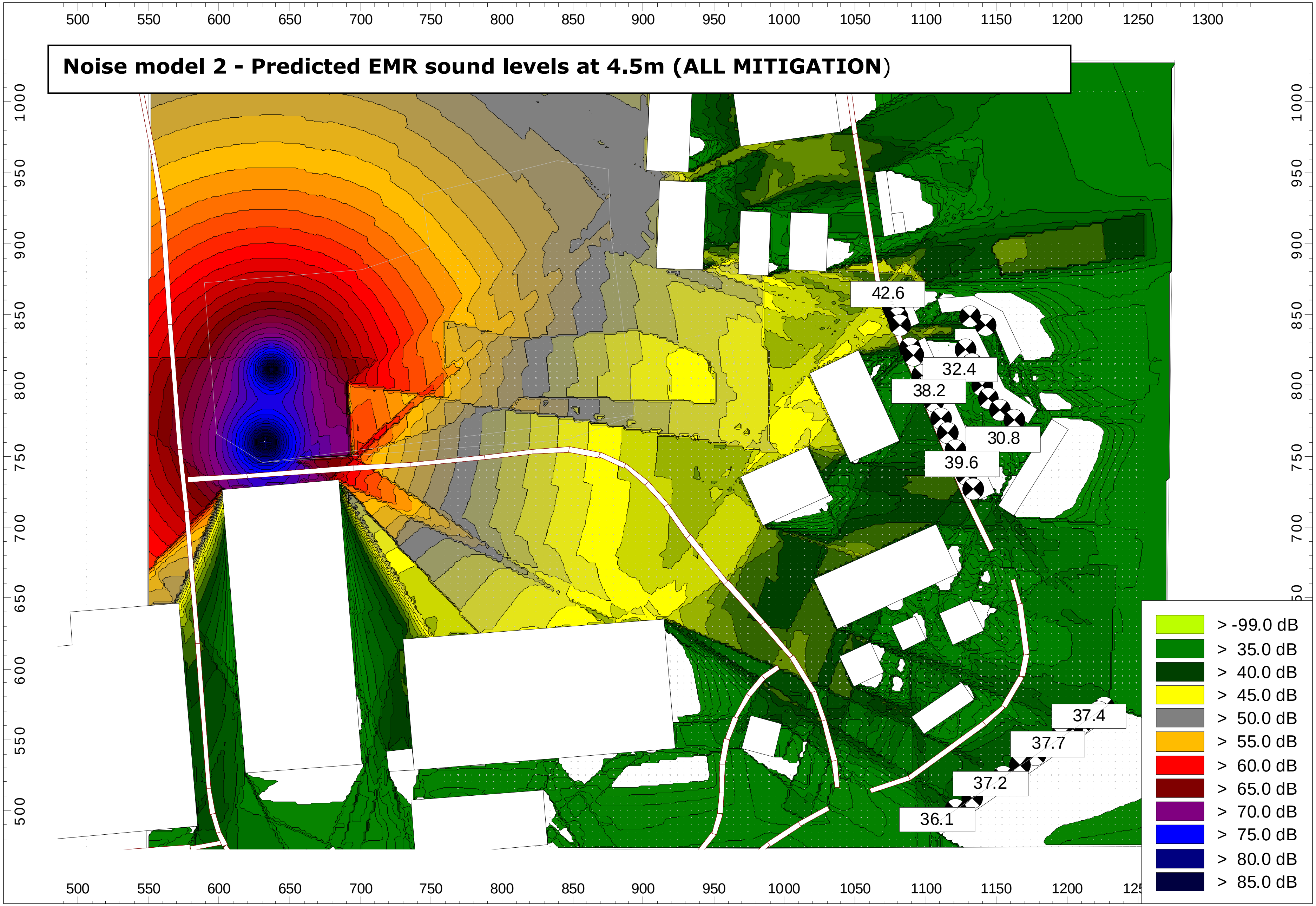

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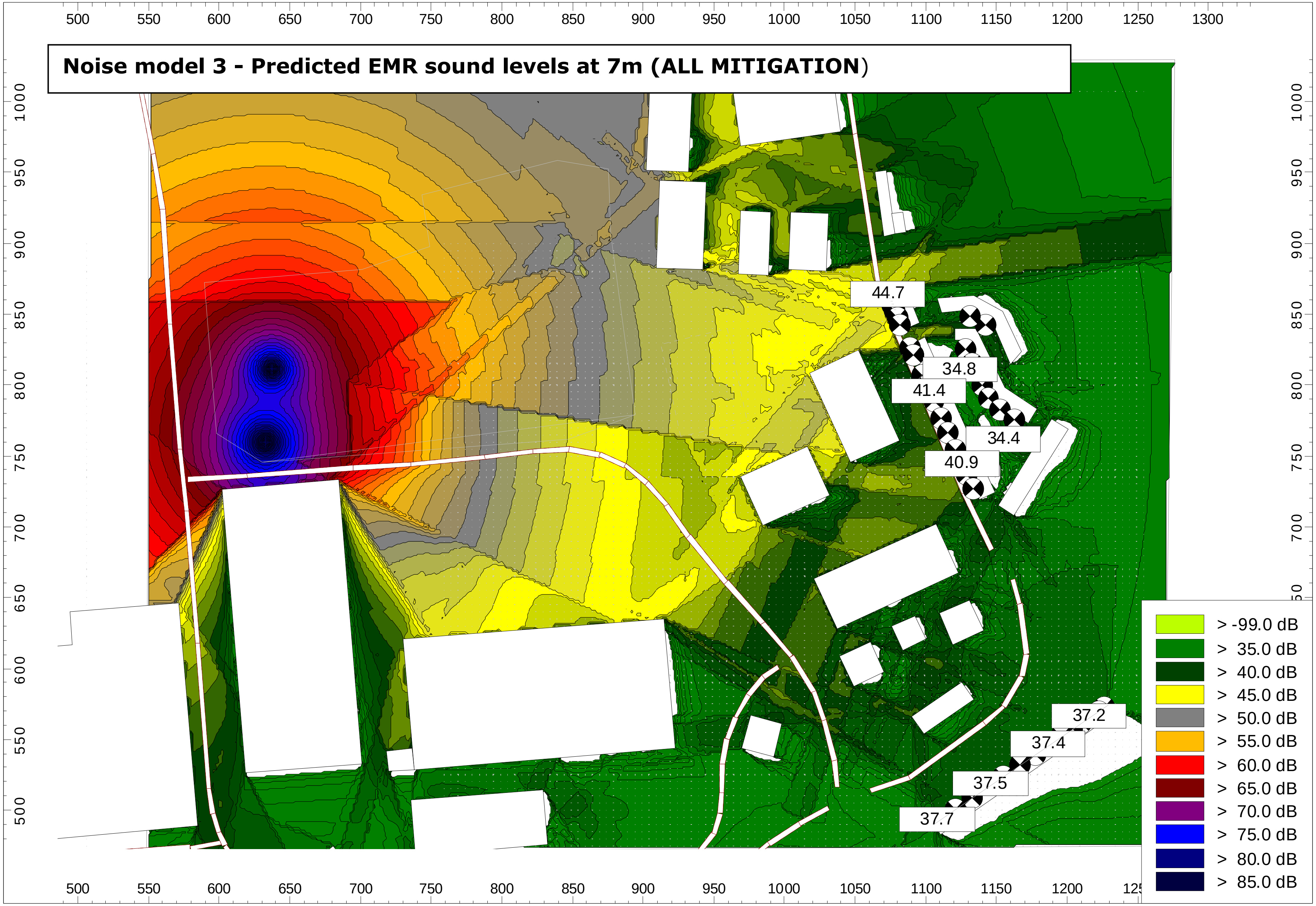

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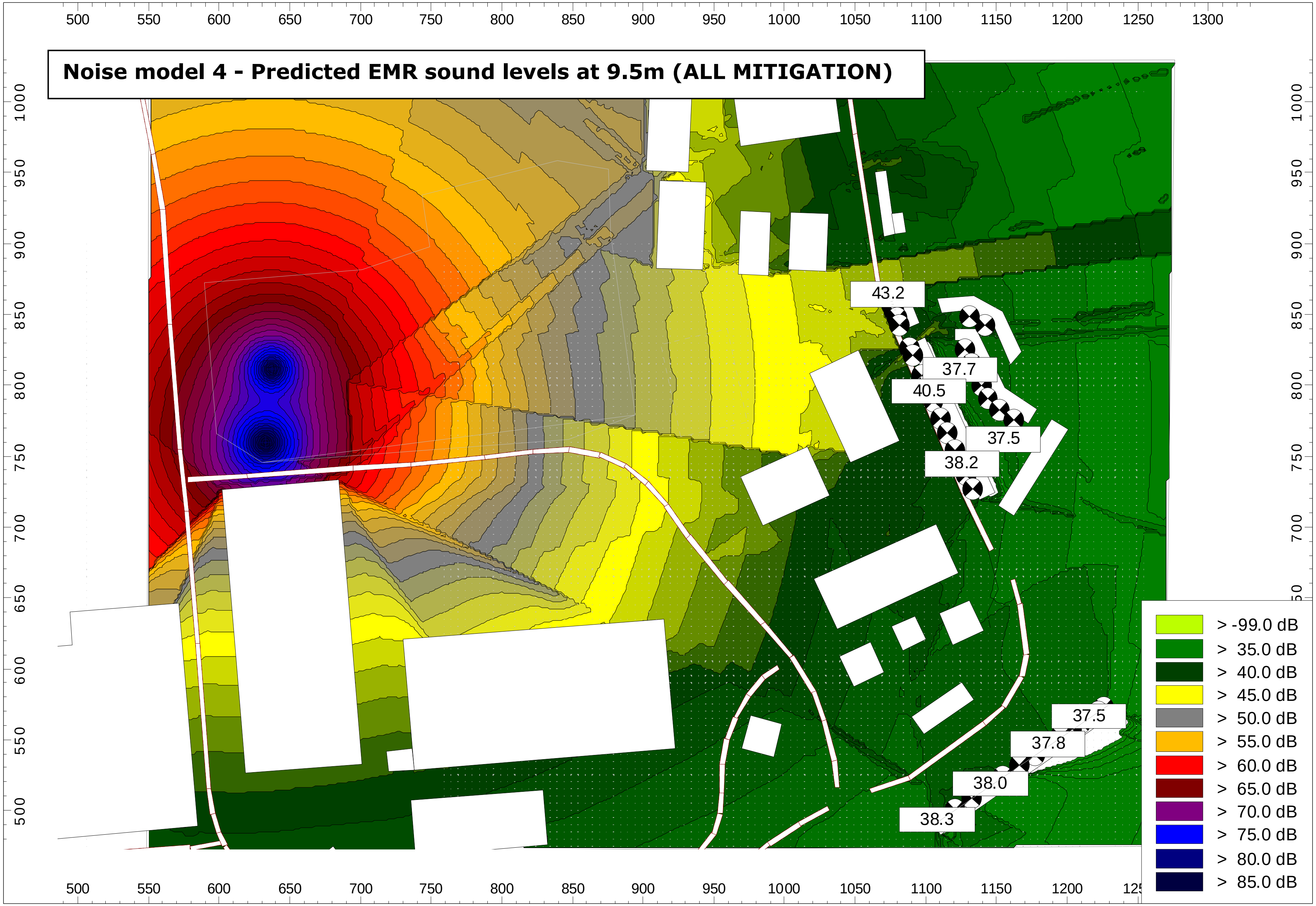

Appendix 6 - BS4142 2014 information to be reported

BS4142 2014 assessment overview (ref BS4142 S.12 - information to be reported)
Location / Scenario: EMR Tyne Dock installation of new shear to existing operations

Ref		Information to be reported	Assessor information
a)		Statement of qualifications, competency, professional experience etc of all personnel contributing to the assessment	D Baker - BSc (Hons) MSc MCIEH MIOA ex-local authority EHO with background in nuisance assessment with additional acoustic qualifications. Published research regarding the assessment of industrial noise and application of noise guidance including BS4142 2014.
b)		Source being assessed as follows:	
	1	description of the main sound sources and of the specific sound	**Specific sound** sources used within noise modelling consist of mobile plant, metals handling including thuds, bangs, impacts, clangs, clatters, tipping, horns, reverse bleepers and HGV engines. Key noise sources include metals impacts, loading and tipping. **Residual sound** consists of frequent traffic movements, intermittent aircraft movements and a variety of industrial activity including fork lift truck movements, HGV/shunter movements, metal impacts from skip, fixed plant and impacts from deliveries etc. Metal impacts from existing EMR activity noticeable within the soundscape.
	2	hours of operation	**Current site**: 0700-1700hrs Monday to Friday and 0700-1200hrs Saturday. Ship loading activity 24/7 consistent with other port activity but agreed with the port not to occur between 10pm and 7am. **Shear:** same as current site above 0700-1700hrs Monday to Friday and 0700-1200hrs Saturday
	3	mode of operation	Potentially continuous operation for 11 hours per day. A worst case of continuous use has been assumed within the assessment (i.e. 1hr continuous loading and preparatory handling).
	4	statement of operational rates of the main sound sources (e.g. maximum load setting used, 50% max rate, low load/power setting etc)	Variation in activity but regularly activity upwards of 45 minutes to over an hour. Some variation in sound level and character generated due to grade of metal.
	5	Description of premises in which the main sound sources are situated (if applicable)	Large open to air metals recycling site used for storage of metals prior to ship loading. No current concrete hard standing.
c)		Subjective impressions including	
	1	dominance or audibility of specific sound	**Specific sound** predicted and unlikely to dominate. Higher impacts may be audible at the closest and most exposed dwellings when background sound levels are at their lowest and for only brief periods.
	2	main sources contributing to the residual sound	**Residual sounds** consist of for road traffic movements and intermittent aircraft movements and existing industrial activity. Road traffic noise dictates residual sound levels.
d)		The existing context, including as assessment of the sensitivity of the receptor e.g. dwelling	Large and established metals recycling site located within a working dock in a mixed residential and industrial area. Metals handling noise established within the soundscape at the closest dwellings.
e)		Measurement locations, their distance from the specific sound source, the topography of the intervening ground and any reflecting surface other than the ground, including a photograph, or a dimensioned sketch with a north marker. A justification for the choice of measurement locations should also be included.	Described within main investigation report. See photographs and aerial / satellite view of locality with measurement locations. Location chosen further from road traffic than most exposed facades with increased screening effects due to presence of 2.5m+ brick wall running alongside Temple Town.
f)		Sound measuring systems, including calibrator	
	1	type and/or model	Nor140 sound level analyser and Nor acoustic calibrator
	2	manufacturer	Norsonic

	3	serial number	SLM 1402998 and calibrator 30997
	4	details of last verification test including dates	SLM 04/12/2012 and calibrator 15/10/2013
g)		operational test:	
	1	reference level(s) of calibrator	113.8 @ 1KHz
	2	meter reading before and after measurements with calibrator applied	113.8 and 113.7dB (drift of 0.1dB = acceptable)
h)		weather conditions, including:	
	1	wind speed and direction	Described within main report. Positive wind vector from EMR site towards Temple Town.
	2	presence of conditions likely to lead to temperature inversion	None noted during daytime measurements
	3	precipitation	None observed on site or reported in local forecast
	4	fog	None observed on site or reported in local forecast
	5	wet ground	Dry ground observed
	6	frozen ground or snow coverage	N/A
	7	temperature	Described within main report.
	8	cloud cover	Described within main report.
i)		Date and times of measurements	30/01/15 between 1040 and 1140. 21/05/15 between 1050 and 1150.
j)		Measurement time intervals	5-15 minute periods chosen for residual and background sound levels
k)		reference time interval	**1 hour** for daytime assessment
l)	**1**	measured sound level	**n/a specific sound level predicted using noise modelling software based on ISO 9613-2**
	2	residual sound level and method of determination	Spot measurements of ambient sound levels considered to represent the residual sound levels in the absence of shear loading and associated activity
	3	ambient sound level and method of determination	5-15 minute periods varied between **61-70dB LAeq,T**
	4	specific sound level and method of determination	31 to 47dB as determined by noise modelling software at receiver heights between 1.5 (ground floor) and 9.5m (second floor).
	5	justification of methods	New activity not present. Established methodology for predicting outdoor sound levels based on sound power measurements of existing metals handling and shear activity
	6	details of any corrections applied	None
m)		Background sound level and measurement time interval and, in the case of measurements taken at an equivalent location, the reasons for presuming it to be equivalent	Daytime range between 52-59dB LA90,T measured during the residual noise measurement with lower level of road traffic movements. However, the background sound level appears determined by localised road traffic movements reducing uncertainty i.e. it is a consistent sound maintaining the background sound level in the area.
n)		Rating level	
	1	specific sound level	**Daytime 31-47dB LAeq,1 hr**
	2	any acoustic features of the specific sound	**Highly impulsive features** from metal impacts, loading and tipping. Assumed to be highly perceptible at existing dwellings and warrants a **+9dB correction** for impulsivity. This is a conservative assessment.
	3	rating level	31-47 + 9 = **40-56dBAr,Tr**
o)		Excess of the rating level over the measured background sound level and the initial estimate of impact	40-56 - 52-59 = -19 to +**4B** The initial estimate of impact indicates a difference below 4dB.
p)		Conclusions of the assessment after taking context into account	See section 8 of report for the full conclusions on impact.
q)		The potential impact of uncertainty	See detailed section on uncertainty within report

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Technical Note

Application of noise guidance to the assessment of industrial noise with character on residential dwellings in the UK

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ABSTRACT

British Standards are used to assist the assessment of noise impact from new or existing sources and assist judgements of acoustic acceptability. Standards may include provision for the assessment of noise with character whilst others are limited to anonymous noise. Noise guidance designed for the assessment of anonymous/characterless noise appears increasingly used to justify acceptable noise impact from industrial noise with character (identifiable site noise). The result is an inappropriate comparison with guideline values that ignore noise character and context in the assessment of noise acceptability at dwellings. This technical note conducts a critical review of noise guidance and considers four sources of industrial noise with character. Preliminary comparisons of analysed noise data with the World Health Organization Guidelines for Community Noise (WHO 1999), World Health Organization Night Noise Guidelines for Europe (WHO 2009), BS8233 2014 Guidance on sound insulation and noise reduction for buildings (BS8233) and BS4142 2014 Methods for rating and assessing industrial and commercial sound (BS4142) demonstrate guidance designed for anonymous noise significantly understates the impact of industrial noise with character on dwellings when compared to noise guidance for rating and assessing industrial sound accompanied with context based observations of noise impact.

1. Introduction and background

Noise can be steady, benign and anonymous (distant road traffic) or unpredictable, intermittent and contain specific inherent characteristics that attract attention or impart a message that is perceived to be unwanted depending on the circumstances (state of affairs or context) in which noise is received.

In the UK, British Standards are used in the design of new buildings to reduce internal and external intrusive noise, assess noise impact on amenity for planning and assist the determination of nuisance (statutory and common law) or pollution. The standards assist assessment of acoustic acceptability on new or existing dwellings.

BS8233 [1] is a design standard that considers noise control in and around buildings and suggests guidelines for different building types and room uses. Clear caveats exist within the guidance on use and application.

Noise guidance designed for assessing anonymous noise is increasingly applied to the assessment of industrial and other noise sources with character[1] from existing sources on dwellings, proposed sources affecting existing dwellings and existing sources adjacent proposed dwellings. The comparison understates impact by ignoring inherent acoustic features/character, context and receiving soundscape.

Industrial noise is emitted in different localities around the UK. An important consideration when town planning for new industrial development is noise impact on noise sensitive receptors. Where dwellings are proposed adjacent existing industrial uses care is required to locate, separate, orientate and design (passive engineering measures[2]) residential development to adequately mitigate environmental noise impact.

Using preliminary data this technical note compares four sources of industrial noise against anonymous noise guidelines in

[1] Sources of noise emanating from industrial premises that contain noticeable and identifiable characteristics e.g. impulsivity, tonality, unpredictability, temporal variation or other distinguishable characteristics that identify site specific noise. These sources cannot be considered 'anonymous' noise. The principle is applicable to other sources of site specific noise.

[2] Passive engineering measures refer to physical design to mitigate noise breakout or break-in (immission) at dwellings. Active measures rely on human action/inaction e.g. closing doors to prevent breakout, not sounding horns etc.

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0003-682X/

BS8233 and WHO [2,3]. Three scenarios consider industrial noise affecting existing dwellings. One scenario considers proposed residential development adjacent existing industry. In all scenarios the industrial noise contains character. Annoyance responses inside and outside dwellings during the daytime and sleep disturbance within dwellings during night time are considered[3]. A comparative noise assessment using BS8233, WHO 1999 & 2009 and BS4142 [4] with context relevant observations is presented.

The UK Planning system allows applicants and regulators to minimise noise impact on new or existing dwellings. Finegold [5] advises it is logical to avoid placing noise sensitive areas near to noise producing land uses. It is important to prevent unreasonable noise immission from new development and the correct application of noise guidance is critical.

2. Psycho-acoustics, annoyance and industrial noise

'Noise' introduces a subjective element to an individual's decision of whether sound has value. Thorne and Shepherd [6] describe reaction modifiers to noise for individuals to include attitude to the source, attitude to the information content of the noise, perceived control over the noise, sensitivity to noise (in general and specific measures) and sensitivity to specific character of the noise (e.g. changes in pitch or modulation).

Thorne and Shepherd suggest noise is sound perceptible to an individual which has identifiable characteristics that modify an individual's response from pleasurable or neutral to adverse. Intrusive noise is sound whose character is adversely perceived compared to the character of the receiving environment in the absence of that sound. Reaction to sound varies based on sensitivity but also the receiving context. The sound may then be considered 'noise'. This perception of the sound and individual reaction modifiers by the receiver are known as the psycho-acoustical factors.

Finegold [5] identifies many reasons for noise annoyance in different situations including interference with speech communication, other desired activities and sleep disturbance which can be very annoying and may lead to long-term health effects. Noise can be perceived as inappropriate in a particular setting without any objectively measurable effect. The context in which sound becomes noise can be more important than the absolute sound level itself.

Industrial noise has been recognised as a source of common law nuisance by the UK Courts since the 1800s. Methodologies recognisable within guidance applicable to the assessment of industrial noise emerged in the 1960s, most notably the Kosten and Van Os [7] Community Reaction Criteria for External Noises and the Committee on the Problem of Noise [8] simplified procedure for assessing reaction to industrial noise in mixed residential areas.

Both studies recognised annoyance from industrial noise is subjective and affected by many factors additional to the absolute decibel level. Kosten and Van Os [7] applied decibel penalties where noise was received in dwellings and considered the receiving room (context), pure tone perceptibility (character and sensitivity to specific character), impulsivity and/or intermittency (character, frequency and duration), occurrence during work hours only, percentage of time present (duration), any economic tie (benefit of noise to receiver and control over noise) and the character of the receiving locality. The simplified procedure for assessing reaction to industrial noise in mixed residential and industrial areas [8] considered specific characteristics, time of occurrence, duration (min) of noise during one hour or half day and type of district. This was the predecessor to BS4142 1967 [9].

[3] Where night time measurement data is available from the selected sources of industrial noise.

Research projects into the assessment of industrial noise were undertaken by Berry and others [10–14]. Berry and Porter [10] highlighted compressor noise as more annoying than road traffic noise when played at the same LAeq,T level. Additional research by Berry et al. [12] evaluated acoustic features present in industrial noise. The study reconsidered the approach to the assessment of industrial noise by considering not only the absolute level of industrial noise but the acoustic features present (including tonality and impulsivity). The emphasis was to not only objectively measure levels of noise but to objectively measure the acoustic features present [14]. The study showed annoyance scores were relatively independent of the traffic noise levels within the combination of noises to which subjects were exposed. Berry and Porter [14] suggested that features contained within the traffic noise component were much less dominant in determining an adverse response than features containing tonal and impulsive components. The research demonstrated the difference and affect of noise characteristics when considering comparable equivalent LAeq,T levels of noise i.e. road traffic noise compared with a source of impulsive industrial noise.

A literature review for DEFRA by Berry and Porter [15] of available evidence into industrial noise annoyance concluded that in general, there was no strong evidence that industrial noise produces a higher annoyance response than transportation noise but there had been extensive studies of transportation noise and annoyance but far fewer studies into the annoyance caused by industrial noise. This conclusion was based on a number of international sources but primarily research by Henk Miedema who was considered the first to produce dose response relationships for combinations of transportation and industrial noise. As Berry and Porter [15] suggested, dose response relationships for transportation and industrial noise sources do apply but this was only relevant to industrial noise without impulsive, tonal or low frequency content. For industrial noises with these features, Miedema suggested corrections could be applied for the annoying character of these aspects [16–18]. The literature review by Morel et al. [18] suggests that locally, industrial noise sources can cause great annoyance but their occurrence is less widespread than transportation noise and their heterogeneity of spectral features may explain the lack of studies. By comparison, steady flows of road traffic noise may be considered homogeneous compared to industrial noise which covers a wide variety and combination of noise sources that may include impulsive, cyclic, tonal, unpredictable, intermittent and contain combined effects (noise and vibration, noise and odour, etc.).

The study by Morel et al. [18] builds on historical work by Miedema and Berry and Porter prior to 2004. The Morel et al. [14] study identifies the specific and total annoyance when comparing different sources of industrial noise and the ability of specific acoustic characteristics to inhibit the annoyance of broad band industrial noise. The study found that the focus of annoyance shifts to the low frequency and 100 Hz component noise inhibiting the annoyance from broad band industrial noise i.e. the psychological focus shifts to the most annoying characteristics of the noise.

The Morel et al. study [18] is supported by work by Fritz van den Berg [19] in relation to health effects from wind turbines. When comparing dose relationship curves for wind turbine noise, annoyance follows a similarly shaped curve to road, rail, aircraft, industrial and shunting yards. In comparison to the above, Van den Berg [19] shows wind turbines appear to be a relatively annoying noise source as shown in Fig. 1 below:

Fig. 1 shows wind turbine noise is more annoying than other environmental noise sources at lower dB(A) levels with the exception of shunting yards for various Lden dB(A) values. In the study by Miedema and Vos [17] the dose relationship curve for shunting yards and higher levels of annoyance appear to be due to the

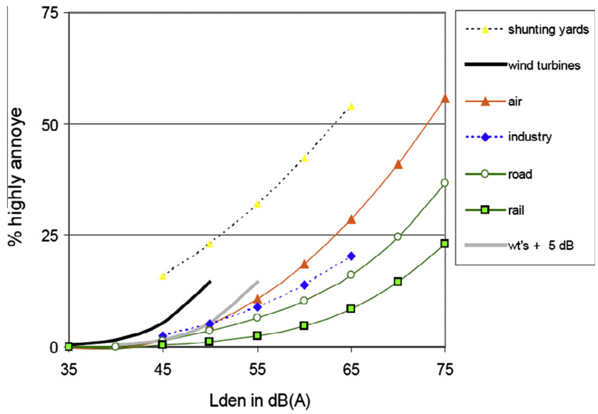

Fig. 1. Percentages of respondents that are highly annoyed when exposed indoors to noise from wind turbines or other.

vibrations and impulsive characteristics of shunting. This supports work by Porter [20] demonstrating the under prediction of the BS4142 1990 [21] methodology to noise with combined effects e.g. noise and vibration experienced in combination at the receiver.

3. Critical review of noise guidance

3.1. Applicability of the WHO to industrial noise

The WHO [2] guidelines relate to the onset of critical health effects from noise exposure based on the lowest levels of noise that affect health which includes sleep disturbance, speech intelligibility and annoyance responses. The guidelines for annoyance, 50 dB or 55 dB LAeq 12–16 h, represent daytime levels below which a majority of the adult population will be protected from becoming moderately or seriously annoyed.

Additional research into sleep disturbance by the WHO [3] for night noise suggests lower thresholds than the LAmax, internal of 45 dB [3] for a number of effects. The WHO [3] conducted a review of scientific evidence and derived a number of guideline values for noise. The WHO [3] is considered an extension to and update of the previous WHO [2].

The WHO restrict LAeq,T and LAmax guidelines to critical health effects and steady, continuous noise only (LAeq,T). The WHO consider critical health effects with noise guideline values based on long term external average noise (LAeq) and short term (impulsive) internal guidelines (LAmax) based on research and measurement into sources of transportation noise and sleep disturbance. The internal LAmax guidelines are comparable to industrial noise but relate to the onset point of critical health effects during sleep and not harm to amenity, annoyance or nuisance. This indicates any limit to assess harm to amenity (Town and Country Planning Act 1990) or contraventions of statute (Environmental Protection Act 1990) must be lower. For noise, neither regime considers critical health effects[4] as a benchmark for acceptability and are above what could be considered reasonable for planning or nuisance.

The WHO [2] reinforce good reasons for sleep with windows open and to prevent sleep disturbance to consider the equivalent sound pressure level (LAeq,T) and the number of sound events (LAmax) during sleep. The LAmax, inside parameter from the WHO [3] is used to characterise instantaneous effects, such as sleep disturbance and is better represented by maximum noise events than longer term averages. The WHO [3] suggest the LAmax parameter is useful to predict short-term or instantaneous health effects.

It is clear the WHO [2,3] restrict LAeq,T guideline values to critical health effects and steady, continuous noise only. For annoyance, the WHO [2] make a key distinction between anonymous noise and industrial noise and state:

> "....it should be recognized that equal levels of different traffic and industrial noises cause different magnitudes of annoyance. This is because annoyance in populations varies not only with the characteristics of the noise, including the noise source, but also depends to a large degree on many non acoustical factors of a social, psychological, or economic nature"

The reference highlights the inapplicability of the WHO to the assessment of industrial noise and was identified in guidance to Local Authorities [22]:

> "While sound can be measured with the help of acoustical instruments such as sound level meters, the actual extent of noise nuisance cannot be measured in this way. One of the negative effects is annoyance. Large-scale population studies show that only one third of noise annoyance can be accounted for through exposure to varying sound levels. Non-acoustical factors, including personal factors such as noise sensitivity, and social factors, can have as much effect as the sound level"

3.2. Applicability of BS8233[5] to industrial noise

BS8233 [1] is designed to ensure a suitable noise environment within rooms for steady external environmental noise. The guidelines apply to airborne and structure-borne noise in combination. Internal noise guidelines for resting in living rooms, dining in a dining room/area and sleeping/resting within a bedroom are provided. Caveats limit the use of guideline values to assessing steady external noise without character (anonymous noise). The standard cannot determine whether sound is pleasant or unpleasant, ignores the existing soundscape and is applied to all areas. These omissions are significant when considering psycho-acoustical factors of noise character associated with identifiable industrial noise and character of the area. It ignores an individual's perception and expectation of noise, or freedom from noise, in the locality.

BS8233 provides guidelines for 'desirable' and 'reasonable' conditions within the receiving room. For external noise BS8233 suggests the main considerations for dwellings are the acoustic effect on resting, listening and communicating and the acoustic effect on sleep within bedrooms. BS8233 allows a relaxation of 5 dB to the desirable guidelines where external noise levels exceed the WHO [2] guidelines on which they are based and advises reasonable internal conditions are achieved.

At 7.7.1 [1] an important caveat states:

> "This sub clause applies to external noise as it affects the internal acoustic environment from sources without specific character, previously termed "anonymous noise". Occupants are usually more tolerant of noise without specific character than, for example, that from neighbours which can trigger complex emotional reactions. For simplicity, only noise without character is considered in Table 4..."

BS8233 states the guidelines should be used for 'anonymous noise' or 'noise without specific character'. For industrial noise BS8233 refers the user to BS4142 [4]. BS8233 recommends

[4] The National Planning Policy Framework 2012 refers to significant adverse impacts on health and quality of life and makes reference to the Noise Policy Statement for England 2010 which provides no quantitative noise guidance on noise acceptability for planning.

[5] References demonstrating the inapplicability of the WHO are relevant to BS8233 2014 as that standard was formulated on scientific research by the WHO. See BS8233 2014 point 7.7.2 Note 2. Page 24.

'desirable' guidelines for external amenity areas space of 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which is considered acceptable in noisier environments.

The guidelines for external amenity space mirror the WHO [2] guidelines for moderate and serious annoyance. BS8233 refers to external noise levels and, as the criteria are based on critical health effects from the WHO [2], can only refer to all steady, ambient noise within the environment. The guidance does not consider noise character, psycho-acoustical factors and context which are significant when assessing noise impact, annoyance and determining acoustic acceptability.

3.3. Applicability of BS4142 to industrial noise

BS4142 uses a reference period of 1 hour for daytime and 15 min for night time to reflect the impact of shorter LAeq,T periods of sound between 2300 and 0700 h [4]. Historically BS4142 applied a threshold approach where industrial noise is predicted to lead to complaints/community dissatisfaction when decibel penalties are applied and exceed the background noise level by a certain margin.

BS4142 2014 [4] uses a context based procedure using outdoor sound levels to assess the likely effects of sound on people who may be inside or outside a dwelling. It applies separate and cumulative decibel penalties for tonality, impulsivity, intermittency and other sound features/characteristics. The standard advises the initial estimate of impact be modified due to the context which includes consideration of additional factors including the absolute sound level, residual sound level, the character and level of the residual sound compared to the character and level of the specific sound, sensitivity of receptor and the incorporation of noise mitigation measures.

BS4142 is the primary guidance for assessing the impact of industrial sound with specific characteristics affecting dwellings. BS4142 considers the character of sound and background levels of the receiving locale to assist determine acceptability.

4. Preliminary results and data analysis

Four sources of industrial noise containing different inherent features were selected including a supermarket delivery, blanking press, metal fabrication and metals recycling.

4.1. Limitations

Measurement details are omitted due to the legal sensitivity of data. The periods chosen are considered representative of the specific sound with minimal extraneous noise affecting measurements. The data is from real-life situations where industrial noise causes impact (complaints) or is likely to cause impact following development.

To provide direct comparison with guidance [1–3] time periods were harmonised with BS4142 2014.[6]

4.2. Comparison with BS4142, WHO and BS8233

A graph[7] for each source except metal fabrication[8] is provided with average (LAeq,T) and maximum (LAmax) sound levels shown. The *X* axis represents absolute time and *Y* axis A-weighted decibel level. Levels are of average sound over time labelled 'period LAeq'. The red line represents the LAeq over the entire monitoring period and includes all ambient sound. The background sound level for a measurement period, labelled 'period LA90', is denoted by the blue line. Custom LAeq,T periods are denoted with an orange line as identified in the key. The 125 ms LAeq black trace shows the temporal variation.

4.3. Supermarket delivery

Fig. 2 shows a 5 min period from 0710 h[9] demonstrating levels from a heavy goods vehicle (HGV) engine and manoeuvring with metal impacts from unloading activity. Noise levels increase at 0711 h as the HGV engine starts. Time averaging 51 dB, 3 min with 40 and 41 dB LAeq, 5 min with an adjustment of −1 dB for the residual sound gives a specific sound level of 44 dB LAeq, 15 min. A BS4142 assessment applying a penalty of +9 dB for highly perceptible impulsive and +3 dB for intermittency characteristics gives an excess of rating level over background of +19 dB. This level of difference with observations of context indicates significant adverse impact.

The 44 dB LAeq, 15 min exceeds the desirable internal bedroom guideline by 2 dB but meets the reasonable guideline. The WHO is exceeded externally by 4 dB. Supermarket deliveries typically occur for 20 min and were proposed between 0600 and 0700 h. Conversion to an LAeq, 8 h night periods gives an external free field level 29 dB LAeq, 8 h. Therefore, one supermarket delivery every morning 365 days a year would meet the BS8233 internal and WHO 2009 external guidelines.

Typical worst case LAmax noise levels varied between 57–61 dB from impact noise and vehicle manoeuvres with the LAmax criteria for awakenings within the bedroom exceeded by 3–7 dB.

4.4. Blanking press

Fig. 3 shows 5 min between 0633 and 0638 h on a Saturday. The graph shows rapid operation of a blanking press dominating the soundscape. The press impacts occur every 0.875 s. This is equivalent to 300 press impacts over 5 min. The specific sound level is 50 dB LAeq, 15 min with an adjustment of −1 dB for residual sound. A BS4142 assessment applying a penalty of +9 dB for highly perceptible impulsive and +3 dB for intermittency characteristics gives an excess rating level of +19 dB indicating significant adverse impact. For daytime background sound levels are higher resulting in an excess rating level of +14 dB indicating a significant adverse impact.

The impulsivity is shown in Fig. 4. The graph shows the rate of change in decibels between the initial noise and 'peak' LAeq, 125 ms. The first six blanking press impacts show the rate of decibel change varies between 44 and 101 dB per second demonstrating highly impulsive characteristics.

For night time, the 50 dB LAeq, 15 min levels exceed the desirable BS8233 guideline by 5 dB but meet the reasonable guideline. The external WHO guideline is exceeded 10 dB. The blanking press occurs sporadically and was observed operating for 30 min prior to 0700 h. Conversion to LAeq, 8 h gives an external façade level of 38 dB LAeq, 8 h. Assuming 30 min of blanking press activity prior to 0700 h every morning for 365 days per year would meet the BS8233 internal and WHO 2009 external guidelines.

Typical worst case LAmax noise levels varied between 53 and 56 dB1m from the facade and meet the internal LAmax guidelines.

For daytime, the 50 dB LAeq, 1 h meets BS8233 and the WHO internally and externally within amenity areas. The blanking press occurs sporadically and was observed for periods of a few minutes to upwards of an hour during daytime. A typical worst case of 4 h per day has been assumed. Conversion to LAeq, 16 h gives an

[6] LAeq, 1 h between 0700–2300 h and LAeq, 15 min between 2300–0700 h.

[7] Graphs and audio available at www.masenv.co.uk/noiseguidancepaper.

[8] The noise graph for metal fabrication was removed following a request from Legal Counsel in that case.

[9] Deliveries were proposed prior to 0700 h and the specific sound level considered over 15 min.

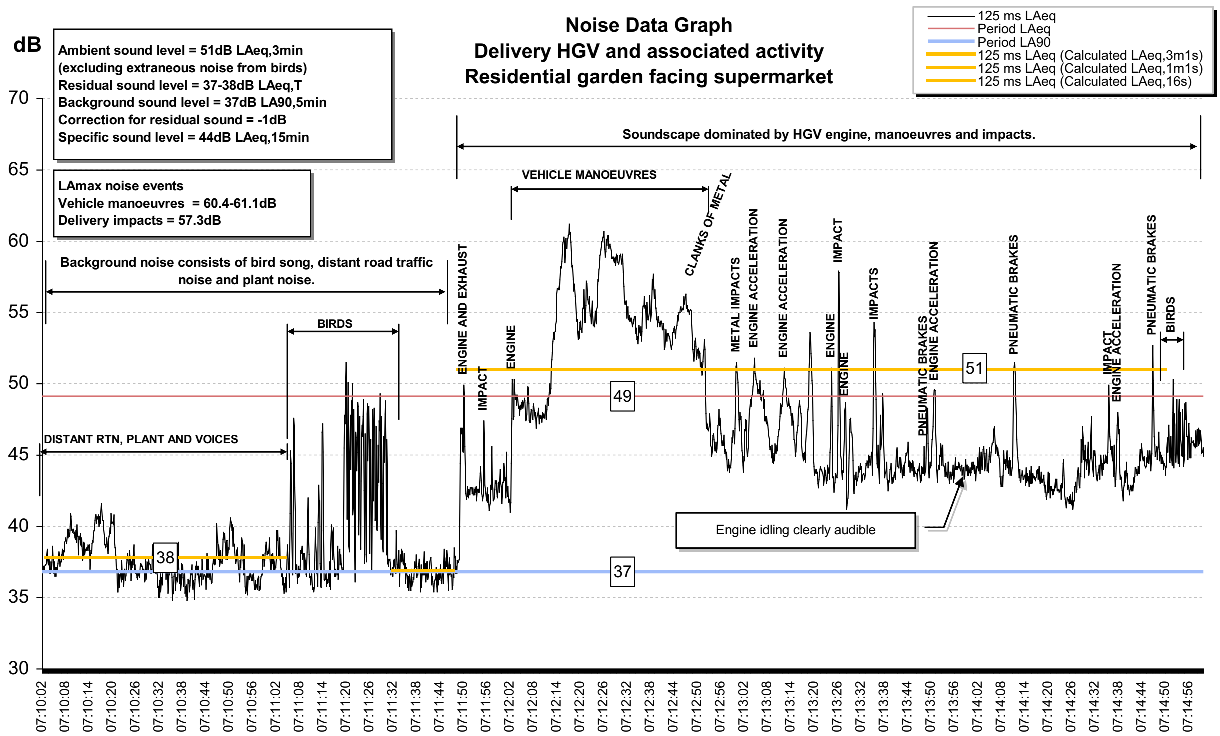

Fig. 2. Graph showing measured noise levels from supermarket delivery.

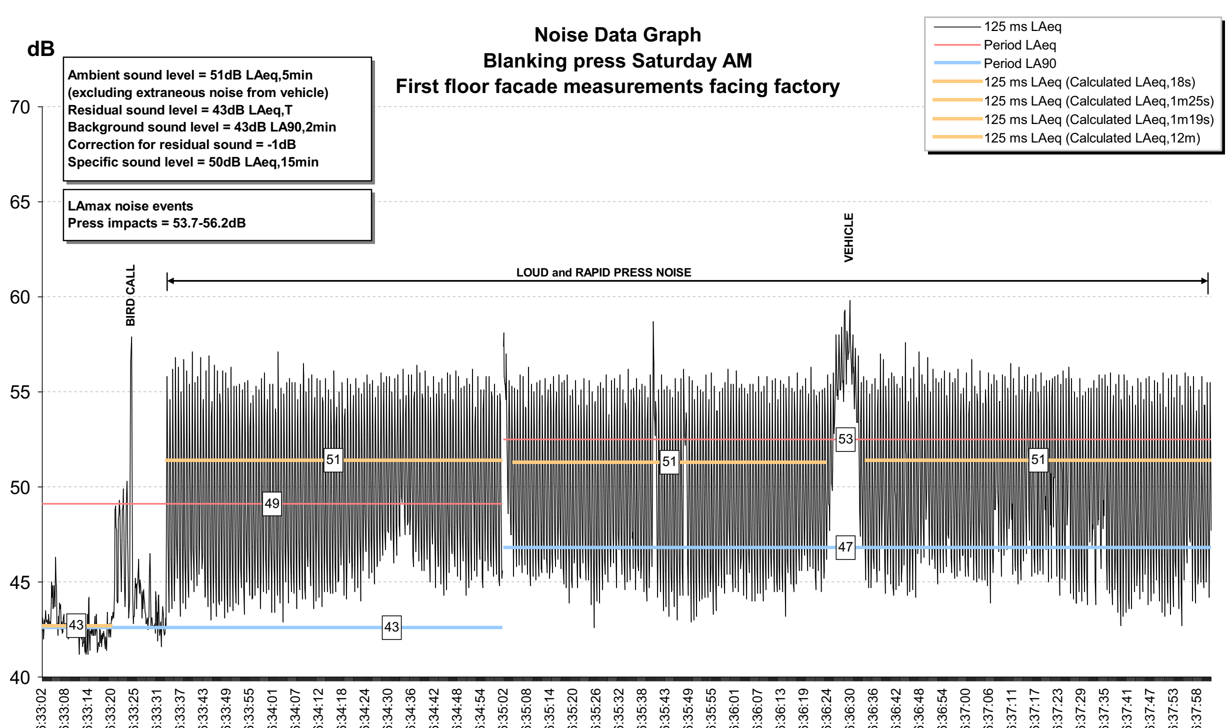

Fig. 3. Graph showing measured noise levels from blanking press.

external façade level of 44 dB LAeq, 16 h. Assuming 4 h of blanking press activity every day would meet the BS8233 and WHO 1999 internal and external guidelines. The blanking press could operate continuously for 16 h per day and still meet the BS8233 and WHO 1999 daytime guidelines.

4.5. Metal fabrication

Metal fabrication includes a number of activities including metal impacts, muffled music, angle grinding, loud clangs and the continuous drone of a fan with a tone at 400Hz. The ambient

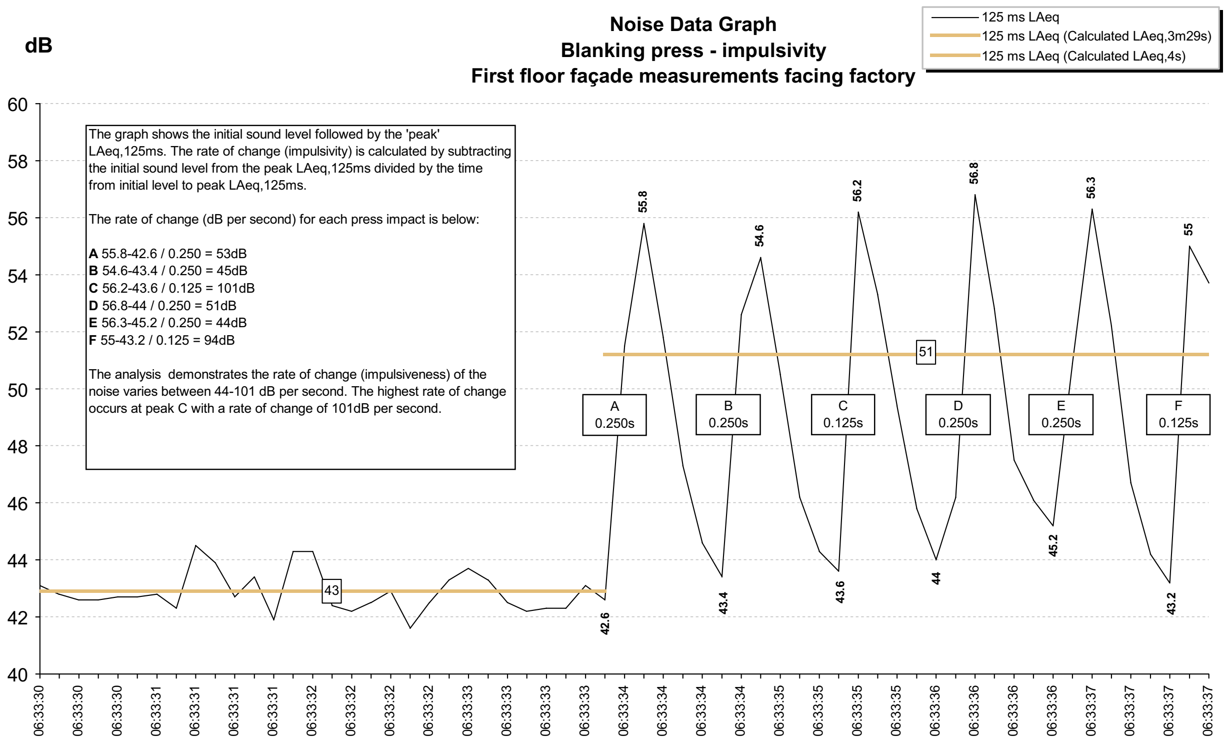

Fig. 4. Graph showing blanking press impulsivity.

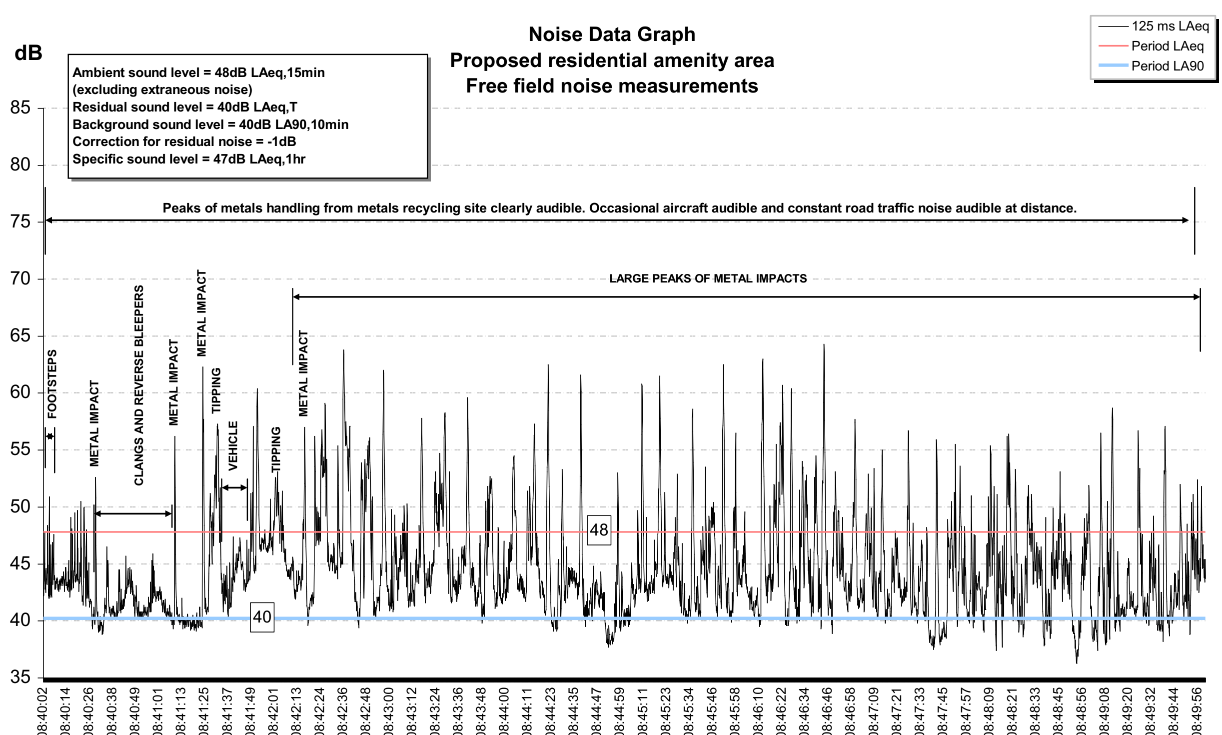

Fig. 5. Graph showing measured noise levels from metals recycling.

sound level was measured concurrently at 45 dB LAeq, 5 min and 44 dB LAeq, 10 min with a residual sound level of 31 dB LAeq, T and background sound level of 29 dB LA90, 5 min. Residual and background sound levels were measured at increased distance from the factory due to the influence of continuous fan noise at an alternative but representative location. No correction for residual sound was applied with the specific sound level of 44 dB LAeq, 15 min. LAmax levels were measured between 47 and 61 dB.

Time averaging 45 dB, 5 min and 44 dB LAeq, 10 min provides a specific sound level of 44 dB LAeq, 15 min. A BS4142 assessment applying a penalty of +6 dB for clearly perceptible impulsive and +4 dB for tonal characteristics gives an excess of

Table 1
Comparison of NIGHT TIME industrial sound with BS8233, WHO 2009 and BS4142 with context related observations.

Source (typical worst case sound levels)	Noise guidance and criteria for night time/bedrooms				Context related observations of impact
	BS8233 2014	WHO 2009		BS4142 2014 assessment of impacts	
	Desirable 30 and reasonable 35 dB LAeq, 8 h (internal)	40 dB Lnight, outside (1 year)	Critical health effect (awakenings) 42 dB LAmax (internal)	Greater difference (+ve dB value) = greater magnitude of impact	
Supermarket delivery (44 dB LAeq, 15 min and 57–61 dB LAmax)	44 − 12 = 32 (2 dB above desirable, 3 dB below reasonable)	44 − 40 = 4 dB above[a]	(57 − 61) − 12 = 45 to 49 (3–7 dB above)	+19 dB indicates significant adverse impact	Loud impulsive impacts and engines dominate soundscape at dwelling. Character of area semi rural with distant road traffic and natural sounds audible. Character distinguishable with impact occurring during sensitive night time periods with low background noise levels. Deliveries proposed with erosion of respite from noise at sensitive times and incongruous with residual sound environment. Considered subjectively[b] unreasonable as predicted to occur early from 0600 h indicating sleep disturbance and harm to amenity
Blanking press (50 dB LAeq, 15 min and 53–56 dB LAmax)	50 − 15 = 35 (5 dB above desirable, meets reasonable)	50 − 40 = 10 dB above	(53 − 56) − 15 = 38 − 41 (1–3 dB below)	+19 dB indicates significant adverse impact	Loud impulsive and repetitive impacts, unpredictable and sporadic occurrence of presses prior to 0700 h. Character of the area mixed residential and commercial/industrial adjacent significant source of single lane road traffic noise (not constant flow). Clearly audible within all rooms of the dwelling and remains audible with windows and doors closed. Likely to cause sleep disturbance and considered subjectively annoying due to repetition, impulsivity and incongruity considered unreasonable and a statutory nuisance (criminal law)
Metal fabrication (44 dB LAeq, 15 min and 47–61 dB LAmax)	44 − 15 = 29 (1 dB below desirable, 6 dB below reasonable)	44 − 40 = 4 dB above	(47 − 61) − 15 = 32 − 46 (10 dB below and up to 4 dB above)	+25 dB indicates significant adverse impact	Loud impulsive impacts of metal, hammering, angle grinding, clangs and the presence of tonal fan noise at 400 Hz clearly audible within bedroom with window ajar. No other industrial noise audible within locality. Considered subjectively unreasonable and at a level likely to prevent and disturb sleep (considered to be a private nuisance

Note, a correction of 15 dB has been applied to convert LAeq and LAmax façade levels to internal levels through a partially open window for the blanking press and metal fabrication. A correction of 12 dB has been applied to supermarket delivery noise and is assumed to be a free field level at the façade.
[a] When compared to 15 min of noise.
[b] Note, any subjective comments are provided based on the author's 10 years professional experience investigating and observing statutory noise nuisance for UK local authorities and private nuisance for civil litigation.

rating level over background of +25 dB indicating significant adverse impact.

The LAmax criteria for awakenings is exceeded internally by up to 4 dB.

The 44 dB LAeq, 15 min meets the desirable and reasonable internal guidelines from BS8233. The WHO 2009 guideline is exceeded by 4 dB. Metal fabrication was observed sporadically through the night for approximately 3 h (periods including impact noise[10]) between 2300 and 0700 h. Conversion to LAeq, 8 h gives an external façade level of 40 dB LAeq, 8 h. Assuming 3 h of metal fabrication per night for 365 days per year would meet the BS8233 internal and WHO 2009 external guidelines.

4.6. Metals recycling

Fig. 5 shows 15 min of metals handling and represents an hour of noise. The graph shows large peaks of metal impacts, tipping and reverse bleepers.

The specific sound level was 47 dB LAeq, 1 h including a −1 dB adjustment for residual noise. A BS4142 assessment applying a penalty of +9 dB for highly perceptible impulsive characteristics gives an excess of rating level over background of +16 dB. This level of difference indicates a significant adverse impact.

The 47 dB LAeq, 1 h noise level meets the BS8233 and WHO internal and external noise guidelines. A comparison shows metals handling could occur continuously for 16 h everyday and meet the BS8233 and WHO 1999 guidelines.

4.7. Summary findings

Tables 1 and 2 show a summary of industrial sound levels for night and daytime compared with BS8233, WHO and BS4142 with context related observations of impact.

4.8. Night time

In all cases the BS8233 reasonable internal guideline for bedrooms is met. The desirable guideline is exceeded for the supermarket delivery and blanking press. The WHO 2009 Lnight, outside is exceeded in all cases when the guideline is considered over 15 min but time averaging noise impact over an 8 h night time period meets the guideline. The LAmax,internal for awakenings is

[10] Fan noise was audible for longer periods than the 3 h considered in the assessment.

Table 2
Comparison of DAYTIME industrial sound levels with BS8233, WHO 1999 and BS4142 with context related observations.

Source (typical worst case sound levels)	Noise guidance and criteria for day time internal and external					Context related observations of impact
	BS8233 2014		WHO 1999		BS4142 2014 assessment of impacts	
	Living rooms desirable 35 and 40 dB reasonable dB LAeq, 16 h (internal)	Amenity areas desirable = 50 to 55 dB LAeq,T (external)	Speech intelligibility and moderate annoyance 35 dB LAeq, 12–16 h (inside dwelling)	Serious annoyance 55 dB and moderate annoyance 50 dB LAeq, 12–16 h (outdoor living area)	Greater difference (+ve dB value) = greater magnitude of impact	
Blanking press (50 dB LAeq, 1 h)	(50 − 15 = 35) meets desirable and 5 dB below reasonable	Meets desirable and 5 dB below desirable upper guideline	(50 − 15 = 35) meets guideline	50 dB meets guideline for moderate annoyance and 5 dB below serious annoyance	+14 dB indicates significant adverse impact	Unpredictable and repetitive impact from presses, fork lift truck and tonal noise from fans. Significant but non continuous source of road traffic noise adjacent dwelling but does not mask noise of press impacts. Clearly audible outside dwelling. Considered subjectively unreasonable even in a high daytime (LAeq,T) noise environment. Noise from press impacts penetrates dwelling and audible in all rooms making escape from noise impossible without adopting coping strategies. When operating is the only source of industrial noise audible at dwelling. Subjectively considered unreasonable and a statutory nuisance
Metals recycling (47 dB LAeq, 1 h)	(47 − 12 = 35) meets desirable and 5 dB below reasonable	3 dB below desirable and 8 dB below desirable upper guideline	(47 − 12 = 35) meets guideline	3 dB below moderate annoyance and 8 dB below serious annoyance	+16 dB indicates significant adverse impact	Loud impulsive impacts of metal on metal with associated tipping, clangs, clatters, reverse bleepers and mobile plant. Character of metals recycling noise considered incongruous with other transport related noise in the locality. Subjectively considered an unreasonable noise environment for new dwellings

Note, a correction of 15 dB has been applied to convert LAeq façade levels to an internal level through a partially open window for the blanking press. A correction of 12 dB has been applied to metals recycling noise and a free field level at the façade.

exceeded when applying typical worst case LAmax noise levels from the supermarket delivery and metal fabrication. The LAmax guideline is met for the blanking press.

Applying BS4142 indicates significant adverse impact in all cases supported by context related observations of impact. Observations of impact demonstrate unreasonable noise.

4.9. Daytime

In both cases the WHO 1999 and BS8233 desirable and reasonable internal guideline for living rooms and amenity areas is met. Applying BS4142 indicates significant adverse impact in all cases supported by context related observations of impact that demonstrate unreasonable noise.

For night and daytime the results show comparison with BS8233, WHO 1999 and 2009 internally and externally (LAeq,T) does not correlate with assessments using BS4142 with context based observations. The LAmax,internal guideline is exceeded for the supermarket and metal fabrication when the highest events are considered demonstrating some correlation.

5. Discussion

Whether sound is perceived to be unwanted depends on many factors including individual sensitivity and context. Inherent noise character and context are more important than absolute decibel levels. Annoyance from industrial noise is affected by the features present and message imparted, duration, intermittency, character of receiving area and level of control over or economic tie. Industrial noise causes annoyance but is less widespread than transportation sources with less research into its effects.

The literature review highlights the significance of acoustic features within industrial noise, notably impulsivity and tonality. Significantly guidelines for anonymous noise (BS8233 and WHO) ignore inherent acoustic features and apply in every context allowing increased impact than shown to be acceptable when compared to BS4142 with context related observations.

The preliminary results show a noise assessment comparing steady anonymous noise guidelines from BS8233 and the WHO against industrial noise with character significantly understates impact. This is shown for night and day time noise. A comparison with BS8233 and the WHO guidelines does not correlate with the level of impact shown when BS4142 is applied with context related observations. The results show the assessment using BS8233 and the WHO to be inappropriate.

It is unlikely simple 'dose relationship' response curves could be produced for industrial noise annoyance in all cases due to the heterogeneity of sources, different noise characteristics, different combinations of noise characteristics and combinations of noise with vibration, smoke, odour, etc.

5.1. Implications of inadequate noise characterisation and assessment

The UK experiences increasing anonymous noise from transportation particularly road traffic, aircraft and HS2 rail project. Modern living standards are high with greater expectation of freedom from pollution including noise.

Population growth increases housing need resulting in construction and pressure to build on brownfield land. This results in encroachment into historic sites of industrial use and reduces separation distances between existing industry and proposed housing. The reverse is true for industrial development. The recession and general decline in industry means it is important to preserve industrial uses and consider the placement of new dwellings and industrial development to prevent land use conflicts.

Applying inappropriate noise guideline values results in incompatible land uses. Introducing housing to an industrial area changes the character of the area from industrial to mixed industrial and residential. Complaints to a local authority or Environment Agency can restrict future industrial operation and viability. It does not create communities where people want to live due to annoyance/nuisance from noise. Introducing new industrial development into residential areas can introduce new noise incongruous with the soundscape. Depending on the specific characteristics of the new industrial noise and context of noise impact, there is a potential for annoyance and complaints. This may result in annoyance to the local community and lead to the demise of industry.

6. Conclusions

BS8233 and the WHO guidelines are often applied to the assessment of industrial noise and other noise sources with character. The guidance confirms it cannot be used in this way and fails to consider noise character and psycho-acoustical factors of whether the sound is pleasant or unpleasant which are significant when assessing impact from industrial noise.

Response to noise is subjective and the likelihood a noise will cause annoyance is multi-factorial. Guidelines for anonymous noise applied to site specific industrial noise understate the true impact and is inappropriate. Careful reading of BS8233 and the WHO 1999 & 2009 is necessary to understand their limitations of application to steady anonymous noise and not industrial noise with character.

The misapplication of BS8233 and the WHO is counterproductive to the long term sustainability of housing construction and the protection of UK industry. The inappropriate use of guideline values to assess noise impact from industrial noise with character does not benefit industry or communities.

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References

[1] BSi. BS 8233:2014 guidance on sound insulation and noise reduction for buildings. London: BSi; 2014.
[2] World Health Organisation. Guidelines for community noise. Geneva: WHO; 1999.
[3] WHO. Night noise guidelines for Europe. Denmark: WHO; 2009.
[4] BSi. BS 4142:2014 methods for rating and assessing industrial and commercial sound. London: BSi; 2014.
[5] Finegold LS. Guidelines for community noise impact assessment and mitigation. Final report of the I-Ince Technical Study Group of Community Noise: Environmental Noise Impact Assessment and Mitigation (TSG 6); 2011. <www.i-ince.org/data/iince111.pdf> [accessed 08.08.13].
[6] Thorne R, Shepherd D. Quiet as an environmental value: a contrast between two legislative approaches. Int J Environ Res Public Health 2013;10(7):2741–59. www.mdpi.com/1660-4601/10/7/2741 [accessed 09.08.13].
[7] Kosten CW, Van Os, GJ. Community reaction criteria for external noises. In: National physical laboratory symposium No. 12. London: HMSO; 1962. p. 373–83.
[8] Committee on the Problem of Noise. Noise: final report. London: HMSO; 1963.
[9] BSi. BS4142:1967 method of rating industrial noise affecting mixed residential and industrial areas. London: BSi; 1967 [includes 1975 amendments].
[10] Berry B, Porter N. The subjective and objective assessment of industrial noise. Proc Inst Acoust 1992;14(4):385–95.
[11] Berry B. BS 4142:1990 – the sequel, towards 1994. Proc Inst Acoust 1993;15(8):159–64.
[12] Berry B, Porter N, Flindell I. An acoustic feature model for the assessment of environmental noise. Acoust Bull 1993;18(6):40–8.
[13] Berry B, Porter N. Standards for industrial environmental noise exposure: current UK research. Invited paper at the 6th international congress on noise as a public health problem. Noise and Man 93' Nice, France; July 5–9 1993.
[14] Berry B, Porter N. The evaluation of acoustic features in industrial noise. Internoise 94' Yokohoma-Japan; August 29–31 1994. p. 803–8.
[15] Berry B, Porter N. Review and analysis of published research into the adverse effects of industrial noise, in support of the revision of planning guidance. DEFRA Ref. NANR 5 Final Report; March 2004.
[16] Miedema HME, Vos Henk. Noise annoyance from stationary sources: relationships with exposure metric day-evening-night level (DENL) and their confidence intervals. J Acoust Soc Am 2004;116(1):334–43.
[17] Miedema HME. et al., TNO Inro report 2002-53 relationships between noise and nuisance industrial and marshalling yards. JA Delft: TNO, <http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&ved=0CEIQFjAD&url=http%3A%2F%2Fwww.tno.nl%2Fdownloads%2Frapport_02_5R_053.pdf&ei=DucIUr_LF7KM0wW7hoGQDg&usg=AFQjCNGhIds4AczxVp9jRxa5Lng0IFMyZw&sig2=DZqpnNQL33bKlpYjA3LoGA&bvm=bv.50500085,d.d2k> [accessed 12.08.13] (translated into English by google translate).
[18] Morel J, Marquis-Favre C, Viollon S, Alayrac M. A laboratory study on total noise annoyance due to combined industrial noises. Acta Acust United Acust 2012;98:286–300.
[19] Van den Berg F. An overview of residential health effects in relation to wind turbine noise. Fourth international meeting on wind turbine noise. Rome Italy; 12–14 April 2011. pp. 1–12.
[20] Porter N. National physical laboratory – study of the application of british standard BS 4142:1990 "Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas" (The Data Sheet Study). Middlesex: NPL; 1995.
[21] BSi. BS4142:1990 method for rating industrial noise affecting mixed residential and industrial areas. London: BSi; 1990.
[22] World Health Organisation. Noise and health (local authorities, health and environment briefing pamphlet series; 36). Denmark: WHO; 2000.