Noise Impact Assessment of Recycling Centre

Job No:	*1805050*
Dated:	*21st January 2019*
Report Status:	*Draft*
Prepared for:	*Amgen Cymru* *Bryn Pica* *Llwydcoed* *Aberdare* *CF44 0BX*
Site address:	*Treherbert Community Recycling Centre* *Treherbert Industrial Estate* *Treherbert* *Rhondda Cynon Taff* *CF42 5HZ*

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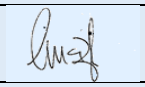
Document Management

Issue / Revision	First issue	Revision 1	Revision 2	Final
Job Number	1805050			1805050
Report Number	1805050R03			1805050R03
ANL File Reference	Shared Folders\Job Files\P - T\RCTCBC\Report\1805050R03			Shared Folders\Job Files\P - T\RCTCBC\Report\1805050R03
Remarks	Amendment to 1805050R02			Final
Date	21st January 2019			22nd January 2019
Prepared by	Chris McDonagh			Chris McDonagh
Signature				
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BRIEF FOR CONSULTANCY:

This report has been prepared by Acoustics & Noise Limited, Newport, South Wales, for Amgen Cymru, Bryn Pica, Llwydcoed, Aberdare, CF44 0BX under the instructions of Mr. Lee Foulkes.

Order No: 014899

OBJECTIVES:

To investigate the sound levels being experienced at a community recycling facility and to carry out an assessment of the potential for adverse impact as per BS 4142 using CAD modelling techniques.

To investigate and report on potential mitigation measures for minimising sound emissions from the site.

NON-TECHNICAL SUMMARY:

Amgen Cymru operate a community waste recycling facility on the outskirts of Treherbert. The operations are subject to environmental permit number EPR/AB3091HR. The facility is located at the southern edge of the town of Treherbert on a small industrial estate. Sound sensitive receptors are located approximately 60m to the north east of the facility at Eleanor Street and George Street.

In response to complaints due to noise from the facility, Acoustics and Noise Ltd investigated whether the noise impact could be practically mitigated by physical means, e.g. acoustic fence or earth bund etc. The findings of the initial assessment are detailed in report '*1805050R01*'.

Whilst accepting the findings of the initial report, Natural Resources Wales requested the following additional information:

- *The monitoring already undertaken by RCT is used to inform a more detailed assessment.*
- *Further information is provided on the monitoring already undertaken by the consultant.*
- *A survey compliant with the BS4142:2014 standard is carried out to capture the sounds relating to the complaint and assess these for impact on the residential receptors.*
- *The source of the shredding operation is identified*
- *Once the sound sources have been identified and ranked in terms of impact, mitigation measures should then be assessed following the steps of the hierarchy of noise control.*

This report details the measurements and an updated assessment of impact on the residential receptors following the methods detailed in BS 4142. The data collected by RCT was deemed unsuitable for use in this assessment. The measurements were not compliant with the requirements of the Standard as the measurements were completed internally.

No monitoring was undertaken by the consultant during the initial site visit as activity noise was not readily discernible against the acoustic climate when observed at the residential receptor. Acoustics and Noise Ltd were also not able to identify the source of the shredding operation previously noted. No instances of shredding were observed during the survey carried out for this assessment and the site operatives confirmed that no shredding is carried out at the waste recycling site at any time.

This report details all significant sound sources observed during a follow up site visit and an assessment of potential mitigation measures following the steps of the hierarchy of noise control. It should be noted that due to the intermittent and random nature of the sound sources, the ranking of the sources in terms of impact is impractical. The impact from a source is wholly dependent on the number of instances or the total duration which varies significantly.

Acoustics and Noise Limited conducted simultaneous surveys, both on-site and at the sound sensitive receptor (SSR), throughout a typical day on 26th November 2018. Activities observed included the use of the site by the community to deposit waste material for recycling purposes, two skip change overs and two site visits by Commercial site users to deposit recyclable items from house clearances.

Measurements of the ambient and residual sound level were taken at the SSR during a typical 1-hour period. On-site activities observed during the ambient survey period included 27 car visits, 2 van visits, 2 Commercial site user vans, 1 compactor operation, 1 bottle deposit and 1 skip change over and is inclusive of all significant sound sources at the site.

Inspection of the results indicate that the ambient sound levels measured at the SSR during this period were actually 1 dB lower than the residual sound levels measured immediately before the site opened for the day. Therefore, using the methods and procedures detailed in BS 4142, it was not possible to determine the specific sound level as discrete entity, distinct and free of other influences by measurement at the SSR due to the relatively high residual sound level.

BS 4142 states that "*Where it is not possible to determine the specific sound level by measurement of the ambient sound level and the residual sound level at the assessment location, for example, because the difference between the ambient sound level and the residual sound level is ≤3 dB, determine the specific sound level by a combination of measurement and calculation*" and *"…it is sometimes convenient to carry out the measurements closer to the source and then use a calculation method to estimate the specific sound level at the assessment location(s)*".

Therefore, this assessment utilises a combination of measurement and calculation to determine the specific sound level at the SSR as recommended by BS 4142.

This assessment utilises nearfield sound measurements of the significant activities at the site as inputs to a 3D acoustic model. The sound emissions associated with the recycling facility

occur randomly and from various locations within the facility. To robustly assess this situation, the sound emissions from each of the significant sources were measured during a worst-case operation of the source at measurement distances of between 1m and 5m.

The following significant sound sources were identified and assessed under controlled conditions to simulate worst-case sound emissions:

- Loading of an empty bin with a small washing machine (metal on metal noise).
- Loading of an empty bin with a wooden bed head (wood on metal noise)
- Loading of a partially full glass bin (glass on glass noise)
- Loading of a full rubble bin (porcelain on porcelain noise)
- Skip change over
- Use of the compactor

The impact from a sound source is wholly dependent on the number of instances or the total duration which varies significantly. As the sound sources are intermittent and random in occurrence, this assessment is based on visitor numbers estimated by the on-site staff. It was indicated that typical numbers of vehicle visits were around 50 in any one hour. It should be noted, however, that during the survey, the actual number of vehicles logged over two separate hourly periods were 18 vehicles/hour and 31 vehicles/hr and therefore the assessment of 50 vehicles in any one hour would be representative of a busy period.

The number of instances for each sound source is estimated to be 50 waste drops into each of the metal and wood bins and 5 drops into each of the glass and rubble bins. The assessment also includes the single use of the compactor and a single skip change. The commercial site usage is also included as 50 waste drops into a metal bin. The above numbers of modelled activities were higher than actual activities observed during the site visit and in our opinion would represent a typical busy period.

The modelling software uses the methods set out in ISO 9613, Part 2 to calculate sound propagation from each of the modelled sound sources to the receptor. The specific sound level at the SSR was then determined from the cumulative level from all sources over the reference time period.

The results of the assessment indicate that the sound emissions from the waste recycling site were assessed as likely having a significant adverse impact at the nearest sound sensitive receptor during a typical busy period. The environmental permit for the site requires the operator to '*identify and minimise the risks of pollution from noise*' and therefore, a range of mitigation measures were subsequently investigated following the hierarchy of noise control described in H3 part 2.

The operating company has already put a number of control measures in place to reduce the potential for noise generation at the site. To date this has included the following:

- Rearrange skip layouts so that bulkier items are located as far as practicably possible away from potential noise receptors.
- Installation of signage requesting site users to reduce noise levels.
- Staff training and active monitoring of noise levels during site usage.
- Rubber mats placed beneath builders' skips.

These practices should continue to be implemented and continuously reviewed to ensure effectiveness.

As all the sound sources at the site are intermittent and random in nature it was difficult to quantify any noise reduction benefits from the majority of the mitigation measures highlighted in this report. However, it was possible to assess the effectiveness of a site boundary acoustic barrier.

An acoustic barrier with an effective minimum height of 2m, located along the north-east and south-east boundary of the community recycling facility, could potentially reduce the sound emissions from the waste recycling facility by 5 dB, when assessed at the nearest sensitive receptors. This would be a clearly perceptible reduction when observed at the receptor.

For an acoustic barrier to achieve the calculated sound reduction performance, there must be no holes or weaknesses in the structure of the barrier. There should also be no gaps between the barrier and the ground in order to prevent sound passing underneath the barrier. The acoustic barrier should have a minimum superficial mass of 15 kg/m^2.

Following mitigation, the likely significant adverse impact will be eliminated and the likelihood of adverse impact from site activities will now be low when assessed at the SSR. The

recommended mitigation will reduce the sound emissions from the waste recycling site to a practicable minimum at the nearest sound sensitive receptor as required by the operational environmental permit. The resultant low likelihood of adverse impact could potentially be reduced further by incorporating the additional recommendations as a routine part of best operational practice at the site to minimise any unavoidable noise.

These additional recommendations were informed by consideration of the hierarchy of noise control and include:

- *All visiting skip lorries and trucks could be fitted with broadband reversing alarms which would be less intrusive off-site than the current tonal alarms. Even though it would be very difficult for the operator to implement a blanket ban on tonal reversing indicators at the site, third party contractors should be encouraged to consider replacing tonal alarms with broadband alarms as part of their maintenance or vehicle replacement procedures.*
- *It was noted that during the skip change over, the site was closed to the general public and consideration should be given to the switching off of reversing alarms whilst on-site and using a banksman during any necessary reversing operations.*
- *Evaluate the viability of the removal of the on-site speed bumps to eliminate a source of occasional significant sound when the trucks pass over them whilst carrying empty skips/bins.*
- *The staff at the site should continue to be proactive in educating the public about potential noise impacts and encourage the placing of waste into the skips/bins instead of throwing or dropping. Additional signage should be further deployed throughout the site to re-enforce the message and encourage the public to be considerate whilst on site.*
- *The installation of a CCTV system at the site should be considered. This could prove beneficial in the event of any necessary investigation into excessive sound emissions. It could also potentially modify visitor behaviour and help to minimise any unnecessary noise emissions.*

1.0 DESCRIPTION OF SITE

1.1 The site is located at Treherbert Community Recycling Centre, Treherbert Industrial Estate, Treherbert, Rhondda Cynon Taff, CF42 5HZ and is currently utilised community recycling facility for household waste.

1.2 The site is located at the southern edge of the town of Treherbert on a small industrial estate.

1.3 The nearest sound sensitive receptors (SSR) are at residential dwellings located approximately 60m to the north east of the facility at Eleanor Street and George Street.

2.0 DISCUSSION

2.1 Amgen Cymru operate a community waste recycling facility on the outskirts of Treherbert. The operations are subject to environmental permit number EPR/AB3091HR.

2.2 Section 3.3 of the permit refers to noise and vibration emissions from the facility. The relevant paragraphs are reproduced below:

"*3.3.1 Emissions from the activities shall be free from noise and vibration at levels likely to cause pollution outside the site, as perceived by an authorised officer of Natural Resources Wales, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved noise and vibration management plan to prevent or where that is not practicable to minimise the noise and vibration.*

3.3.2 The operator shall:

a) if notified by National Resources Wales that the activities are giving rise to pollution outside the site due to noise and vibration, submit to Natural Resources Wales for approval within the period specified, a noise and vibration management plan which identifies and minimises the risks of pollution from noise and vibration.

b) implement the approved noise and vibration management plan, from the date of approval, unless otherwise agreed in writing by Natural Resources Wales."

2.3 In response to complaints due to noise from the facility, Acoustics and Noise Ltd were initially engaged by Amgen Cymru to investigate whether the noise impact can be practically mitigated by physical means, e.g. acoustic fence or earth bund etc. and if not to advise on any other practical mitigation.

2.4 Following submission of our initial assessment for the above as detailed in report '*1805050R01*' [1], Natural Resources Wales requested the following additional information:

- *The monitoring already undertaken by RCT is used to inform a more detailed assessment.*
- *Further information is provided on the monitoring already undertaken by the consultant.*
- *A survey compliant with the BS4142:2014 standard is carried out to capture the sounds relating to the complaint and assess these for impact on the residential receptors.*
- *The source of the shredding operation is identified*
- *Once the sound sources have been identified and ranked in terms of impact, mitigation measures should then be assessed following the steps of the hierarchy of noise control.*

2.5 A request for the results of the monitoring already undertaken was made to RCT. We were informed that the measurements were not compliant with the requirements of BS 4142:2014 as the measurements were completed internally and therefore, the data collected by RCT was deemed unsuitable for use in this assessment.

2.6 No monitoring was undertaken by the consultant during the initial site visit as activity noise was not readily discernible against the acoustic climate when observed at the residential receptor.

2.7 This report details the measurements and an updated assessment of impact on the residential receptors following the methods detailed in BS 4142:2014.

2.8 BS 4142 describes the methods and procedures for rating and assessing sound of an industrial and/or commercial nature by comparing the rating level of the sound source(s) with the underlying sound level, or background sound level, at the assessment location.

2.9 Inspection of the measurement results obtained at the residential receptor indicated that the ambient sound levels measured during typical activities at the waste recycling site were actually 1 dB lower than the residual sound levels measured immediately before the site opened for the day.

2.10 Therefore, it was not possible to determine the specific sound level as discrete entity, distinct and free of other influences by measurement at the assessment location due to the relatively high residual sound level. This assessment, therefore, utilises a combination of measurement and calculation to determine the specific sound level at the SSR as recommended by BS 4142.

2.11 Acoustics and Noise Ltd were not able to identify the source of the shredding operation previously noted. No instances of shredding were observed during the survey carried out for this assessment and the site operatives confirmed that no shredding is carried out at the waste recycling site at any time.

2.12 This report details all significant sound sources observed during the site visit and an assessment of potential mitigation measures following the steps of the hierarchy of noise control.

2.13 Due to the intermittent and random nature of the sound sources, the ranking of the sources in terms of impact is impractical. The impact from a source is wholly dependent on the number of instances or the total duration which varies significantly.

2.14 To enable a robust assessment of the potential impact from activities on the site, a series near field measurements were made for each of the significant sound sources. Measurements were made of the loading of an empty bin with both metal and wood to simulate the worst-case sound emissions from each activity.

2.15 Additional measurements were made for the loading of the glass bin and for the loading of the rubble bin. At the time of the survey, these bins were full. However, for these activities the worst-case sound emissions will be attributable to the material on material impacts, i.e. glass on glass and porcelain on porcelain.

2.16 The results of the measurement were used as inputs to a 3D acoustic propagation model to predict the specific sound level at the nearest sensitive receptor.

3.0 ASSESSMENT METHODOLOGY

3.1 Relevant Guidance

3.2 As a matter of best practice, this assessment has been undertaken based on the relevant guidance on noise. This includes but not necessarily exclusive to:

3.3 Horizontal Guidance Note, IPPC H3 [2]

3.3.1 Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single Permitting process.

3.3.2 To gain a Permit, Operators will have to show that they have systematically developed proposals to apply the Best Available Techniques (BATs) and meet certain other requirements, taking account of relevant local factors.

3.3.3 The purpose of the *IPPC Horizontal Guidance Note for Noise Assessment and Control* is to provide supplementary information, relevant to all sectors, to assist Applicants in preventing and minimising emissions of noise and vibration as described in the IPPC Sector Guidance Notes.

3.3.4 This guidance is in two parts:

- *Part 1 Regulation and Permitting: Outlines the main considerations relating to the setting of Permit conditions and subsequent regulation of noise. It is aimed primarily at the information needs of Regulators.*
- *Part 2 Noise Assessment and Control: This document, describes the principles of noise measurement and prediction and the control of noise by design, by operational and management techniques and abatement technologies. It forms a background to Part 1 and will assist in determining BAT for a given installation.*

3.3.5 The guidance documents provide information and procedures for assessing the impact from noise sources. The impact from noise will depend upon many factors including the difference between the off-site noise and the existing background

sound level, the nature of the noise, its frequency, duration, and the times of the day the exposure occurs.

3.3.6 The measurement and evaluation of noise and vibration is covered in a number of British Standards. These give guidance on a wide range of related topics including equipment types, calibration, measurement techniques and locations and also the interpretation of data. Wherever possible a recognised method should be followed as closely as possible.

3.3.7 The Horizontal Guidance highlights a number of relevant British Standards and documents with particular emphasis on the application of BS 4142:1997. Since the publication of the Horizontal Guidance, BS 4142 was comprehensively revised and updated in 2014.

3.3.8 Part 2 describes a hierarchy for control of noise which needs to be considered on a process or site specific operation basis to minimise the risk of adverse impact.

3.4 **Objective Assessment using BS 4142 [3]**

3.4.1 **General guidance**

3.4.1.1 The Foreword to the standard states "*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 sound level, its absolute level, time of day, and change in the acoustic environment, as well as local attitudes to the source of the sound and the character of the neighbourhood.*"

3.4.1.2 The scope of BS 4142 includes the following guidance "*The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*".

3.4.1.3 It should be noted that exclusions to the use of the standard is carefully defined as follows

- *"The determination of noise amounting to a nuisance is beyond the scope of this British Standard "and that the*

- *"Sound of an industrial and/or commercial nature does not include sound from the passage of vehicles on public roads and railway systems" also*
- *"The standard is not intended to be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels" and.*
- *"The standard is not applicable to the assessment of low frequency noise"*

Therefore, the consideration of any of the above is outside the scope of this report.

3.4.1.4 The Scope of the standard goes on to state that:

"*This standard is applicable to the determination of the following levels at outdoor locations:*

- *Rating levels for sources of sound of an industrial and/or commercial nature; and*
- *Ambient, background, and residual levels*

For the purposes of:

- *Investigating complaints;*
- *Assessing sound from proposed, new, modified or additional sources(s) of sound of an industrial and/or commercial nature; and*
- *Assessing sound at a proposed new dwellings or premises used for residential purposes.*"

3.4.1.5 The unit of measurement usually used for measuring environmental sound is the A weighted decibel (dB). The "A weighting" is an internationally agreed frequency response, generally similar to that of the human ear, so that measured sound levels correspond reasonably well with what is heard.

3.4.1.6 In most situations, sound levels vary continuously, and it is customary to use a system of percentile values, which enable the noise climate to be described statistically. For example, the L_{A10} is the A-weighted noise level exceeded for 10% of a given time period and in the case of road traffic, for which it is widely used, it provides an indication of typical maximum levels. The L_{A90}, being the noise level

exceeded for 90% of the time, represents the typical minimum noise level in an area and is often referred to as the background noise level.

3.4.1.7 Sometimes it is convenient to give a single figure summarising all the sound received by equating it to the equivalent continuous sound level L_{Aeq} in dB, which would contain the same sound energy as the actual fluctuating sound levels.

3.4.1.8 Measurement locations are chosen that will give results that are representative of the ambient sound and residual sound at the assessment location(s). Specific, ambient and background sound measurements are usually taken at a height of 1.2m to 1.5m above the ground and under similar conditions to the assessment location(s) and at least 3.5m from any other reflecting surface. Where this is not possible, calculated levels as per an accepted methodology e.g. BS 5288 or ISO 9613-2, can be used.

3.4.2 **Specific Sound Level**

3.4.2.1 The specific sound level in terms of L_{Aeq}, produced by the sound source under investigation, is determined at the assessment location(s) as a discrete entity, distinct and free of other influences contributing to the ambient sound.

3.4.3 **Reference Time Interval**

3.4.3.1 The specific sound level is evaluated over an appropriate reference time interval, T_r defined in the standard as:

- 1 hour during the daytime period (07:00 – 23:00 hours)
- 15 minutes during the night time period (23:00 – 07:00 hours)

3.4.4 **Background Sound Level**

3.4.4.1 The background sound level is discussed in Clause 8.1 in BS 4142 as follows "*The background sound level is an underlying level of sound over a period, T, and might in part be an indication of relative quietness at a given location. It does not reflect the occurrence of transient and/or higher sound level events and is generally governed by continuous or semi-continuous sounds".*

3.4.4.2 And *"…Since the intention is to determine a background sound level in the absence of the specific sound that is under consideration, it is necessary to understand that*

the background sound level can in some circumstances legitimately include industrial and/or commercial sounds that are present as separate to the specific sound.

3.4.4.3 BS 4142 [3] gives guidance on the lowest limit to which the background sound level can be measured as follows "*Care is necessary in circumstances where background sound levels are low to ensure that self-generated and electrical noise within the measurement system does not unduly influence reported values, which might be the case if the measured background sound levels are less than 10 dB above the noise floor of the measuring system.".*

3.4.4.4 BS 4142 provides extensive guidance on assessing the representative background sound level advising that "*In practice, there is no "single" background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be representative of the period being assessed."*

3.4.5 **Residual Sound Level**

3.4.5.1 The ambient sound level i.e., all sounds near and far measured without the specific sound level present is termed the residual level. If the residual level is close to the specific sound level, the specific sound level is corrected to account for the addition of the background sound to the specific sound level measured.

3.4.5.2 Where the ambient sound level and the measured specific sound level are within 10dB of each other, then the specific sound level is corrected as follows

$$L_S = 10lg\left(10^{\frac{L_A}{10}} - 10^{\frac{L_R}{10}}\right)$$

where:
L_S is the specific sound level;
L_A is the ambient sound level; and
L_R is the residual sound level.

3.4.5.3 As per the guidance in BS 4142 "*Where it is not possible to determine the specific sound level by measurement of the ambient sound level and the residual sound level at the assessment location(s), for example, because the difference between the ambient sound level and the residual sound level is ≤3 dB, determine the specific*

sound level by a combination of measurement and calculation. Report the method of calculation in detail and give the reason for using it."

3.4.5.4 If the specific sound is intermittent and the on-time of the source is less than the reference time period, then the specific sound level corrected for the effect of the residual level determined above is further corrected for the on-time using the correction term:

$$10 \lg \left(\frac{T_o}{T_r} \right)$$

where T_o is the on-time of the specific source

and T_r is the reference time period

3.5 **Specific Sound Acoustic Features Corrections**

3.5.1 Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background level.

3.5.2 If the source sound has a feature which makes it particularly noticeable, e.g., a tonal or impulsive characteristic, a character correction is added to the measured or calculated specific sound level to obtain the rating level in order to account for its more noticeable nature.

3.5.2.1 BS 4142 specifies the following methods to assess this penalty

- Subjective method;
- Objective method for tonality;
- Reference method.

3.5.3 **Subjective method**

3.5.3.1 Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.

3.5.3.2 BS 4142 specifies the following penalties for tones:

- 2 dB for a tone which is just perceptible at the noise receptor
- 4 dB where it is clearly perceptible
- 6 dB where it is highly perceptible

3.5.3.3 BS 4142 specifies the following penalties for impulsivity:

- 3 dB for impulsivity which is just perceptible at the noise receptor
- 6 dB where it is clearly perceptible
- 9 dB where it is highly perceptible

3.5.3.4 Where the specific sound features characteristics are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

3.5.3.5 Where the specific sound is intermittent and has identifiable on/off conditions that are "*readily distinctive against the residual acoustic environment*", a penalty of 3 dB can be applied.

3.5.3.6 BS 4142 further explains that "*…where tonal and impulsive characteristics are present in the specific sound within the same reference period, then these two corrections can both be taken into account. If one feature is dominant then it might be appropriate to apply a single correction. Where both features are likely to affect perception and response, the corrections ought normally to be added in a linear fashion.*"

3.5.3.7 The maximum character corrections that could be applied to the specific sound level would be 18 dB for a specific sound that has both highly perceptible tonal and impulsive characteristics with identifiable on/off conditions.

3.5.4 **Rating Level**

3.5.4.1 The correction for any acoustic features present in the sound source is added to the specific sound level to give the rating level $L_{Ar,Tr}$ which is then compared with the background sound level, $L_{A90,T}$, by subtracting the background sound level from the rating level and the significance of impact is assessed.

3.5.5 **Uncertainty**

3.5.5.1 Consideration should be given to the level of uncertainty in the data and associated calculations. Where the level of uncertainty could affect the conclusion, any assessment should take reasonably practicable steps to reduce the level of uncertainty.

4.0 ASSESSMENT PROCEDURES

4.1 Acoustics and Noise Limited conducted simultaneous surveys, both on-site and at the sensitive receptor, throughout a typical day on 26th November 2018. Activities observed, included the use of the site by the community to deposit waste material for recycling purposes, two skip change overs and two site visits by Commercial site users, to deposit recyclable items from house clearances.

4.2 During the survey, staff were instructed not to approach site users to encourage the 'quiet' placement of waste which is part of the noise control measures currently in place at the site. This instruction was in order to replicate 'worst-case' noise emissions during typical operation of the site.

4.3 BS 4142 [3] describes methods for rating and assessing sound of an industrial and/or commercial nature. Typically, this is achieved by measurements at the assessment location or sound sensitive receptor (SSR).

4.4 The specific sound level at the assessment location should be determined as a discrete entity, distinct and free of other influences contributing to the ambient sound.

4.5 To determine the specific sound level, the ambient sound level measured during the operation of the specific sound source is corrected for the effect of the residual sound in the absence of the specific sound.

4.6 BS 4142 states that "*Where it is not possible to determine the specific sound level by measurement of the ambient sound level and the residual sound level at the assessment location, for example, because the difference between the ambient sound level and the residual sound level is ≤3 dB, determine the specific sound level by a combination of measurement and calculation"* and "*…it is sometimes convenient to carry out the measurements closer to the source and then use a calculation method to estimate the specific sound level at the assessment location(s)".*

4.7 Measurements of the ambient and residual sound level were taken at the assessment location prior to and during a period of typical activities at the waste

recycling site. On-site activities observed during the ambient sound survey period included 27 car visits, 2 van visits, 2 Commercial site user vans, 1 compactor operation, 1 bottle deposit and 1 skip change over and is inclusive of all significant sound sources at the site.

4.8 Inspection of the results detailed in Appendix 3, indicate that the ambient sound levels measured at the assessment location, during typical activities at the waste recycling site, were actually 1 dB lower than the residual sound levels measured immediately before the site opened for the day.

4.9 Therefore, it was not possible to determine the specific sound level as discrete entity, distinct and free of other influences by measurement at the assessment location due to the relatively high residual sound level. This assessment, therefore, utilises a combination of measurement and calculation to determine the specific sound level at the SSR as recommended by BS 4142 [3].

4.10 This assessment utilises nearfield sound measurements of the significant activities at the site as inputs to a 3D acoustic model.

4.11 The following significant sound sources were identified and assessed:

- Loading of an empty bin with a small washing machine (metal on metal noise).
- Loading of an empty bin with a wooden bed head (wood on metal noise)
- Loading of a partially full glass bin (glass on glass noise)
- Loading of a full rubble bin (porcelain on porcelain noise)
- Skip change over
- Use of the compactor

4.12 The above operations were measured under controlled conditions to simulate worst-case sound emissions.

4.13 The modelling software uses the methods set out in ISO 9613, Part 2 [2] to calculate sound propagation from each of the sources to the receptor. The specific sound level at the SSR was then determined from the cumulative level from all sources over the reference time period.

4.14 **Prediction of Specific Sound Levels from Waste Recycling Site**

4.14.1 As the site is relatively large and comprises multiple sources, a 3D acoustic CAD model of the site was constructed to include the sound sources and the nearest sound sensitive receptors.

4.14.2 B&K Predictor Type 7810 ver2019 Software was utilised to model the noise emissions from the site. This noise prediction software allows for the investigation of noise emissions in complex or large outdoor environments. The software can be used to analyse industrial noise sources and traffic measurements to the latest European and U.K. Standards.

4.14.3 A major advantage of using this method is the ability to remodel changes and alterations to the site and/or sources.

4.14.4 Results are displayed in easily understood noise contours overlaid onto a site centred OS drawing of the area downloaded from Stanfords Portal.

4.14.5 **CAD Model Construction**

4.14.5.1 Topographical information for the area was obtained from 'Stanfords Portal' in the form of Digital Terrain height data (5m resolution).

4.14.5.2 This data was imported into the CAD software and used to construct the 3D terrain for the area.

4.14.5.3 A site centred OS drawing for the area was also downloaded from Stanfords Portal and used to accurately position the existing buildings onto the terrain. All buildings were modelled with a height of 8m with the exception of the industrial unit located to the north-west of the site, which was modelled with a height of 12m.

4.14.5.4 The sound emissions associated with the recycling facility occur randomly and from various locations within the facility. To robustly assess this situation, the sound emissions from each of the significant sources were measured during a worst-case operation of the source at measurement distances of between 1m and 5m.

4.14.5.5 Each of the sound sources were modelled as a point source with a height of 1m. Each of the sources were placed into the model at their location observed during the site visit.

4.14.5.6 Commercial site users utilise an area of the site at the southern corner for depositing mixed materials into bins retrieved from house clearances. They visit the site up to three times a day several times per week. To represent worst case, the Commercial site user operations are included in the assessment and modelled as 50 drops into a metal waste bin during the 1-hour reference time period.

4.14.5.7 As the sound sources are intermittent and random in occurrence, this assessment is based on visitor numbers estimated by the on-site staff. It was indicated that typical numbers of vehicle visits were around 50 in any one hour.

4.14.5.8 It should be noted that, during the survey, the number of vehicles were logged over two separate hourly period. The observed number of vehicles were 18 vehicles/hour and 31 vehicles/hr and therefore the assessment of 50 vehicles in any one hour represents a robust assessment.

4.14.5.9 Observations during the survey, indicated that the metal and wood bins were used by the majority of visitors. Only two deposits at the bottle bank were observed during the whole of the survey period and three deposits at the rubble bin.

4.14.5.10 During the 1-hour assessment period, it is assumed that the number of activities is as described in Table 1 below and, in our opinion, represents a busy period based on the on-site observations during the survey.

Table 1 – Description of Sound Sources and Operational Times

Sound Source	Individual Activity Duration	Number of Activities within 1-hour Reference time Period	Total Activity Duration
Loading Metal Waste Bin	2 seconds	50	100 seconds
Loading Wood Waste Bin	2 seconds	50	100 seconds
Use of Compactor	60 seconds	1	60 seconds
Loading Glass Bin	9 seconds	5	45 seconds
Loading Rubble Bin	71 seconds	5	355 seconds
Commercial site user Area*	2 seconds	50	100 seconds
Skip Change	698 seconds	1	698 seconds

** Commercial site user activity is represented by the loading of a metal waste bin activity (worst case)*

4.14.5.11 For each of the identified sound sources, the measured sound pressure level frequency spectrum, measurement distance and total activity time are used as inputs to the model to describe the sound power level from each source. The

conversion from sound pressure level into sound power level and the source on-time correction factor are calculated by the software.

4.14.6 **CAD Model Prediction**

4.14.6.1 A noise contour grid covering the whole assessment area was constructed to display the calculated external free field noise levels. The grid represents the free field noise levels throughout the assessment area and is actually a collection of receivers set 1m apart at a height of 1.2m.

4.14.6.2 A receiver was located 1m from the façade of the nearest SSR and was set to calculate the cumulative free-field sound pressure levels during a 1-hour reference time period. This represents the specific sound level attributable to the modelled activities during the 1-hour reference time period.

4.14.6.3 The specific sound levels calculated at the SSR were then used to determine the likelihood of adverse impact following the procedures detailed in BS 4142 [3].

4.14.6.4 A second model was created to calculate the effect of the installation of an acoustic barrier along the north-east and south-east boundary of the facility.

4.14.6.5 Barriers with heights of 2m and 3m were modelled for consideration.

4.14.6.6 For each of the models, using Predictor ver2019 software, calculations were made for the sound propagation attenuation across the area following the procedures set out in ISO 9613-2 [4].

4.14.6.7 Calculations are made for the daytime period only to represent the operational hours of the facility.

4.14.7 **Sound Propagation Contour Maps**

4.14.7.1 The sound propagation contour maps are presented in Appendix 4.

4.14.7.2 Colour coded sound propagation contour maps are generated by the acoustic model to aid identification of the following:

- *Specific sound levels from site activities for the existing site layout*
- *Efficacy of 2m Barrier. Resultant specific sound levels from site activities with a 2m high barrier located at the north east and south east site boundary*

- *Efficacy of 3m Barrier. Resultant specific sound levels from site activities with a 3m high barrier located at the north east and south east site boundary*

4.15 ASSESSMENT OF IMPACT AS PER BS 4142 [3]

4.15.1 Assessment Locations

4.15.1.1 The assessment location was agreed with Natural Resources Wales and was deemed to be representative of the acoustic climate at the nearest sensitive receptor (see Appendix 2).

4.15.2 Reference Time Interval

4.15.2.1 The site operates during the hours of 08:00 -17:30, November to April and 08:00 – 19:30 hours April to November. Therefore, the appropriate reference time period for a daytime impact assessment is 1 hour as defined in BS 4142.

4.15.3 Suitability of Measurement Equipment

4.15.3.1 BS 4142 [3] gives guidance on the lowest limit to which the background sound level can be measured. The requirement for the measurement equipment is that the measured background sound levels are greater than 10 dB above the noise floor of the measuring system.

4.15.3.2 The meter used for the surveys was a B&K 2250 which has a specified internal noise floor of 16.6 dB which means that sound levels of equal to or greater than 16.6 + 10 dB(A) = 27 dB will meet the above criteria.

4.15.3.3 The lowest recorded background sound level during the survey was 42.2 dB $L_{A90,5\ mins}$. This comfortably exceeds the internal noise floor of the measurement equipment as described above.

4.15.4 Specific Sound Level

4.15.4.1 As explained previously, due to the intermittent and random nature of the activities at the site, it was not possible to determine the specific sound level at the assessment position as a discrete entity, distinct and free of other influences contributing to the ambient sound as required by BS 4142.

4.15.4.2 Using the 3D CAD modelling techniques described above the specific sound level, from worst-case site activities, was determined at the sound sensitive receptor. The results of the modelling exercise are presented in Appendix 4 and summarised in Table 2 below.

Table 2 – Summary of Calculated Specific Sound Level at SSR

Sound Sensitive Receptor	Free-Field Specific Sound Level $L_{Aeq,1\ hour}$ (dB)
SSR	44

4.15.5 **Representative Background Sound Level**

4.15.5.1 It was agreed with Natural Resources Wales that the representative background sound level could be determined from a 1-hour measurement conducted at the assessment location immediately prior to commencement of daily activities at the site.

4.15.5.2 The representative daytime background sound level was determined from the 1-hour period 07:40 – 08:40 hours. Even though the site opened at 08:00, there was no significant activity observed by the onsite representative from Acoustics and Noise Ltd. The measured background sound during this period was deemed to be representative of the acoustic conditions at the assessment location when not subject to the specific sound.

4.15.5.3 The results of the baseline survey are presented in Appendix 3 with the representative background sound levels summarised in Table 3 below.

Table 3 – Summary of Representative Background Sound Level

Reference Time Period	Free-Field Background Sound Level $L_{A90,t}$ (dB)
Daytime, t = 1 hour	43

4.15.6 **Residual Sound Level**

4.15.6.1 The residual sound level was determined during the background sound survey in the absence of site activity. The residual sound level was determined to be 49 dB $L_{Aeq,1hr}$ which was 1 dB higher than the ambient sound level.

4.15.6.2 As per the guidance in BS 4142 "*Where it is not possible to determine the specific sound level by measurement of the ambient sound level and the residual sound level at the assessment location(s), for example, because the difference between the ambient sound level and the residual sound level is ≤3 dB, determine the specific sound level by a combination of measurement and calculation. Report the method of calculation in detail and give the reason for using it.*"

4.15.6.3 In this case, the specific sound level was determined by calculation using CAD modelling techniques and the sound propagation calculations follow the procedures detailed in ISO 9613 [4]. No correction for the influence of the residual sound level is necessary.

4.15.7 **Acoustic Feature Correction**

4.15.7.1 At the time of the survey, the sound characteristics of the waste recycling site activities were subjectively described as random and impulsive in nature. These observations were made at the assessment location.

Tonality

4.15.7.2 At the time of the measurement, the survey engineer at the assessment location did not observe any tonal components associated with the waste recycling site activities. No tonal feature correction was applied to the specific sound.

Impulsivity

4.15.7.3 At the time of the measurement, the survey engineer at the assessment location, described the specific sound as being impulsive and clearly perceptible at the assessment location. A +6dB impulsive feature correction was applied to the specific sound.

Other Sound Characteristics

4.15.7.4 The waste recycling activities do not feature any other acoustic characteristics that would be "*readily distinctive against the residual acoustic environment*" and no additional acoustic feature corrections were applied.

Intermittency

4.15.7.5 At the time of the measurement, the survey engineer subjectively described the activities at the waste recycling site as intermittent with clearly identifiable on/off conditions and therefore, a 3dB acoustic feature correction was applied to the specific sound level.

4.15.7.6 To account for the acoustic features described above, a total correction of + 9 dB is applied to the specific sound level to determine the rating level.

4.15.8 **Rating Level**

4.15.8.1 The acoustic corrections are added to the specific sound level to give the rating levels for the operations at the site, $L_{Ar,Tr}$, and are summarised in Table 4 below.

Table 4 – Summary of Calculated Rating Levels

Sound Sensitive Receptor	Specific Sound Level $L_{Aeq,1hr}$ (dB)	Acoustic Feature Correction (dB)	Rating Level $L_{Ar,Tr}$ (dB)
SSR1	44	+9	53

4.15.8.2 The rating level is then compared with the background sound level, by subtracting the background sound level from the rating level. and the significance of any impact is assessed as per BS 4142 [3].

4.15.9 **Uncertainty**

4.15.9.1 There is a potential for uncertainty in the determination of the representative daytime background sound levels due to the relatively short survey period. This uncertainty was minimised by measuring during the period immediately prior to the commencement of daytime operations at the site as agreed with Natural Resources Wales.

4.15.9.2 All measurements and calculations have adopted a worst-case approach to minimise the significance of uncertainty.

4.15.9.3 The uncertainty due to atmospheric effects is minimal due to the short source receiver distance.

4.16 **Significance of Impact**

4.16.1 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.

4.16.2 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level and using the magnitude of this difference to assess the significance of impact as summarised in Table 5. Typically, the greater this difference, the greater the magnitude of the impact.

4.16.3 Adverse impacts include, but are not limited to, annoyance and sleep disturbance.

Table 5 – Summary of BS 4142 Daytime Assessment

Sound Sensitive Receptor	Rating Level (dB)	Background Sound Level (dB)	Excess over Background (dB)	BS 4142 Assessment of Impact
SSR	53	43	+10	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context

4.16.4 The initial estimate of the impact of the specific sound indicates that there is a likelihood of the specific sound having a significant adverse impact during busy periods when assessed at the nearest sound sensitive receptor depending on the context.

4.16.5 It should be noted that not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

4.17 Consideration of the Context

4.17.1 The acoustic climate at the site is dominated by the sound of road traffic travelling along the nearby roads in addition to intermittent train pass-bys. The acoustic climate was also impacted upon by plant noise from the industrial unit adjacent to the waste recycling site and a commercial premise adjacent to the SSR.

4.17.2 During the survey period, there was also significant activity from a nearby yard servicing large mobile plant and machinery.

4.17.3 Even though the absolute sound levels from the site are below the residual sound levels, the activity sound levels are still perceptible due to the differing acoustic characteristics.

4.17.4 Modelling of the worst-case sound emissions from the significant sound sources at the site indicated that there was likely to be a significant adverse impact at the nearest sound receptor during busy periods.

4.17.5 The frequency during which such conditions persist at the site has not been assessed. However, given the nature of the operation and the absence of multiple noise complaints in the surrounding residential properties, the worst-case conditions simulated during the modelling exercise are not anticipated to be present over significant periods of time.

4.17.6 However, it is anticipated that the modelling exercise is representative of busy periods at the site during which there would be a likelihood of significant adverse impact. At other times, the significance of impact would be lower.

4.17.7 The rating level is significantly above the measured background sound level and in this instance, any uncertainty would not have any significance to the outcome of the assessment.

4.17.8 Following consideration of the context, modification of the initial estimate of impact is not appropriate and the conclusion of a significant adverse impact would still apply during busy periods.

4.17.9 The sound emissions at the site should be reduced as much as practicable to minimise the risk of significant adverse impact.

5.0 MITIGATION

5.1 This assessment concludes that there may be a likelihood of significant adverse impact from the current operations at the waste recycling site during the busiest times. The sound emissions at the site should be reduced as much as practicable to minimise the risk of significant adverse impact.

5.2 Measures for preventing or minimising sound emissions were considered with reference to the hierarchy of control detailed in Horizontal Guidance Note, IPPC H3 (part 2) [2].

5.3 The hierarchy for control should be to:

- **Prevent** generation of noise at source by good design and maintenance.
- **Minimise or contain noise at source** by observing good operational techniques and management practice.
- **Use physical barriers or enclosures** to prevent transmission to other media.
- **Increase the distance** between the source and receiver.
- **Sympathetic timing and control** of unavoidably noisy operations.

5.4 The above steps are considered in more detail in the following sections.

5.5 **Prevent**

5.5.1 The waste recycling facility is used by the local community to drop off household waste for recycling. Visitors to the site arrive in cars or small vans and deposit the waste into material specific skips or bins. The significant source of noise is from the impact of the waste as it is deposited into the bins.

5.5.2 The only item of permanent plant is a small compactor which operates for 60 seconds every hour. The results of the modelling indicate that this source is the least significant of all sources assessed.

5.5.3 Full skips and bins are changed over throughout a day. Typically, there are three change overs in a day, but this could rise to a maximum of six. The change overs are carried out using a skip lorry. The larger bins are wheeled onto the lorry to eliminate the noise from any scraping or dragging along the ground.

5.5.4 The layout of the site encourages one-way flow of traffic and minimises the need for reversing. It was observed that the skip lorries were fitted with tonal reversing alarms.

5.5.5 The site itself comprises a smooth concrete surface with several speed control humps. It was observed that when the skip lorries travel over the humps there is a significant increase in noise particularly when the skip is empty.

5.5.6 The operating company has already put a number of control measures in place to reduce the potential for noise generation at the site. To date this has included the following:

- *Rearrange skip layouts so that bulkier items are located as far as practicably possible away from potential noise receptors.*
- *Installation of signage requesting site users to reduce noise levels.*
- *Staff training and active monitoring of noise levels during site usage.*
- *Rubber mats placed beneath builders' skips.*

5.5.7 These practices should continue to be implemented and continuously reviewed to ensure effectiveness.

5.5.8 Given the nature of the activities at the site, there is limited scope for the further prevention of sound emissions.

5.5.9 Consideration of the removal of the speed bumps could eliminate a source of occasional noise but could compromise other aspects of site safety.

5.5.10 All visiting skip lorries and trucks could be fitted with broadband reversing alarms which would be less intrusive off-site than the current tonal alarms. However, it would be very difficult for the operator to implement a blanket ban on tonal reversing indicators at the site. The company frequently uses third party contractors to service waste at the site and it would be impractical to require each contractor to make such adjustments. However, all third party contractors should be encouraged to consider replacing tonal alarms with broadband alarms as part of their maintenance or vehicle replacement procedures.

5.5.11 It was noted that during the skip change over, the site was closed to the general public and consideration should be given to the switching off of reversing alarms whilst on-site and using a banksman during any necessary reversing operations.

5.5.12 The installation of a CCTV system at the site should be considered. This could prove beneficial in the event of any necessary investigation into excessive sound emissions. It could also potentially modify visitor behaviour and help to minimise any unnecessary noise emissions.

5.5.13 As all the sound sources at the site are intermittent and random in nature it will be difficult to quantify any noise reduction benefits from any of the measures highlighted above. However, they should form a routine part of best operational practice at the site to minimise any unavoidable noise.

5.6 **Minimise or Contain Noise at Source**

5.6.1 As the site is extensively used by the local community, there is minimal scope for significant control of noise using management practice or good operational techniques.

5.6.2 The only practical measures have already been considered and/or implemented as detailed in step 1.

5.6.3 The lining of the skips/bins with resilient layers would potentially reduce the impact noise from waste being dropped into the bin. However, this would only be effective for a minimal number of drops. Once the resilient layer is covered with waste it becomes ineffective with the material on material impact noise remaining significant. The additional costs for management and maintenance to the linings would potentially outweigh the minimal reduction in noise.

5.6.4 Also, as the skips are not under the control of the site operator, it will be impractical to ensure that only lined skips are used on site.

5.7 **Use Physical Barriers or Enclosures**

5.7.1 There is the potential to enclose each skip or bin with a purpose-built enclosure. Each enclosure would need to be lined with sound absorbing material and be constructed of sufficient mass to effectively mitigate sound transmission.

5.7.2 Due to access requirements these enclosures would need to be open to one side. The open side should be oriented away from the sensitive receptors. The enclosures should include a roof and be of sufficient height to allow the effective removal of the skip during change over. The scale and number of enclosures required may prove unacceptable from a visual impact.

5.7.3 The use of enclosures could potentially reduce the sound transmission from each material drop significantly. However, the number and physical size of the enclosures may result in a much smaller usable area on the site and could result in a less efficient means of skip removal resulting in longer change over times, more vehicle manoeuvres and a resultant increase in noise.

5.7.4 An alternative solution would be the installation of an acoustic barrier along the north-east and south-east boundary of the site. This has the advantage of minimal disruption to the site whilst potentially attenuating all sources of site noise.

5.7.5 The effectiveness of site boundary barriers was evaluated and is discussed in the next section.

5.8 **Increase the Distance**

5.8.1 Due to the relatively small scale of the operational site, there is limited scope for the locating of the noisiest activities further from the sensitive receptor. Where possible, the site layout is utilised so that the bulkiest items are located as far as practicably possible away from potential noise receptors.

5.9 **Sympathetic Timing and Control**

5.9.1 There are no site activities during the more sensitive night time periods.

5.9.2 All operations and skip change overs are carried out during the daytime opening hours.

5.9.3 Any further reduction in the opening hours will need to be balanced against the community value of the site.

5.9.4 As stated earlier, staff training is utilised to minimise unavoidable noisy operations.

5.10 EFFECTIVENESS OF MITIGATION

5.10.1 As all the sound sources at the site are intermittent and random in nature it will be difficult to quantify any noise reduction benefits from the majority of the measures highlighted above.

5.10.2 However, it is possible to assess the effectiveness of the site boundary barrier.

5.10.3 The 3D model was updated to assess the effectiveness of a barrier located at the northeast and south east boundary of the site. Barriers with heights of 2m and 3m were assessed and the resultant specific sound levels were calculated at the SSR.

5.10.4 The results are detailed in Appendix 4 and summarised in Table 6 below.

Table 6 – Summary of Effectiveness of Boundary Barrier Mitigation

Sound Sensitive Receptor	Calculated Specific Sound Level Existing Site Layout $L_{Aeq,1hr}$ (dB)	Calculated Specific Sound Level 2m Boundary Barrier $L_{Aeq,1hr}$ (dB)	Calculated Specific Sound Level 3m Boundary Barrier $L_{Aeq,1hr}$ (dB)
SSR	44	39	38

5.10.5 Installation of a 2m high barrier at the north-east and south-east site boundary will potentially reduce the sound emissions at the sensitive receptor by 5 dB. Increasing the height of the barrier to 3m will only reduce the sound emissions by a further 1 dB.

5.10.6 The human perception to a change in the level of sound is described in Table 7 below.

Table 7 – Human Perception to Change in Sound Level

Change in Sound Level	Perceived Change to the Human Ear
± 1 dB	Not Perceptible
± 3 dB	Just Perceptible
± 5 dB	Clearly Perceptible
± 10 dB	A doubling or halving of loudness
± 20 dB	A quadruple change in loudness

5.10.7 A 5dB reduction in sound level is clearly perceptible, whereas the additional 1 dB reduction from the 1m increase in barrier height would not be perceptible.

5.10.8 Given that the additional costs associated with increasing the height of the barrier would be significant without a perceptible improvement in the sound levels at the SSR, this report concludes that a boundary acoustic barrier with a minimum height of 2m will result in a clearly perceptible reduction in sound emissions from the site into the surrounding area.

5.10.9 The acoustic barrier should have a minimum superficial mass of 15 kg/m^2.

5.10.10 For an acoustic barrier to achieve the calculated sound reduction performance, there must be no holes or weaknesses in the structure of the barrier. There should also be no gaps between the barrier and the ground in order to prevent sound passing underneath the barrier.

5.11 **Re-Assessment of Impact following Mitigation**

5.11.1 Following mitigation, the specific sound level at the receptor will be reduced by 5 dB and will now be 4 dB below the background sound levels. It is anticipated that at these levels, the specific sound will be just perceptible at the SSR.

5.11.2 For a just perceptible impulsive characteristic, BS 4142 specifies a +3dB correction is applied to the specific sound. Further, if we assume that the specific sound will still be observed as intermittent to represent worst-case, then BS 4142 specifies a +3dB correction to the specific sound.

5.11.3 The acoustic corrections are added to the specific sound level to give a rating level for the operations at the site of 39 + 6 = 45 dB $L_{Ar,Tr}$ which is 2dB above the background sound level.

5.11.4 BS 4142 states that '*The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact'*.

5.11.5 Therefore, following the installation of an acoustic barrier, with a minimum height of 2m, along the north-east and south-east boundary of the site, the significant adverse impact will be eliminated and the likelihood of an adverse impact from site activities will now be low when assessed at the SSR.

6.0 CONCLUSIONS

6.1 During a survey conducted at the sensitive receptor during typical operations at the site, it was not possible to determine the specific sound level as discrete entity, distinct and free of other influences by measurement due to the relatively high levels of residual sound. This assessment, therefore, utilises a combination of measurement and calculation to determine the specific sound level at the SSR as recommended by BS 4142.

6.2 Nearfield sound level measurements were made of all significant sound sources during worst-case conditions with the results being utilised as inputs to a 3D acoustic model to predict the specific sound level at the sensitive receptor.

6.3 The results of the assessment represent the potential impact during the busiest times at the site. At other times, the impact will likely be much lower.

6.4 The results of the worst-case modelling indicate that the sound emissions from the waste recycling site were assessed as likely having a significant adverse impact at the nearest sound sensitive receptor.

6.5 A range of mitigation measures were investigated following the hierarchy of noise control described in H3 part 2.

6.6 As all the sound sources at the site are intermittent and random in nature it was difficult to quantify any noise reduction benefits from the majority of the mitigation measures highlighted in the report. However, it was possible to assess the effectiveness of a site boundary acoustic barrier.

6.7 Locating an acoustic barrier along the north-east and south-east boundary of the community recycling facility will reduce the sound emissions from the facility to the surrounding sensitive receptors.

6.8 An acoustic barrier with an effective height of 2m will reduce the sound emissions by 5 dB when assessed at the nearby sensitive receptors. A 5 dB reduction is clearly perceptible.

6.9 Increasing the height of the barrier by 1m would not result in any perceived reduction in sound emissions over and above that achieved by the 2m barrier.

6.10 Following mitigation, the significant adverse impact is eliminated and the likelihood of an adverse impact from site activities will now be low when assessed at the SSR.

6.11 The resultant low likelihood of an adverse impact could potentially be reduced further by incorporating the additional mitigation recommendations as a routine part of best operational practice at the site to minimise any unavoidable noise.

7.0 RECOMMENDATIONS

7.1 An acoustic barrier should be located at the north-east and south-east boundary of the site. The acoustic barrier should have a minimum effective height of 2m with a minimum superficial mass of 15 kg/m^2.

7.2 For an acoustic barrier to achieve the calculated sound reduction performance, there must be no holes or weaknesses in the structure of the barrier. There should also be no gaps between the barrier and the ground in order to prevent sound passing underneath the barrier.

7.3 All visiting skip lorries and trucks should be encouraged to consider fitting broadband reversing alarms which would be less intrusive off-site. It was noted that during the skip change over, the site was closed to the general public and consideration could be given to the switching off of reversing alarms whilst on-site and using a banksman during any necessary reversing operations.

7.4 Evaluate the viability of the removal of the on-site speed bumps to eliminate a source of occasional significant sound when the trucks pass over them whilst carrying empty skips/bins.

7.5 The staff at the site should continue to be proactive in educating the public about potential noise impacts and encourage the placing of waste into the skips/bins instead of throwing or dropping. Additional signage should be deployed throughout the site to re-enforce the message and encourage the public to be considerate whilst on site.

7.6 The installation of a CCTV system at the site should be considered. This could prove beneficial in the event of any necessary investigation into excessive sound emissions. It could also potentially modify visitor behaviour and help to minimise any unnecessary noise emissions.

P.A.T. 09/01/19
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Appendix 1
Survey Details

A1.0 SURVEY DETAILS

Background and Residual Sound Survey

A1.1.1 The meter was calibrated at the start of the measurement procedure and checked after each set of measurements. No significant deviation i.e. > 0.5 dB was recorded.

A1.1.2 Measurements were carried out on 26th November 2018 over a 1-hour measurement period prior to any activity at the waste recycling site.

A1.1.3 The survey commenced at 07:40 hours.

A1.1.4 Weather conditions: 100% cloud cover, 6°C, dry, still.

A1.2 **Measurement Procedure:**

A1.2.1 The meter was located on a tripod at a height of 1.4m and positioned at an assessment location at the rear of the nearest sound sensitive receptor (SSR).

A1.2.2 This location was agreed with Mr Lee Foulkes of Rhondda Cynon Taff County Borough Council and Natural Resources Wales and was deemed representative of the acoustic climate at the nearest SSR.

A1.2.3 The meter was adjusted to log and store L_{Aeq} and L_{A90} in 5-minute periods for the duration of the survey. No on-site activity was observed during the background and residual sound survey period.

A1.2.4 On completion of the survey, the data was downloaded to a computer for further analysis.

A1.2.5 The data was further analysed to determine the background and residual sound level over the 1-hour reference time period.

A1.2.6 **SUBJECTIVE OBSERVATIONS**

A1.2.7 The acoustic environment during the survey was dominated by road traffic and intermittent birdsong. During the survey, a continuous tonal sound was also observed, possibly from plant associated with the factory unit adjacent to the recycling site.

A1.2.8 Additional sources were from occasional train pass-bys along the line to the south of the recycling site approximately 150m from the assessment position.

Ambient Sound Survey

A1.2.9 The meter was calibrated at the start of the measurement procedure and checked after each set of measurements. No significant deviation i.e. > 0.5 dB was recorded.

A1.2.10 The survey commenced at 11:34 hours on 26th November 2018 over a continuous 1-hour period. During this period, on-site observations subjectively described it as being the 'busiest' period of the day with over thirty vehicle visits during the hour.

A1.2.11 On-site activities observed during this period included 27 car visits, 2 van visits, 2 Commercial site user vans, 1 compactor operation, 1 bottle deposit and 1 skip change over.

A1.2.12 The meter was located as for the background and residual survey described above.

A1.2.13 Weather conditions: 100% cloud cover, 8°C, dry, still.

A1.2.14 The meter was adjusted to log and store L_{Aeq} and L_{A90} in 1-second periods for the duration of the survey.

A1.2.15 On completion of the survey, the data was downloaded to a computer for further analysis.

A1.2.16 The data was further analysed to determine the ambient sound level at the assessment location over the 1-hour reference time period.

A1.2.17 **SUBJECTIVE OBSERVATIONS**

A1.2.18 The acoustic environment during the survey was dominated by road traffic and intermittent birdsong. Activities at the waste recycling site were perceptible at the measurement position and impulsive in character. The sound emissions from the skip change were also perceptible.

A1.2.19 During the survey period, three train pass-bys were observed.

A1.2.20 Acoustics and Noise Ltd. maintained a presence at the assessment location throughout the day up to 14:30 hours. During this time, additional sources of sound were observed. These included occasional tannoy announcements from within the factory unit adjacent to the waste recycling site, intermittent plant operation associated with a nearby commercial property, occasional plant and machinery

movements associated with a nearby yard, intermittent dog barking and intermittent residential vehicle movements.

Nearfield Activity Sound Survey

A1.2.21 The meter was calibrated at the start of the measurement procedure and checked after each set of measurements. No significant deviation i.e. > 0.5 dB was recorded.

A1.2.22 Weather conditions: 100% cloud cover, 8°C, dry, still.

A1.2.23 The meter was adjusted to measure manually L_{Aeq} for the duration of each activity. The third-octave linear sound spectrum was also measured for each activity.

A1.2.24 The measurement equipment was located as close to the source as was practicable, typically at a distance of 1m.

A1.2.25 Measurements were made under controlled conditions for all significant sound sources observed during the site visit.

A1.2.26 The sound sources assessed are detailed in Table 8 below.

Table 8 – Description of Significant Sound Sources

Sound Source/Activity	Comment
Metal Bin (for deposit of metal waste)	Measurements were made at 1m from the entrance to the bin. The activity comprised of the 'throwing' of a small washing machine into an empty bin to represent worst-case sound emissions. Two measurements were completed and the average sound pressure level of the two measurements was determined to be representative.
Wood Bin (for deposit of wood waste)	Measurements were made at 1m from the entrance to the bin. The activity comprised of the 'throwing' of pine double bed headboard into an empty bin to represent worst-case sound emissions. Two measurements were completed and the average sound pressure level of the two measurements was determined to be representative.
Compactor (compacts non-recyclable waste)	Measurements were made 1m from the compactor motor during a typical operation.
Glass Bin (for deposit of glass waste)	Measurements were made 1m from the entrance slot of the glass bin during a typical deposit of a number of glass bottles. At the time of the measurement the skip was reasonably full and the sound emissions are representative of glass on glass impacts.
Rubble Bin (for deposit of building waste including porcelain)	Measurements were made 2m from the side of the skip during the controlled deposit of porcelain toilet components and bathroom tiles. The activity was completed by Mr Lee Foulkes of RCTCBC and videoed for evidence. At the time of the measurement the skip was reasonably full and the sound emissions are representative of material on material impacts.
Skip Change (replace full skip with empty skip)	Measurements were made 1m from the side of the skip being replaced. The significant source of sound during the operation was from the skip lorry movements. The measurement position was at an average distance of 5m from the lorry during the operation. Sound emissions from two separate skip

	changes were completed and the average sound pressure level of the two measurements was determined to be representative.
	Note: All measurements were completed in isolation of any other site activities to minimise the contribution from extraneous sources.

A1.2.27 On completion of the survey, the data was downloaded to a computer for further analysis.

A1.2.28 The data was further analysed to determine the sound emission level for each activity in addition to the octave band frequency spectrum to be utilise in the modelling exercise.

A1.3 Equipment Used:

Table 9 – Equipment Used (Background, Residual and Ambient Sound Surveys)

ITEM	Serial No	UKAS Calibration Certificate Date (if applicable)
(ANL-M3) B&K 2250 Handheld Analyser	2559188	Certificate: 15418 Date: 16/05/18
(ANPC3) B&K 4231 Calibrator	2162602	Certificate: 15338 Date: 29/01/18

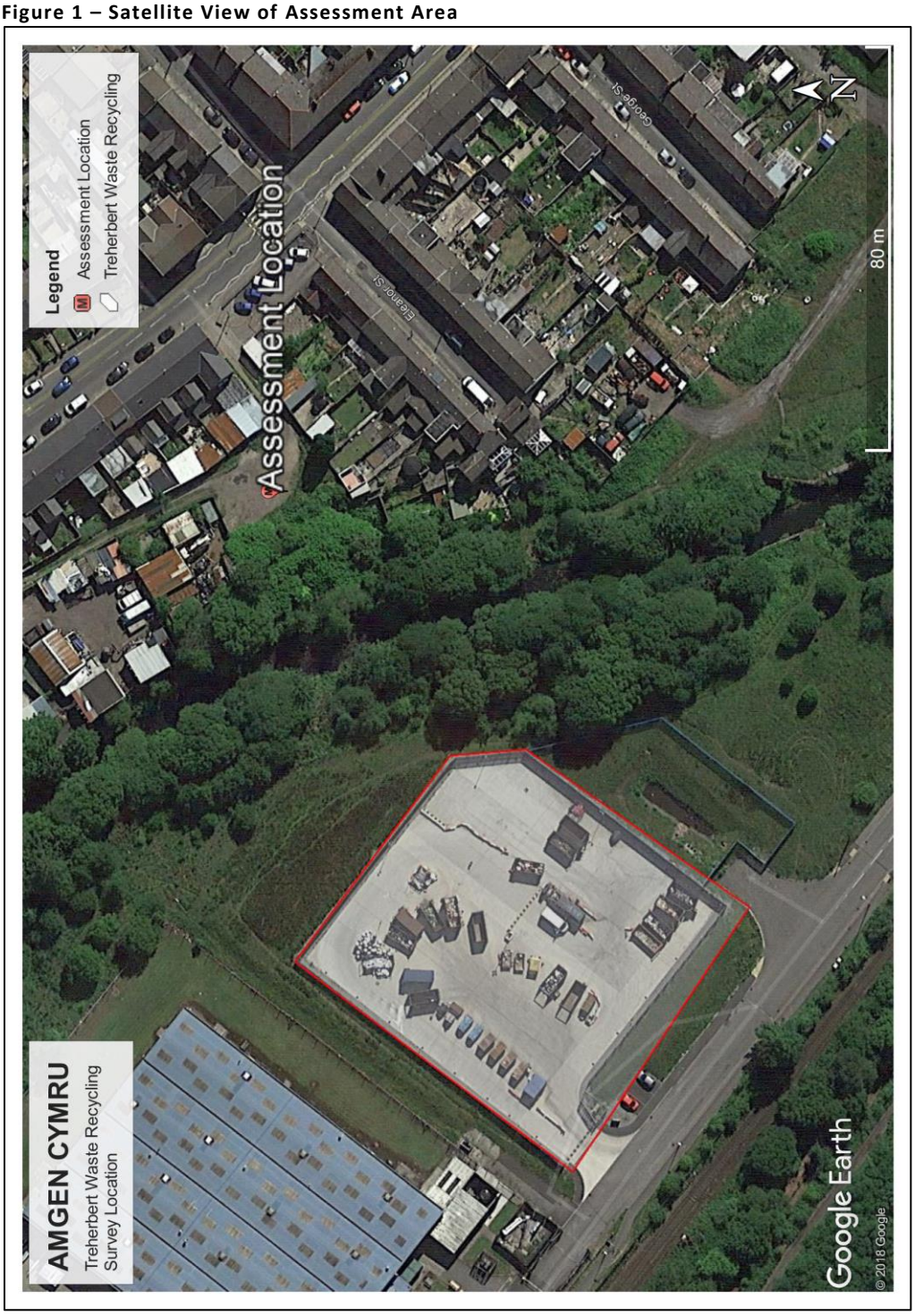
Table 10 – Equipment Used (Nearfield Activity Sound Surveys)

ITEM	Serial No	UKAS Calibration Certificate Date (if applicable)
(ANL-M4) B&K 2250 Handheld Analyser	2567736	Certificate: 15417 Date: 16/05/18
(ANL-C4) B&K 4231 Calibrator	2567363	Certificate: 15416 Date: 15/05/18

Appendix 2
View of Assessment Area

A2.0 VIEW OF ASSESSMENT AREA

Figure 1 – Satellite View of Assessment Area



Appendix 3
Survey Results

A3.0 SURVEY RESULTS

A3.1 Measurements Completed at Assessment Location

Table 11 – Background, Residual and Ambient Sound Level Measurement Results at Assessment Location

Name	Start time	Overload [%]	Duration, t (hh:mm:ss)	$L_{Aeq,t}$ [dB]	$L_{A90,t}$ [dB]
Background and Residual Sound Level	26/11/2018 07:40:00	0.0	1:00:00	49.1	43.3
Ambient Sound Level	26/11/2018 11:34:03	0.0	1:00:00	48.2	42.8

A3.2 Measurements Completed On-Site

Table 12 – Nearfield Measurement Results of Significant On-Site Activity

Measurement	r (m)	Duration (hh:mm:ss)	63	125	250	500	1000	2000	4000	8000	Total $L_{Aeq,t}$ (dB)
Metal Bin #1	1	0:00:09	90.4	90.6	85.9	84.7	79.6	78.3	75.4	70.5	86.5
Metal Bin #2	1	0:00:10	82.6	87.3	86.9	86.4	79.5	78.8	75.4	69.2	87.1
Wood Bin #1	1	0:00:07	83.7	89.1	85.3	79.6	77.5	78.7	73.5	70.5	84.9
Wood Bin #2	1	0:00:08	78.3	87.6	84.5	84.1	85.0	86.0	79.3	70.7	90.6
Compactor	1	0:00:54	63.3	63.4	76.0	65.1	69.9	60.5	57.4	53.9	72.7
Glass Bin	1	0:00:09	55.8	60.2	65.6	66.4	75.2	82.1	81.8	74.4	86.7
Site 1hr Corner	n/a	1:01:49	58.3	56.5	45.9	41.7	41.5	41.7	36.5	27.8	47.8
Skip Change #1	5	0:11:38	71.0	64.4	62.8	64.4	62.8	62.5	56.8	50.9	68.2
Site 1hr Centre	n/a	0:56:36	64.3	61.7	58.2	55.2	52.4	50.5	47.1	42.2	58.3
Skip Change #2	5	0:04:16	71.2	67.9	67.9	66.8	66.6	64.4	59.3	53.2	71.0
Rubble Bin	2	0:01:11	66.1	62.9	71.5	70.6	74.5	78.3	78.3	73.9	83.6
Average Metal Bin	1	0:00:10	69.3	66.0	70.1	69.1	72.2	75.5	75.3	70.9	86.8
Average Skip Change	5	0:11:38	68.0	64.7	70.9	69.9	73.5	77.1	77.1	72.6	69.8
Average Wood Bin	1	0:00:08	68.7	65.4	70.5	69.5	72.9	76.4	76.3	71.8	88.6

** r is the measurement distance in metres where applicable*

Appendix 4
Modelling Results

A4.0 MODELLING RESULTS

Figure 2 – Sound Emission Contours from Site (Existing Layout)

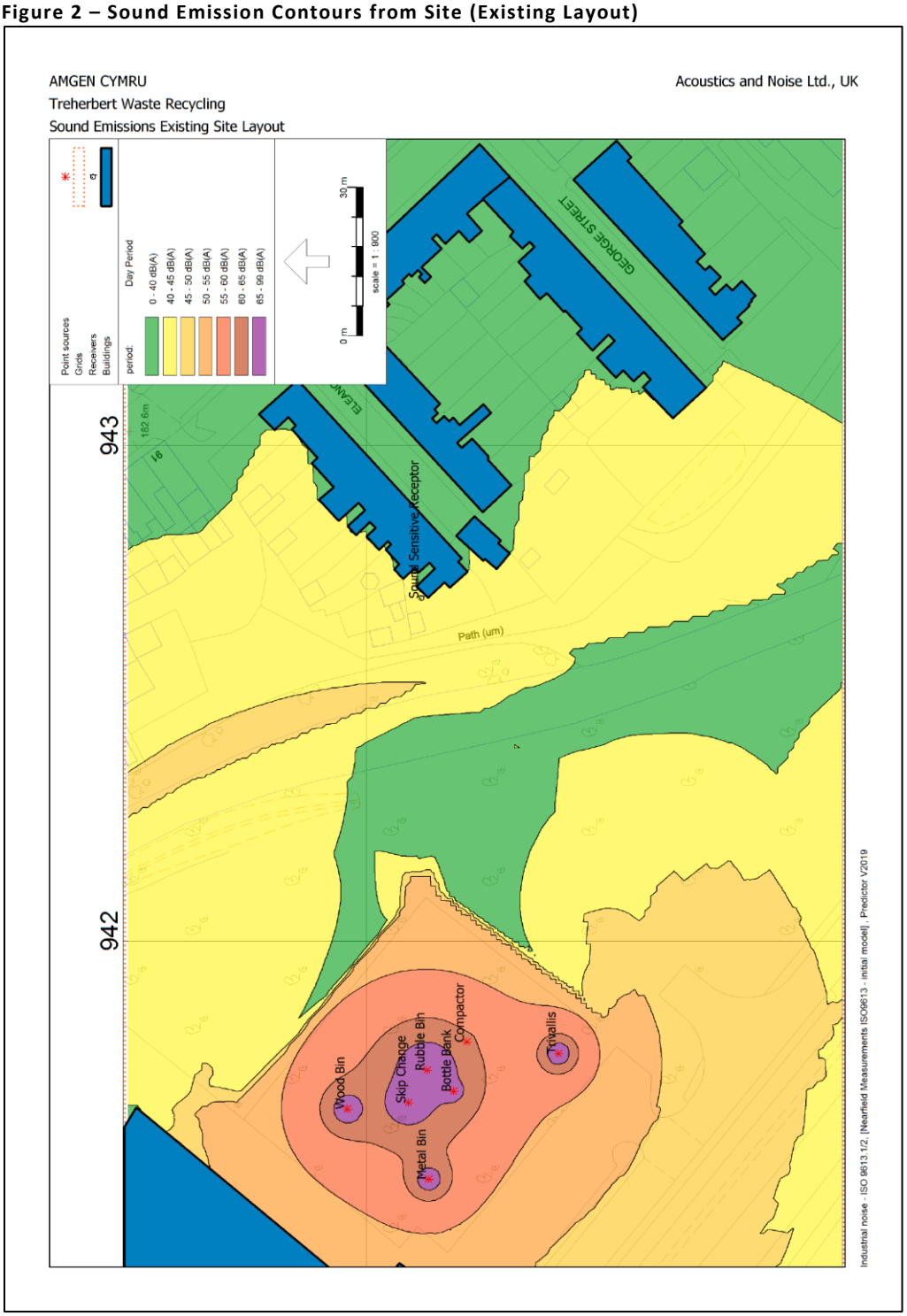


Figure 3 – Sound Emission Contours from Site (2m Boundary Barrier Mitigation)

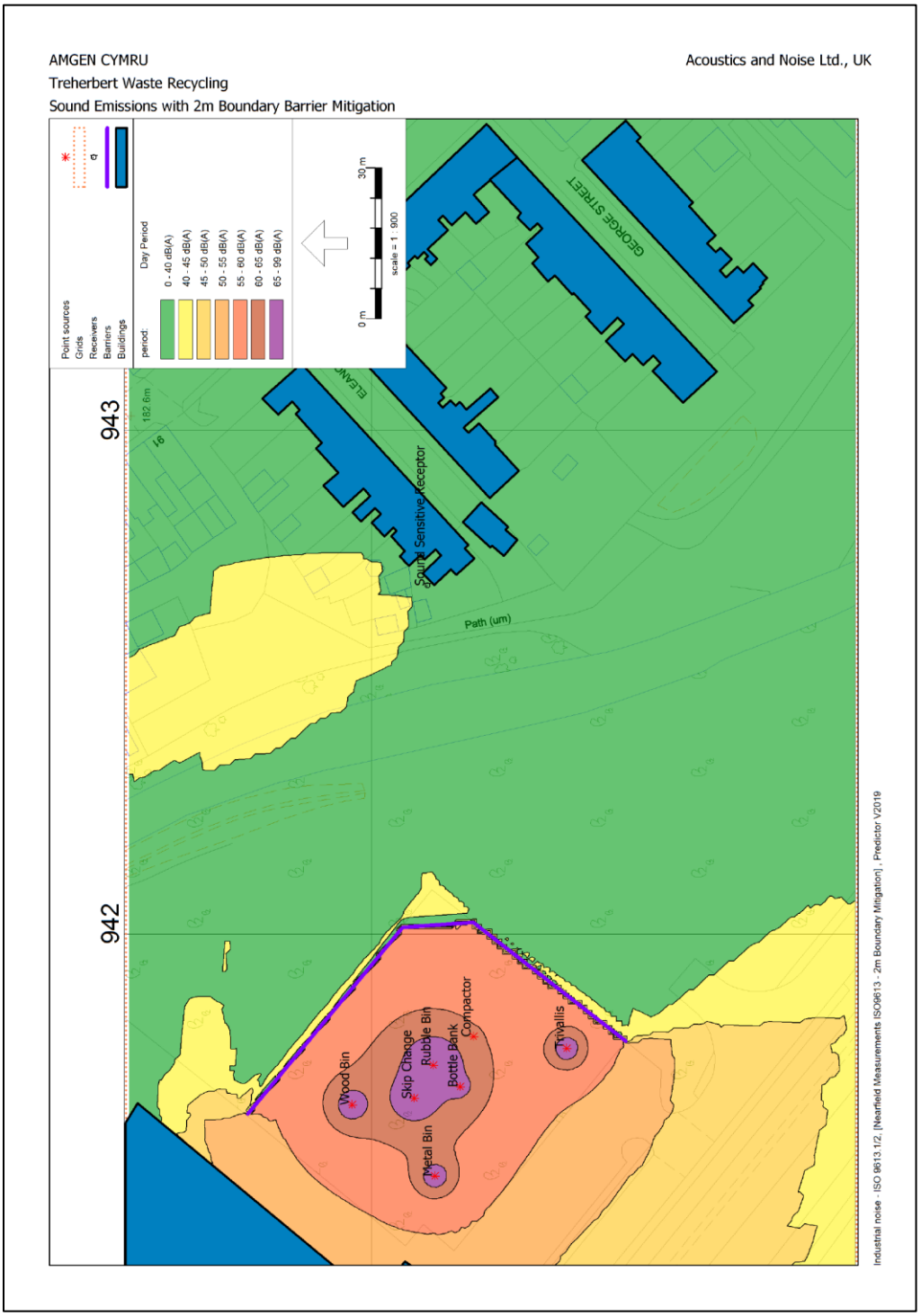


Figure 4 – Sound Emission Contours from Site (3m Boundary Barrier Mitigation)

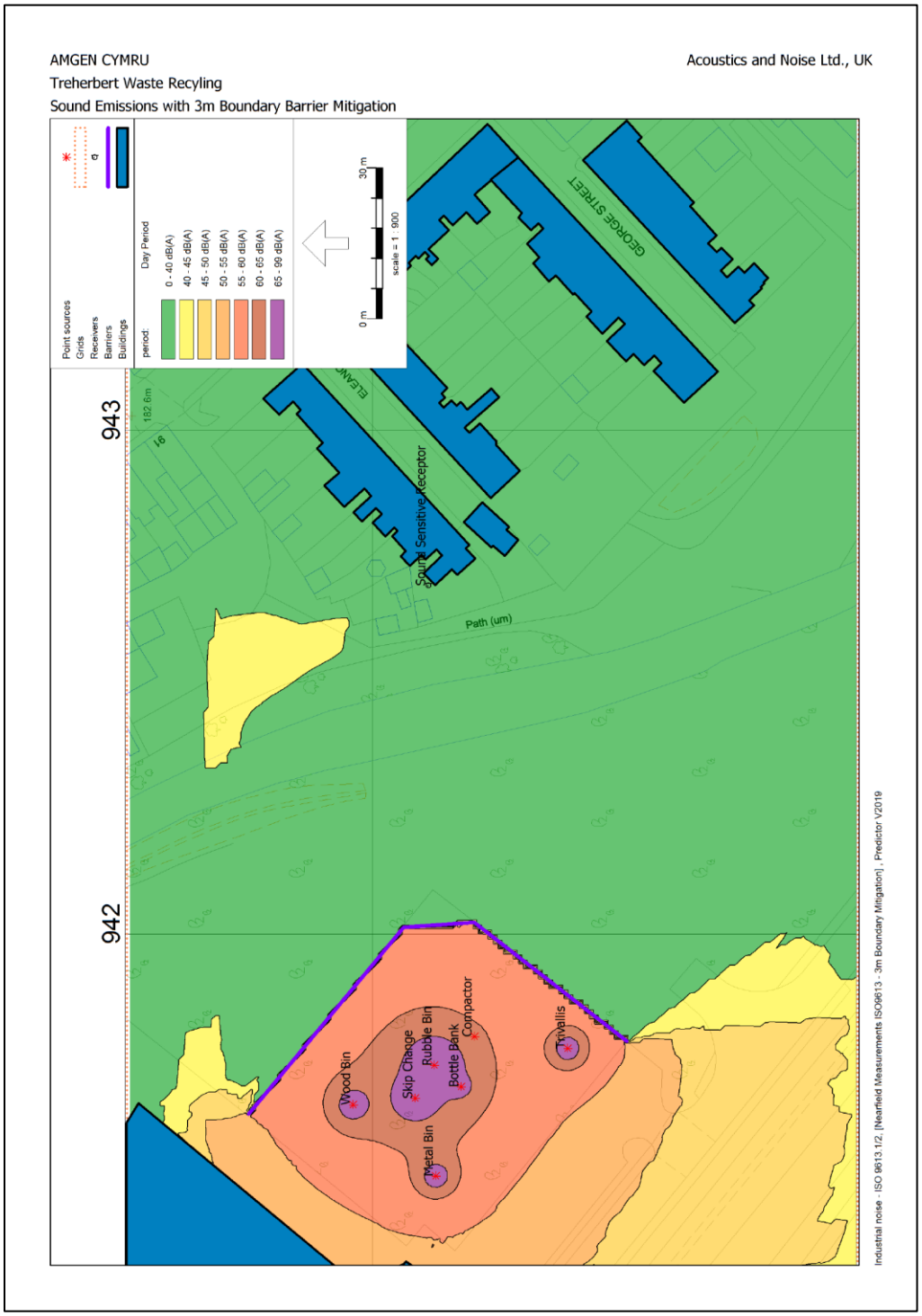


Figure 5 – Calculated Specific Sound Level at SSR (Existing Site Layout)

Description (Existing Site)	Height (m)	Specific Sound Level $L_{Aeq,1hr}$ (dB)
Sound Sensitive Receptor	1.2	43.7
Rubble Bin	1	40.2
Skip Change	1	37.8
Wood Bin	1	34.4
Commercial site user	1	32.8
Metal Bin	1	32.2
Bottle Bank	1	28.0
Compactor	1	17.1

Table 13 – Calculated Specific Sound Level at SSR (2m Boundary Barrier Mitigation)

Description (with 2m Boundary Barrier Mitigation)	Height (m)	Specific Sound Level $L_{Aeq,1hr}$ (dB)
Sound Sensitive Receptor	1.2	39.2
Rubble Bin	1	35.4
Skip Change	1	33.0
Wood Bin	1	31.5
Commercial site user	1	27.6
Metal Bin	1	27.4
Bottle Bank	1	23.2
Compactor	1	13.7

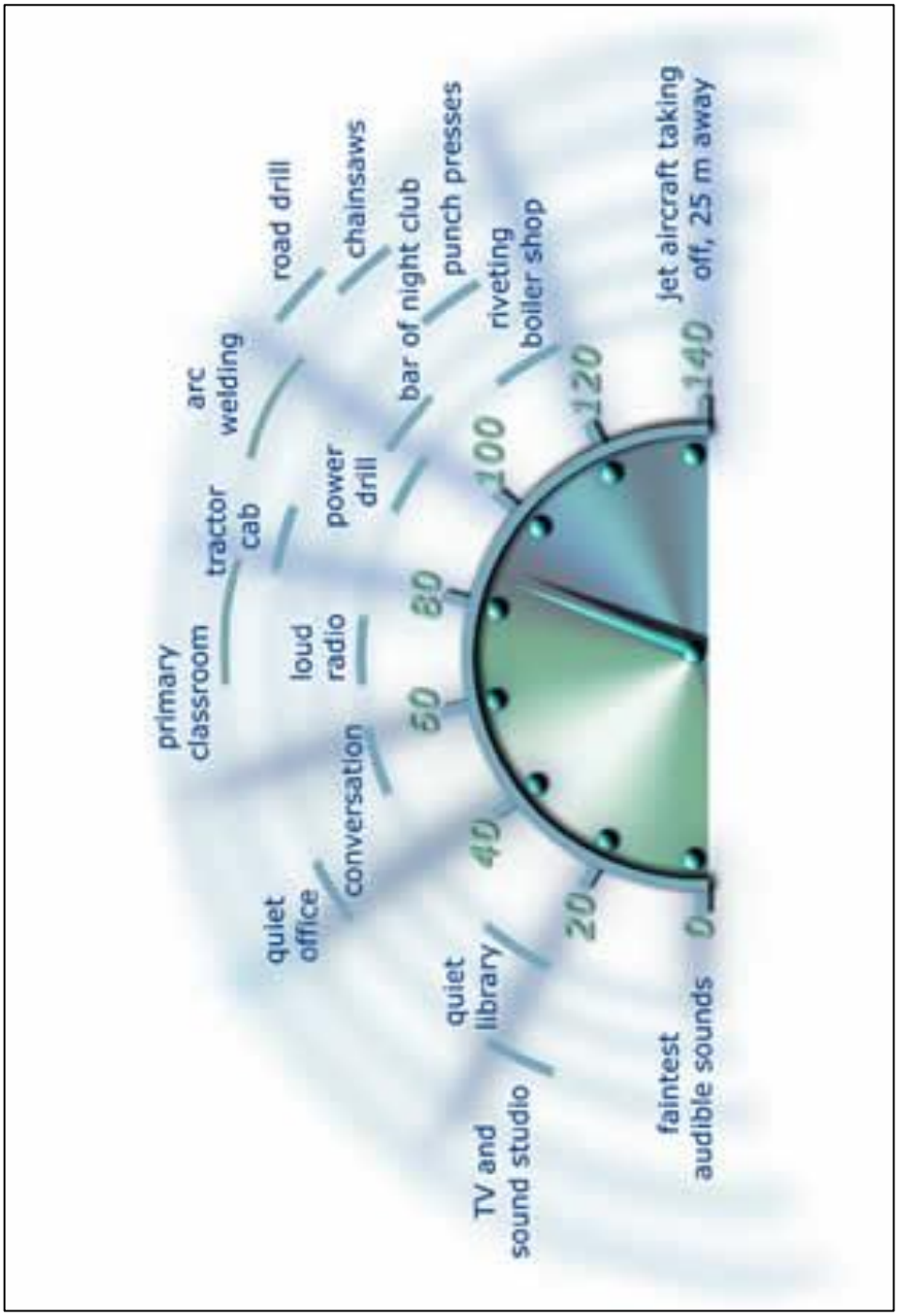
Table 14 – Calculated Specific Sound Level at SSR (3m Barrier Boundary Mitigation)

Description (with 3m Boundary Barrier Mitigation)	Height (m)	Specific Sound Level $L_{Aeq,1hr}$ (dB)
Sound Sensitive Receptor	1.2	37.7
Rubble Bin	1	33.2
Skip Change	1	32.1
Wood Bin	1	30.7
Metal Bin	1	27.2
Commercial site user	1	25.5
Bottle Bank	1	21.3
Compactor	1	12.7

Appendix 5
Range of Typical Noise Levels

A5.0 RANGE OF TYPICAL NOISE LEVELS

Figure 6 – Range of Typical Noise Levels



Appendix 6
Glossary of Acoustic Terms

A6.0 GLOSSARY OF ACOUSTIC TERMS

A6.1 **Acoustic Environment:**

Sound from all sound sources as modified by the environment.

A6.2 **Ambient Sound:**

Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far.

NOTE: The ambient sound comprises the residual sound and the specific sound when present.

A6.3 **Ambient Sound Level, $L_a = L_{Aeq,T}$:**

Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the measurement location over a given time interval, T.

NOTE: The ambient sound level is a measure of the residual sound and the specific sound when present.

A6.4 **A-Weighting:**

Normal hearing covers the frequency (pitch) range from about 20 Hz to 20,000 Hz but sensitivity is greatest between about 500 Hz and 5,000 Hz. The 'A-weighting' is an electrical circuit built into noise meters to approximate this characteristic of human hearing.

A6.5 **Background Sound Level, $L_{A90,T}$:**

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 whole number of decibels.

A6.6 **Decibel (dB):**

The logarithmic measure of sound level. 0dB (A) is the threshold of normal hearing. 140 dB (A) is the level at which instantaneous damage to hearing is caused. A change of 1 dB is detectible only under laboratory conditions.

A6.7 **dB(A):**

Decibels measured on a sound level meter incorporating a frequency weighting (A-weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with an individual's assessment of loudness. A change of 3 dB (A) is the minimum perceptible under normal conditions and a change of 10 dB(A) corresponds roughly to doubling or halving the loudness of a sound.

A6.8 **Equivalent Continuous A-weighted Sound Pressure Level, $L_{Aeq,T}$**

Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 - t_1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{Aeq,T} = 10lg_{10}\left\{\left(\frac{1}{T}\right)\int_{t_1}^{t_2}\left[\frac{p_A(t)^2}{{p_0}^2}\right]dt\right\}$$

where

p_0 is the reference sound pressure (20 µPa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure at time t

NOTE: the equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number of decibels.

A6.9 **Free Field:**

A sound field in which no significant sound reflections occur

A6.10 **Frequency:**

The number of cycles per second of a vibration usually expressed in units of Hertz, Hz

A6.11 **Hertz:**

Unit of frequency, equal to one cycle per second. Frequency determines the pitch of a sound.

A6.12 **$L_{A10,T}$:**

The 'A-weighted' noise level exceeded for 10% of the specified measurement period (T). It gives an indication of the upper limit of fluctuating noise such as that from

road traffic. $L_{A10,18hr}$ is the arithmetic average of the 18 hourly $L_{A10,1hr}$ values from 06:00 - 24:00.

A6.13 **L_{Amax}:**

The maximum 'A-weighted' level of noise recorded during a noise event. The time weighting used (Fast or Slow) should be stated.

A6.14 **Measurement Time Interval, T_m:**

Total time over which measurements are taken.

NOTE: This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.

A6.15 **Rating Level, $L_{Ar,Tr}$:**

Specific sound level plus any adjustment for the characteristic features of the sound.

A6.16 **Reference Time Interval, T_r:**

Specified interval over which the specific sound level is determined.

NOTE: This is 1h during the day from 07:00 h to 23:00 h and a shorter period of 15min at night from 23:00 h to 07:00 h.

A6.17 **Residual Sound:**

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

A6.18 **Residual Sound Level, $L_r = L_{Aeq,T}$:**

Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T.

A6.19 **Specific Sound Level, $L_s = L_{Aeq,T}$:**

Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.

A6.20 **Specific Sound Source:**

Sound source being assessed.

A6.21 **Tonality:**

The degree to which a noise contains audible pure tones. Broadband noise (across a wider range of frequencies) is generally less annoying than noise with identifiable tones.

Appendix 7
References

A7.0 REFERENCES

1 1805050R01, 'Assessment of Efficacy of Acoustic Barrier', Acoustics and Noise Ltd, 4th July 2018

2 Horizontal Guidance for Noise, Part 2 – Noise Assessment and Control, IPPC, Environment Agency, 2004

3 BS 4142, "Methods for rating and assessing industrial and commercial sound", The British Standards Institution, 2014

4 ISO 9613, 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation' International Organization for Standardization, 1996