Gipsy Patch Lane – Noise Assessment

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Cribbs Patchway Metrobus Extension
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Contents

Appendices

Executive Summary

As part of the Cribbs Patchway metrobus extension (CPME) scheme, a section of Gipsy Patch Lane has been widened to accommodate new bus lanes, and a new railway overbridge constructed to accommodate the wider carriageway and to relieve the previous traffic pinchpoint caused by the original narrow bridge. This report summarises the results from a series of noise measurements undertaken at residential receptors in the Gipsy Patch Lane area. These surveys have been undertaken to examine noise levels following implementation of the CPME scheme, in order for South Gloucestershire Council to fulfil its duties under the Noise Insulation Regulations 1975 which requires the determination of whether any households are eligible for a grant towards noise insulation.

In June 2022, noise surveys were undertaken at three separate locations, as follows:

- Location 1 - 26 Gipsy Patch Lane
- Location 2 - 32 Gipsy Patch Lane
- Location 3 - 22 Smithcourt Drive

26 Gipsy Patch Lane survey

The noise survey at location 1 (26 Gipsy Patch Lane) was undertaken specifically to compare the results with an identical survey from 2017. In addition, the results have been used to quantify noise from passenger trains and freight train movements on the railway as number 26 is the closest dwelling to the railway bridge. This survey was unattended, with the noise logger installed for six days in the rear garden.

Table 1 shows a summary of the noise levels measured in June 2022 and compares them against the noise levels measured at the same location in April 2017 prior to the construction of the CPME scheme.

Table 1: 26 Gipsy Patch Lane - Comparison of noise measurements for 2022 and 2017

Survey Date	Measured noise level, dB(A)	
	Daytime $L_{eq, 18hr}$	Night time $L_{eq, 6hr}$
June 2022	53.4	49.2
April 2017	55.3	50.9

Table 1 shows that in June 2022 the daytime noise level was 53.4 dB(A)[1] and the night-time noise level was 49.2 dB(A).

The noise levels measured in June 2022 for both daytime and night-time show a slight reduction, of around 2 dB, from the survey undertaken in April 2017. There are likely to be two factors, which contribute to the reduction in noise at location one:

1. An acoustic fence has been installed along the property boundary, which will likely be providing some reduction in noise from road traffic on Gipsy Patch Lane, and;
2. the electrification of the railway, enabling most of the passenger trains to use the quieter electric power units, which produce less noise than diesel powered trains.

It is noted that the freight trains still use diesel power units.

[1] This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies. See Appendix A for further information about A weighting.

Detailed analysis of the train noise levels measured at 26 Gipsy Patch Lane has been undertaken for 2017 and 2022. The results show a reduction in the measured noise level from passenger trains and no change in the noise levels from freight trains.

32 Gipsy Patch Lane & 22 Smithcourt Drive surveys

Noise measurements at locations 2 and 3 were undertaken specifically to determine eligibility for noise insulation in accordance with the Noise Insulation Regulations 1975.

The surveys at location two and location three were undertaken as an attended exercise, using 3-hour measurements in accordance with the procedures as set out in the Calculation of Road Traffic Noise (CRTN)[2].

The Environmental Statement (ES) (the output of the Environmental Impact Assessment process) undertaken for the CPME scheme in 2017/18 identified that seven dwellings on Smithcourt Drive may be eligible for noise insulation due to the potential for increased traffic noise levels. The noise levels measured at location three (22 Smithcourt Drive) are representative of all seven properties identified in the ES due to their proximity to each other and the widened carriageway. It should be noted that location two (32 Gipsy Patch Lane) was not identified in the ES as being potentially eligible for noise insulation but has been included in the surveys to demonstrate a comprehensive approach to the 2022 assessment along Gipsy Patch Lane.

Table 2 shows a summary of the noise levels measured at location two and location three and the total predicted noise level increase with the metrobus service in operation which is due to commence in early 2023.

Table 2: Gipsy Patch Lane - results summary

Location	Address	Measured noise level, $L_{A10,18h}$ dB	Change with Metrobus in operation, dB	Total noise level with Metrobus service in operation, $L_{A10,18h}$ dB
Location 2	32 Gipsy Patch Lane	60.7	0.4	61.1
Location 3	22 Smithcourt Drive	57.7	0.8	58.5

The total predicted noise levels shown in Table 2 are compared to the eligibility criteria set out in the Noise Insulation Regulations 1975. In order for properties to be eligible for insulation the traffic noise level at any point within the next 15 years from 2022 would need to be at or above 68 $L_{10,18\text{-hour}}$ dB(A).

Traffic noise levels are below the 68 dB(A) threshold at both locations, therefore, properties on Gipsy Patch Lane and Smithcourt Drive are not eligible for noise insulation. The inclusion of the potential noise from future metrobus operation does not change this conclusion.

For traffic noise to increase from the current levels up to the 68 dB(A) threshold, there would need to be over a four-fold increase (i.e. 400%) in traffic flow on Gipsy Patch Lane. The calculations undertaken to demonstrate the traffic increase required to increase noise levels up to the noise insulation threshold are provided in Appendix E. Even with local developments either planned or under construction, this increase in traffic flow is not realistically possible within 15 years, as there are current network constraints and limited geometry junctions that physically limit the amount of traffic that can access Gipsy Patch Lane. In any case, this very unlikely increase in traffic is corroborated by the West of England Combined Authority's Joint Local Transport Plan 4 2020-2036 (March 2020), where it states that vehicle trips are expected to increase by up to 26% by 2036 without any intervention, which is significantly less than the 400% necessary for the noise levels to meet the 68dB(A) threshold.

[2] The 3-hour survey methodology (known as the 'Shortened Measurement Procedure) is described within the Calculation of Road Traffic Noise (CRTN) and can be used where a full 18-hour or longer survey may not be possible. Although CRTN is over 30 years old, this shortened measurement method was validated within the 2011 version of the noise assessment guidance contained within the Design Manual for Road and Bridge (DMRB).

1. Introduction

1.1 General

As part of the Cribbs Patchway metrobus extension (CPME) a section of Gipsy Patch Lane has been widened to accommodate new bus lanes, and a new railway overbridge has been constructed to accommodate the wider carriageway and to replace the original brick arch bridge which caused a traffic pinchpoint.

This report summarises the results from a series of noise measurements undertaken at residential receptors in the Gipsy Patch Lane area in 2022. These surveys have been undertaken to examine noise levels following implementation of the CPME scheme, in order for South Gloucestershire Council to fulfil its duties under the Noise Insulation Regulations (NIR) 1975, which require the determination of whether any households are eligible for a grant towards noise insulation. These surveys follow a previous noise assessment undertaken as part of the Environmental Impact Assessment process for the CPME scheme in 2017/18.

Two noise surveys have been undertaken around the Gipsy Patch Lane area. The results of these surveys (discussed in Sections 3 and 4) have been compared to the noise insulation threshold criteria (discussed in Section 2) to confirm if any properties are eligible for noise insulation under the NIR.

A third survey has been undertaken to compare with the results from a survey in 2017 prior to the implementation of the CPME scheme. The aim of this survey was threefold. First to compare the overall noise level with that from 2017, secondly to compare the noise from individual train movements, and finally to compare with the threshold for noise insulation from the use of a railway. The results from this survey are presented in Section 3.

This report sets out the methodology, assessment and results of the noise surveys and the results of the noise assessment.

A glossary of acoustics terminology is provided in Appendix A.

2. Standards, Guidance and Best Practice

2.1 General

This section sets out the standards, guidance and best practice methods used in this report.

2.2 The Noise Insulation Regulations 1975 (Amended 1988)

The Noise Insulation Regulations 1975 (the 'NIR regulations') as amended in 1988 are intended to protect residents subject to increases in traffic noise at or above a specified level arising directly from the use of new or altered roads, by making available grants for noise insulation work to be carried out on their homes.

Potential noise insulation work that can be carried out includes secondary glazing, supplementary ventilation and, where appropriate, Venetian blinds and double or insulated doors. To be eligible for a grant due to increased road traffic noise levels, the dwelling must be within 300 m of the nearest point of the carriageway of the highway to where works have been undertaken and the road traffic noise level at the dwelling within 15 years of the scheme opening must be:

1. *Above a façade level of 68 $L_{10,18h}$ dB(A) (note that 67.5 would be rounded up to 68);*
2. *Be at least 1 dB(A) greater than the noise level immediately before the work; and,*
3. *The noise level from the highway, additional carriageway, or alteration must contribute at least 1 dB(A) to the noise level at the receptor.*

The NIR apply to the CPME scheme because the Gipsy Patch Lane highway has been altered (i.e. widened).

2.3 The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996

The Noise Insulation (Railways and Other guided Transport Systems) Regulations 1996 ("NIRR") were introduced to meet a need to consider the impact of railways, tram systems and other guided transport systems upon existing residential properties along their route, and to consider the need for noise insulation measures to those properties as a result of the development of the transport system.

It is important to note that the NIRR do not formally apply to the CPME scheme, as the replacement of the railway bridge has not involved the addition or alteration of railway track apparatus.

The NIRR provide a duty to install noise insulation for eligible dwellings affected by noise from the operation of a new or additional railway line or guided transport system, and powers to carry out similar works for properties affected by altered existing rail systems. The criteria for eligibility are defined in the NIRR. The three conditions to qualify for noise insulation under the NIRR are as follows:

1. *The noise level, for new or additional railways / guided systems (and in some cases where a relevant railway / guided system is altered, as provided for in the railway noise Insulation Regulations), together with other railway/guided transport system noise in the vicinity, must not be less that the specified noise levels (i.e. 68 $L_{eq,18h}$ dB(A) during the day or 63 $L_{eq,6h}$ dB(A) at night) ;*
2. *The noise level must be greater by at least 1.0 dB(A) than the pre-scheme railway / guided transport system noise (ie the total noise level from the railway / guided transport systems existing before the works to construct or improve the system were begun);*
3. *The contribution to the noise level from the new, additional or altered railway/guided transport system must be at least 1 dB(A).*

2.4 Land Compensation Act 1973

Part I of the Land Compensation Act provides a means by which compensation can be paid to owners of land or property due to a loss in value of these assets caused by public works, such as new or improved railways

and roads. Noise and vibration are two of the factors which would be considered in any claims for compensation, but the claim should consider all changes and effects, including betterment. Part II of the Act imposes a duty on authorities to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings. This is subject to meeting certain criteria given in the Noise Insulation Regulations.

Applications for compensation cannot be made until one year after scheme completion and the responsibility lies with affected individuals to pursue a claim.

2.5 Design Manual for Roads and Bridges ("DMRB") Volume 11, Section 3, Part 7 (HD213/11), Noise and Vibration

This provides the methodology that was followed when undertaking the assessment described within the 2018 Environmental Statement for the CPME scheme (an Environmental Statement is the name for the output document of the Environmental Impact Assessment process). This sets out how to define the study area and guides the user through the assessment process. When calculating the level of noise from a road, HD213/11 describes procedures that follow the methodology within the Calculation of Road Traffic Noise (CRTN, Department for Transport and Welsh Office, 1988). It should be noted that in 2020 this guidance within DMRB was updated.

2.6 Department for Transport Calculation of Road Traffic Noise 1988

The Department for Transport Calculation of Road Traffic Noise (CRTN) 1988 offers a practical tool for the prediction of broadband road traffic noise levels in urban environments. It is extensively used by acoustic consultants, land planners and highways engineers. One of the original motivations for the development of CRTN was to enable calculation of entitlement to sound insulation treatment for residential properties. CRTN contains a methodology, called the 'shortened measurement procedure' that can be used to determine an 18-hour noise level from a measurement taken over 3-hours.

2.7 Department for Transport Calculation of Railway Noise 1995

The Department for Transport Calculation of Railway Noise (CRN) 1995 is an empirical scheme and is associated with the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996. CRN is similar in many places to CRTN, but there are several differences in the calculation method.

2.8 British Standard 7445 Description and Measurement of Environmental Noise

BS 7445 Parts 1-3 (BSI, 1991-2003) outline best practice during measurement, reporting and assessment of environmental noise.

The survey described in section 3 below has been carried out with reference to the guidance and requirements contained in BS 7445-2:1991 (BSI, 1991).

3. Noise survey location 1 - 26 Gipsy Patch Lane

3.1 Survey overview

The noise survey at location 1 (26 Gipsy Patch Lane) was undertaken to compare the results with an identical survey undertaken at the same location in 2017 as part of the CPME scheme's Environmental Impact Assessment. In addition, the results have been used to quantify the specific noise from passenger trains and freight train movements on the railway following the construction and operation of the new railway overbridge.

The survey location is shown in Figure 1, together with the other survey locations that are discussed in Section 4.

Figure 1: Noise Monitoring Locations

The survey at location 1 was undertaken as an unattended exercise. The set-up of the sound level meter (SLM) and associated equipment followed the requirements of BS7445 (Parts 1 – 3) Description and Measurement of Environmental Noise. All measurements were taken at approximately 1.5 metres above the ground and are considered to be free field levels (ie away from any large reflecting surfaces).

The SLM was installed in the rear garden of 26 Gipsy Patch Lane in the same location as used for the survey undertaken in 2017. Photographs of the equipment set up from the 2022 survey are included in Appendix F. The SLM was left to log noise levels continuously for a period of six days, between and inclusive of 15th June to 21st June 2022.

The SLM type used for the survey was a 01dB Fusion. The SLM was calibrated using a 01dB type CAL21 acoustic calibrator immediately before and after the measurements, to ensure a drift of no greater than 0.1 dB occurred during the measurement period. Details of the equipment used for the survey are shown in Table 3.

Table 3: Location 1 survey - Measurement equipment details

Equipment	Serial No
01dB Fusion sound level meter	11242
01dB Pre-amp type Pre22	1605097
01dB Microphone type GRAS 40 CE	233259
01dB calibrator type CAL21	50441914

3.2 Results

A summary of the measured railway noise levels at location 1 is shown in Table 4. It should be noted that for the NIRR the daytime assessment period is 18 hours (between 06:00hrs to 24:00hrs), the night-time assessment period is 6 hours (between 00:00hrs to 06:00hrs).

Accordingly, the results in Table 4 are shown as an A-weighted equivalent continuous sound level[3] for the Noise Insulation (Railways and Other guided Transport Systems) Regulations 1996 (NIRR) daytime and night-time assessment periods.

It is important to note that the NIRR do not formally apply to the CPME scheme, as the scheme has not involved the addition or alteration of railway track apparatus. However, they are being referred to here for completeness and to demonstrate a fully robust noise assessment.

Table 4: Results summary for survey location 1

Location	Address	Measured noise level, dB(A)	
		Daytime $L_{eq,\ 18hr}$	Night-time $L_{eq,\ 6hr}$
Location 1	26 Gipsy Patch Lane	53.4	49.2

Table 4 shows that the measured noise level at location 1 over the whole survey period during the daytime was 53.4 dB(A) and the night-time was 49.2 dB(A).

3.3 Comparison 2017 vs 2022

The measured noise levels from all noise sources at location one are compared against the survey undertaken in 2017, which was used to inform the CPME Environmental Statement. The result comparison is shown in Table 5.

Table 5: Comparison between 2017 and 2022 at location one

Location	Address	Survey date	Measured noise level, dB	
			Daytime $L_{Aeq,\ 18hr}$	Night-time $L_{Aeq,\ 6hr}$
Location 1	26 Gipsy Patch Lane	April 2017	55.3	50.9
		June 2022	53.4	49.2

Both daytime and night-time periods measured in 2022 show a slight reduction in noise of nearly 2 dB(A) from the survey undertaken in 2017. There are likely to be two factors, which contribute to the reduction in noise at location 1:

1. An acoustic fence[4] has been installed along the property boundary, which will likely be providing some reduction in noise from road traffic on Gipsy Patch Lane, and;

[3] LAeq, T is an A-weighted equivalent continuous sound level, T denotes the time period over which the fluctuating sound levels were averaged, for example LAeq,8h is the equivalent continuous noise level over an 8 hour period. For further information about terminology see Appendix A.

[4] The fence installed is marketed as an 'acoustic fence' but there is no evidence that the product has passed through a test in accordance with British Standard 1793-2:2018 (Road traffic noise reducing devices) and therefore no conclusions can be drawn on the performance of the fence as a noise barrier.

2. The electrification of the railway, enabling some of the passenger trains to use the quieter electric power units, which produce less noise than diesel powered trains.

It is noted that the freight trains still use diesel power units.

3.4 Noise insulation regulations for rail (NIRR) – Assessment

The measured noise levels from all train movements on the railway have been compared to the eligibility criteria set out in the Noise Insulation (Railways and Other guided Transport Systems) Regulations 1996. As stated previously, the NIRR do not formally apply to the CPME scheme, as the scheme has not involved the addition or alteration of railway track apparatus. However, they are being referred to here for completeness and to demonstrate a fully robust noise assessment for Gipsy Patch Lane.

The results in Table 5 show that railway noise levels measured in 2022 have reduced from the levels measured in 2017. Location 1 (26 Gipsy Patch Lane) is the closest residential property to the railway. Noise levels measured at location 1 will further reduce with increasing distance from the railway. Therefore, properties on Gipsy Patch Lane would not qualify for noise insulation under the NIRR even if they did formally apply.

3.5 Analysis of train specific noise levels

Detailed analysis of the train noise levels measured at 26 Gipsy Patch Lane has been undertaken. Train movements have been analysed using dBTrait® analytical software. This analysis has been undertaken using detailed historical records provided by Network Rail for the passage of individual freight and passenger trains and comparing with the measured noise levels. With the noise levels at location 1 also being influenced by road traffic noise, only those instances of trains passing that can be clearly identified from the noise time history trace have been included within the comparisons. Where the passage of trains has been clearly identified, then the maximum noise level associated with that passage has been noted and used for the comparison.

The maximum noise levels measured during passenger and freight train movements in 2017 and 2022 have been compared to identify if any change has occurred. It is noted that for this assessment the maximum (highest) measured noise level during each train movement has been used, rather than the average noise level, thereby providing a worst-case approach to the assessment.

The overall results of the passenger train noise comparison are shown in Table 6, with the individual maximum noise levels by train movement shown in Appendix B.

Table 6: Passenger train noise level comparison at location 1 - 2017 vs 2022

Location	Address	Survey date	Average of passenger train maximum noise level, dB(A)	Range of maximum noise levels, dB(A)
Location 1	26 Gipsy Patch Lane	April 2017	67	62 - 70
		June 2022	65	61 - 67

The passenger train noise level comparison shows a minor reduction in the measured levels in 2022 from those measured in 2017.

The overall results of the freight train noise comparison are shown in Table 7, with the individual maximum noise levels shown in Appendix C.

Table 7: Freight train noise level comparison at location one - 2017 vs 2022

Location	Address	Survey date	Average of freight train maximum noise level, dB(A)	Range of maximum noise levels, dB(A)
Location 1	26 Gipsy Patch Lane	April 2017	73	64 – 77
		June 2022	73	63 – 77

The freight train noise level comparison is consistent and shows no change in the average maximum noise levels between 2017 and 2022.

4. Noise survey locations 2 & 3 – 32 Gipsy Patch Lane & 22 Smithcourt Drive

4.1 Survey overview

The Environmental Statement (ES) (the output of the Environmental Impact Assessment process) undertaken for the CPME scheme in 2017/18 identified that seven dwellings on Smithcourt Drive may be eligible for noise insulation due to the potential for increased traffic noise levels. Due to proximity, the noise levels measured at location 3 (22 Smithcourt Drive) are considered to be representative of all seven properties identified in the ES. It should be noted that location 2 (32 Gipsy Patch Lane) was not identified in the ES as being potentially eligible for a grant towards noise insulation but has been included in the surveys to demonstrate a comprehensive and robust approach to the noise assessment for Gipsy Patch Lane.

The location of these two surveys is shown on Figure 1 presented in Section 3.

The noise measurements at locations 2 and 3 were undertaken specifically to determine whether properties are eligible for a grant towards noise insulation in accordance with the Noise Insulation Regulations 1975.

All measurements were undertaken using a B&K 2250 SLM. The SLM allows direct measurement of the following indices: $L_{A10,T}$ and $L_{Aeq,T}$. All measurements were taken at approximately 1.5 metres above the ground and are considered façade levels (i.e. the microphone was positioned 1m from the façade of the dwelling). The SLM was calibrated immediately before and after each set of measurements to ensure a drift of no greater than 0.1 dB occurred during each measurement. Details of the measurement equipment are shown in Table 8.

Table 8: Locations 2 and 3 - Measurement equipment details

Equipment	Serial No
B&K 2250 sound level meter	2579749
B&K Pre-amp type ZC 0032	9587
B&K microphone type 4189	2578591
B&K calibrator type 4231	1807572

All measurements were undertaken using the Department for Transport's CRTN 'shortened measurement procedure' methodology. This procedure allows traffic noise to be measured during any three consecutive hours between 10:00 and 17:00 hours. The measured noise level over this period is then corrected by subtracting 1 dB(A) from the $L_{A10,3h}$ level to derive the $L_{A10,18h}$ noise level. The shortened measurement procedure is an allowable method to be used where a full 18-hour survey cannot be undertaken. It was not considered practical to undertake a full 18-hour survey at either location due to the need for the equipment to be attended since it was in the front garden and exposed. Although CRTN is over 30 years old, this shortened measurement method was validated[5] within the 2011 version (i.e. HD 213/11) of the noise assessment guidance contained within the Design Manual for Road and Bridge (DMRB).

4.2 Survey at location 2 – 32 Gipsy Patch Lane

An attended noise survey was undertaken at No 32 Gipsy Patch Lane during the daytime of Wednesday 15th June 2022. Noise measurements were undertaken continuously between 13:14hrs and 16:14hrs using the

[5] This validation exercise examined results from 1,160 noise surveys that were undertaken in 2000 and concluded that the relationship between the measured and estimated traffic noise indices that was developed over thirty years ago is still valid for today's traffic conditions. The validation exercise confirmed that a three hour survey period presents a reliable representation of noise levels compared to a survey over the full 18-hour assessment period.

CRTN 'shortened measurement procedure'. Photographs of the equipment set up from the 2022 survey are included in Appendix G.

The weather during the survey was dry and sunny, with a temperature of around 24°C and the road surface dry. There was a gentle breeze from the west (less than 5ms^{-1}). During the survey the traffic flow on Gipsy Patch Lane was considered to be normal for that time of the day.

4.3 Survey at location 3 – 22 Smithcourt Drive

An attended noise survey was undertaken at No 22 Smithcourt Drive during the daytime of Wednesday 22nd June 2022. Noise measurements were undertaken continuously between 10:27hrs and 13:27hrs using the CRTN 'shortened measurement procedure'. Photographs of the equipment set up from the 2022 survey are included in Appendix H.

The weather during the survey was dry and sunny, with a temperature of around 25°C and the road surface dry. There was a gentle breeze from the west (less than 5ms^{-1}). During the survey the traffic flow on Gipsy Patch Lane was considered to be normal for that time of the day.

4.4 Results

The measured results at location 2 and location 3 are shown in Table 9. The measured noise levels shown in the final column of the table is that after the 1 dB(A) has been subtracted to derive the 18-hour noise level.

Table 9: Gipsy Patch Lane traffic noise survey - results summary

Location	Address	Date	Start time	End time	Measured noise level, $L_{A10,18h}$ dB
Location 2	32 Gipsy Patch Lane	15th June 2022	13:14	16:14	60.7
Location 3	22 Smithcourt Drive	22nd June 2022	10:27	13:27	57.7

4.5 Metrobus noise levels

It is noted that the metrobus service is programmed to commence operation in early 2023. Therefore, when the noise surveys were undertaken in June 2022 the metrobus service was not operational. However, during the survey it was noted that other existing bus services and HGV traffic were travelling along Gipsy Patch Lane.

Calculations have been undertaken to predict the additional noise level that would be likely at the closest receptors when the metrobus service is in operation. The detailed calculations are provided in Appendix D. The predicted noise level increase with the metrobus service in operation is shown in Table 10.

Table 10: Predicted noise level increase at receptors with metrobus service in operation

Receptor	Additional noise with Metrobus in operation, dB(A)
32 Gipsy Patch Lane	0.4
22 Smithcourt Drive	0.8

The results shown in Table 10 identify that an increase of <1 dB(A) is predicted when the metrobus service is in operation. The predicted noise level from the metrobus in operation alone is less than that measured at either location. With the measured noise level at 32 Gipsy Patch Lane being higher than that at 22 Smithcourt Drive, any additional noise (i.e. that from the metrobus in operation) would increase this existing noise level by less, and hence the additional noise at 32 Gipsy Patch Lane is lower than that at 22 Smithcourt Drive.

4.6 Noise Insulation Regulations – Assessment

The total measured noise levels on Gipsy Patch Lane (Table 9) have been summed with the predicted noise level increase with the metrobus service in operation (Table 10), the results are shown in Table 11.

Table 11: Total predicted noise level at receptors with metrobus service in operation

Location	Address	Measured noise level, $L_{A10,18h}$ dB	Additional noise with Metrobus in operation, dB	Total noise level with metrobus service in operation, $L_{A10,18h}$ dB
Location 2	32 Gipsy Patch Lane	60.7	0.4	61.1
Location 3	22 Smithcourt Drive	57.7	0.8	58.5

The total predicted noise levels shown in Table 11 are compared to the eligibility criteria set out in the Noise Insulation Regulations 1975. In order for properties to be eligible for insulation the traffic noise level at any point within the next 15 years from 2022 would need to be at or above 68 $L_{10,18\text{-hour}}$ dB(A).

Traffic noise levels are below the 68 dB(A) threshold at both locations, therefore, properties on Gipsy Patch Lane and Smithcourt Drive do not meet the criteria for noise insulation. The inclusion of the potential noise from future metrobus operation does not change this conclusion.

For traffic noise to increase from the current levels up to the 68 dB(A) threshold, there would need to be over a four-fold increase (i.e. 400%) in traffic flow on Gipsy Patch Lane. The calculations undertaken to demonstrate the traffic increase required to increase noise levels up to the noise insulation threshold are provided in Appendix E. Even with local developments either planned or under construction, this increase in traffic flow is not realistically possible within 15 years, as there are current network constraints and limited geometry junctions that physically limit the amount of traffic that can access Gipsy Patch Lane. In any case, this very unlikely increase in traffic is corroborated by the West of England Combined Authority's Joint Local Transport Plan 4 2020-2036 (March 2020), where it states that vehicle trips are expected to increase by up to 26% by 2036 without any intervention, which is significantly less than the 400% necessary for the noise levels to meet the 68dB(A) threshold.

5. Summary

Following the completion of the Cribbs Patchway metrobus extension scheme a series of noise surveys were undertaken. The noise surveys were undertaken at three separate locations in the Gipsy Patch Lane area to quantify railway noise and road traffic noise, the survey locations were as follows:

- Location 1 - 26 Gipsy Patch Lane
- Location 2 - 32 Gipsy Patch Lane
- Location 3 - 22 Smithcourt Drive

Location 1 - overall and railway noise

The survey at location one was undertaken to examine the overall noise level from all sources, and to also quantify noise levels from the railway following the completion and operation of the new railway overbridge. The results of the survey were compared against an identical survey undertaken in 2017 used to inform the CPME Environmental Statement. The comparison of measured noise levels between 2017 and 2022 has shown the following:

- There is no change in noise level from freight trains at location one;
- There is a minor reduction in noise level from passenger trains at location one, and;
- The overall measured noise level with all noise sources considered together (road and rail) there is a slight reduction in noise at location one in the order of 1dB.

The slight overall reduction in noise is likely to be due to the electrification of the line for passenger trains and the installation of an acoustic fence on the property boundary.

For completeness, the results from the survey at location one were reviewed against the Noise Insulation (Railways and Other guided Transport Systems) Regulations 1996 criteria for noise insulation. The assessment has identified that properties on Gipsy Patch Lane and Smithcourt Drive would not be eligible for noise insulation under these Regulations if they applied.

Locations 2 and 3

The surveys at location 2 and location 3 were undertaken specifically to quantify noise on Gipsy Patch Lane to determine if any households are eligible for a grant towards noise insulation under the Noise Insulation Regulations 1975. Calculations were then undertaken to predict the total traffic noise level at receptor locations on Gipsy Patch Lane and Smithcourt Drive with the metrobus scheme in operation.

The results of the review have identified that properties on Gipsy Patch Lane and Smithcourt Drive are not eligible for a grant towards noise insulation.

Appendix A. Introduction to Noise

Human Perception

Noise is commonly defined as unwanted sound and is subjective.

The human perception of noise is influenced by physical, physiological and psychological factors. Physical factors include the sound pressure level at the position of the listener, physiological factors include the acuity of hearing, and psychological factors include acclimatisation to steady noise and the activity that an individual is undertaking while the noise is present.

Sound consists of vibrations transmitted to the ear as rapid variations in air pressure which can be measured accurately. The more rapid the fluctuation the higher the frequency of the sound. Frequency is the number of pressure fluctuations per second and is expressed in Hertz (Hz).

The ear can detect both loudness and frequency of sound. However, the sensitivity of the human ear varies with frequency, and therefore noise is commonly measured using the A-weighted filter network which mimics the frequency response characteristics of the human ear. The 'A' notation is used to indicate when noise levels have been filtered using the A-weighting network.

Noise levels range from the threshold of hearing at 0 dB(A) to levels of over 130 dB(A) at which point the noise becomes painful. Noise levels over 80 dB(A) are considered potentially damaging to hearing. The table below presents a guide to the A-weighted sound pressure levels due to common objects and activities.

Table A1: A-weighted noise emissions of common objects and activities

Source	Sound Pressure Level, dB(A)
Threshold of hearing – silent	0
Quiet bedroom	25 – 30
Quiet rural area	45 – 50
Suburban areas away from main traffic routes	50 – 60
Conversational speech at 1m distance	60 – 70
Busy urban street	70 – 80
Passenger car at 60 kph and 7m distance	70 – 75
Health & safety 'lower exposure level' to prevent damage to hearing	80
Heavy diesel lorry at 40 kph and 7m distance	85
Pneumatic drill (un-silenced) at 7m distance	95
Threshold of pain	130 – 140

Generally, a change of 1 dB(A) in environmental noise is the minimum change perceptible. A change of around 5 dB(A) is easily perceptible and most people perceive a 10 dB(A) change as halving or doubling the noise level.

Acoustic Descriptors

Outdoor noise levels fluctuate rapidly over time, and therefore to describe the acoustic environment it is necessary to collect statistical data on the distribution of noise levels during the period of interest.

The nomenclature used to represent statistical acoustic quantities can appear complicated, however once understood it becomes a logical and efficient way of qualifying measures. An example is given below in Figure 1:

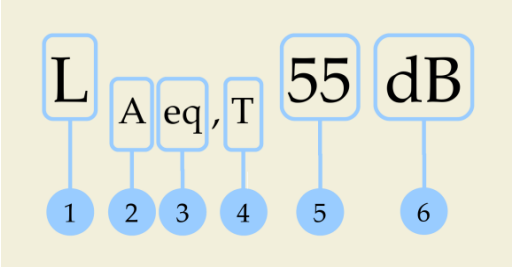

Figure 1 – Acoustic descriptors

The above descriptor is comprised as follows:

- The first grouping ('L') indicates that the quantity is a sound pressure level. Other common quantities are sound intensity (LI) and sound power (LW).
- The second grouping ('A') denotes that the sound pressure level is evaluated using the A-weighted filter network for humans.
- The third grouping of characters identify the statistical descriptor. In this example, the letters indicate that the quantity is in terms of the equivalent continuous noise level (eq), which has some similarities with the concept of an average noise level. Numerical values are also shown, and these indicate the level exceeded for n per cent of the measurement (e.g. a value of $L_{A90,T}$ 45 dB indicates that the A-weighted sound pressure level exceeds 45 dB for 90% of the period analysed).
- The quantity ('T') shown after the statistical descriptor is the duration over which the quantity is evaluated. This is typically represented in minutes or hours, e.g. 15min, 18hr.
- The fifth part of the statistical descriptor identifies its numeric value. This value is usually given as a whole number or to one decimal place.
- The sixth and final group of characters indicate that the units of the sound pressure level are decibels.

A variety of statistical indices are used to quantify noise in different situations.

A-Weighting

This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

Equivalent Continuous Sound Pressure Level (L_{eq})

The Equivalent Continuous Sound Pressure Level is the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.

Façade and free-field levels

Due to the effects of reflection, sound pressure levels measured close to large vertical reflecting surfaces such as building façades are higher than those that are measured away from reflective surfaces. Sound pressure levels measured 1m from a large solid, reflecting surface are termed 'façade' levels, while those measured at least 3m away from any reflective surfaces (apart from the ground) are termed 'free-field'. Façade levels are typically 2.5 dB higher than free-field levels and therefore it is important to know the conditions under which a noise measurement or prediction has been undertaken.

L_{10} or L_{A10}

Acoustic nomenclature indicating that the value is exceeded for 10% of the period of interest. This index, evaluated over the period 06:00 to 24:00, is commonly used to describe road traffic noise.

Maximum Sound Level

The maximum sound level (L_{Amax}) is the highest time-weighted sound level measured during a period. The time constant of the measure may either be fast (125ms), slow (1s) or impulsive (35ms), and it is usual to identify the time constant in the notation – e.g. L_{AFmax} indicates that the maximum sound level was measured with the fast time-weighting. The longer the time constant over which the measurement is integrated, the greater the smoothing effect of the time-weighting, which gives a lower numeric value of the measurement.

Road Traffic Noise

The index adopted by the Government to quantify traffic noise is the $L_{A10,18hr}$ which is the arithmetic mean of the noise levels exceeded for 10% of the time in each of the 18 one-hour periods between 6am and midnight. The $L_{A10,18hr}$ index has been shown to have the best relationship with annoyance caused by road traffic noise, which has a strong low frequency content and is often more steady over the course of a day than other sources of environmental noise.

Appendix B. Analysis of Passenger Train Noise

Passenger train noise level comparison (2017 vs 2022) Measured at 26 Gipsy Patch Lane

Passenger Trains - 2017		
13/04/2017	Time	Max Noise Level dB(A)
	14:59	69
	15:11	62
	17:44	68
	20:47	68
14/04/2017	05:52	66
	14:09	69
	14:59	70
	17:00	68
	18:03	62
	23:20	68
	05:20	64
15/04/2017	06:31	68
	09:04	62
	11:21	64
	14:07	67
	16:04	69
	19:03	68
	05:41	67
17/04/2017	09:09	68
	12:04	69
	15:12	67
	17:04	67
	20:00	69
Average, dB(A)		**67**

Passenger Trains - 2022		
16/06/2022	Time	Max Noise Level dB(A)
	05:09	62
	07:29	67
	10:05	64
	14:26	65
	20:13	64
17/06/2022	05:09	66
	08:54	65
	11:45	67
	15:01	67
	18:42	67
	21:49	66
18/06/2022	09:09	64
	12:10	65
	15:42	65
	18:11	66
	21:12	66
	23:01	61
20/06/2022	07:41	64
	09:20	62
	12:55	62
	15:40	67
	18:43	62
	21:09	66
Average, dB(A)		**65**

Appendix C. Analysis of Freight Train Noise

Freight Train Noise Comparison (2017 vs 2022) Measured at 26 Gipsy Patch Lane

Freight Trains - 2017		
13/04/2017	Time	Max Noise Level dB(A)
	03:48	72
	05:45	73
	13:26	72
	15:21	72
	17:16	68
	19:27	71
14/04/2017	01:15	66
	05:56	74
	10:44	73
	20:17	73
15/04/2017	11:45	77
	13:21	64
	14:45	68
17/04/2017	04:24	77
	19:23	74
18/04/2017	04:59	76
	05:57	73
Average, dB(A)		**73**

Freight Trains - 2022		
16/06/2022	Time	Max Noise Level dB(A)
	04:22	65
	08:54	76
	15:15	67
	22:21	74
	22:33	63
17/06/2022	05:42	75
	09:44	75
	15:18	74
	16:25	77
18/06/2022	03:59	73
	05:17	72
	16:34	71
	21:31	75
	22:04	71
20/06/2022	03:59	77
	05:53	67
	14:23	74
	15:56	74
	16:52	73
	23:44	69
Average, dB(A)		**73**

Appendix D. Calculation of noise from metrobus operation at sensitive receptor locations

Calculations have been undertaken to predict the additional noise level that would be likely at the closest receptors when the metrobus service is in operation.

The distance between the sensitive receptor locations and the bus movements on Gipsy Patch Lane is a factor in the calculations. It is noted that both 32 Gipsy Patch Lane and 22 Smithcourt Drive are at an equivalent distance of 25m from the centre line of the new bus lane, which is on the opposite side of Gipsy Patch Lane to these receptors. It is also noted that the metrobus service will operate on both sides of Gipsy Patch Lane, eastbound buses will be in the bus lane and westbound will be in the general traffic lane.

Below is a summary of the general calculation method used to predict the total noise level at receptor locations. It should be noted that the results have been adjusted for distance and façade corrections.

The contribution in noise level from the metrobus service has been calculated using the following formula:

$$\text{Equation 1:} \quad L_{eq,T} = \text{SEL} + 10*\text{Log}(n) - 10*\text{Log}(T)\ \text{dB(A)}$$

Where:

- $L_{eq,T}$ is the continuous equivalent sound pressure level in decibels (dB(A))
- SEL is the sound exposure level for a single event (i.e. a single bus passing by)
- n is the number of events
- T is the time period

The SEL value has been sourced from the environmental impact assessment undertaken for the CPME scheme in 2017, whereby an SEL of 73.7 dB was derived from noise measurements of buses on Hatchet Road and Long Mead in Bristol. Although this data contains the noise levels from a wide variety of buses, it is considered to be appropriate for providing an approximation of the noise contribution expected from metrobus.

The number of events (n) is the total number of bus movement in an 18 hour period. A change to the L_{eq} dB(A) noise index has also been made to align with Equation 1. From discussions with South Gloucestershire Council officers it is understood that there is an aspiration for six metrobus movements an hour in each direction (except at night). Therefore, n = 6 x 18 = 108 (in each direction).

The time period (T) is the total time period (i.e. 18 hrs) presented in seconds, therefore T = 64,800 s

In order to calculate the total noise level at receptors (ie total measured noise level + predicted noise level from metrobus service) the following decibel addition relationship has been used:

$$\text{Equation 2:} \quad L_{Total} = 10 * \text{Log}(10^{\frac{L1}{10}} + 10^{\frac{L2}{10}})$$

Where:

- L_{Total} is the total sound pressure level in A weighted decibels (dB).
- L_1 is the measured $L_{eq,18h}$ dB(A) sound pressure level at 32 Gipsy Patch Lane or 22 Smithcourt Drive.
- L_2 is the calculated sound pressure level from the Metrobus service.

Calculated noise contribution from metrobuses
Based on 12 buses / hour

Formula: LeqT = SEL + 10log(n) - 10Log(T) dB(A)

	Eastbound buses	Westbound buses
18hrs in seconds = 18x60x60	64800	64800
SEL of buses from measurements in ES, dB(A)	73.7	73.7
n = 6 x 18 (in each direction)	108.0	108.0
Leq dB(A)	45.9	45.9
SEL measurement distance, m	10.0	10.0
Receptor distance eastbound carriageway, m	25.0	25.0
Receptor distance westbound carriageway, m	17.0	17.0
Disantance correction eastbound [10*LOG(10/25)]	-4.0	-
Disantance correction westbound [10*LOG(10/17)]	-	-2.3
Façade correction, dB(A)	2.5	2.5
Distance & Façade corrected, Leq dB(A)	44.4	46.1
22 Smithcourt Drive		
Noise from metrobuses, Leq dB(A)	48.4	
18hr Leq dB(A) from measurement at No 22	55.4	
Total noise = measured + metrobuses, Leq dB(A)	56.2	
Increase with noise from metrobuses, dB(A)	0.8	
32 Gipsy Patch Lane		
Noise from metrobuses, Leq dB(A)	48.4	
18hr Leq dB(A) from measurement at No 32	58.6	
Total noise = measured + metrobuses, Leq dB(A)	59.0	
Increase with noise from metrobuses, dB(A)	0.4	

Appendix E. Calculations for traffic noise increase

Assuming the lowest NIR threshold of 67.5 dB(A) since levels are rounded up, the total predicted noise level (measured noise + predicted noise from Metrobus operations) at 32 Gipsy Patch Lane is 61.1 dB(A), which is 6.4 dB(A) under the NIR threshold.

It is possible to calculate what the traffic flow would need to be in order for the NIR threshold to be reached. Changes in noise level follow a logarithmic relationship, with a doubling or halving of traffic flow required for a change of 3 dB. To calculate the traffic flow that would be required for the measured noise level to be 67.5 dB(A), the following equation is used:

L = 10 x log(T_2036/T_2021), where

- L is the required change in noise, in this case 6.4 dB(A)
- T_2036 is the required traffic flow for the change in noise to be reached
- T_2021 is the with scheme traffic flow in the opening year (2021) used for the noise assessment within the ES. This was an Annual Average Weekday Traffic of 24,072 over an 18-hour period.

Re-arranging this equation to calculate T_2036:

T_2036 = (10^(6.4/10)) x 24,072

T_2036 = 105,078

Therefore, the traffic flow would need to be 105,078 in the 15th year after opening in order for the NIR threshold to be met. This is an increase of 4.4 times the existing traffic flow.

Appendix F. Photographs from 26 Gipsy Patch Lane Survey

Appendix G. Photographs from 32 Gipsy Patch Lane Survey

Appendix H. Photographs from 22 Smithcourt Drive Survey