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St. Athan Northern Access Road

Noise and Vibration

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AECOM Limited

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60509148 / NORP0001

AECOM Limited
1 Callaghan Square
Cardiff
CF10 5BT
United Kingdom

Telephone: +44(0)29 2067 4600

www.aecom.com

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St. Athan Northern Access Road Noise and Vibration	60509148/ NORP0001	Welsh Government	Suzanne Scott	16/3/17	Alf Maneylaws

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1. INTRODUCTION

This report details the assessment of predicted noise and vibration impacts associated with the construction and operation of the proposed St Athan Northern Access Road, the 'Scheme'.

Temporary noise and vibration impacts arising from the construction works associated with the proposed Scheme are discussed herein. However, at present a construction contractor has not been appointed, and as such the construction methods and plant to be used are not known. As there are insufficient details available to undertake a quantitative assessment, a qualitative construction noise and vibration assessment has been carried out based on the currently available information on the nature and duration of the construction works, including potential volumes of construction traffic.

The proposed Scheme operation will potentially affect traffic noise and vibration levels as experienced by sensitive receptors, such as occupiers of residential properties, in the vicinity of the proposed scheme, and along any other existing affected roads on the local road network.

The traffic noise and vibration assessment has been undertaken following the methodology for a detailed assessment, as described in the current version of the Design Manual for Roads and Bridge (DMRB[1]), with due regard to Planning Policy Wales[2].

The assessment considers absolute traffic noise levels, changes in traffic noise levels and the effects on residential properties and other sensitive receptors. The assessment considers the following scenarios for which traffic data were generated:

- Base 2016, current baseline conditions;
- Do-Minimum 2019 (DM 2019): the year of full opening 2019 without the proposed scheme. The traffic data includes 200 existing business park jobs and the Aston Martin committed development, both accessed via the existing Eglwys Brewis Road;
- Do-Minimum 2034 (DM 2034): future assessment year 15 years after full opening, without the proposed scheme. The traffic data includes the Aston Martin committed development, housing developments in the local plan but not committed, and 3000 business park jobs (including 200 existing jobs). All developments accessed via the existing Eglwys Brewis Road;
- Do-Something 2019 (DS 2019): year of full opening, with the proposed scheme. The traffic data includes 200 existing business park jobs and the Aston Martin committed development, both accessed via the Scheme; and
- Do-Something 2034 (DS 2034): future assessment year 15 years after full opening, with the proposed scheme. The traffic data includes the Aston Martin committed development, housing developments in the local plan but not committed, and 3000 business park jobs (including 200 existing jobs). All developments accessed via the Scheme.

The assessment scenarios have been discussed with Vale of Glamorgan Shared Regulatory Services Department[3]. It should be noted that the 3000 business park jobs included in the 2034 traffic data is the maximum permissible number of jobs at the business park. The actual number of jobs, and therefore associated traffic, may be less than this and therefore the

[1] Highways Agency (2011), Design Manual for Roads and Bridges Volume 11, Section 3, Part 7, HD 213/11 Revision 1 Noise and Vibration
[2] Welsh Government (2016), Planning Policy Wales (Edition 9, November 2016)
[3] Correspondence between Suzanne Scott Aecom and Sue Brown Vale of Glamorgan Shared Regulatory Services Department 21/11/16 – 29/11/16

quantitative traffic noise assessment for 2034 detailed in this report is considered to be a conservative worst case scenario.

In addition, the purpose of this assessment is to consider the impact of the St Athan Northern Access Road. Any future business park or residential developments would require a noise and vibration impact assessment to support their planning application.

Appendix A provides details of relevant noise and vibration terminology as used herein.

2. REGULATORY/ POLICY FRAMEWORK

2.1 Planning Policy Wales 2016

Planning Policy Wales2 sets out the land use planning policies of the Welsh Government. It is supplemented by a series of Technical Advice Notes (TANs).

Paragraph 13.13.1 of Planning Policy Wales states that:

'Noise can affect people's health and well-being and have a direct impact on wildlife and local amenity. Noise levels provide an indicator of local environmental quality. The objective of a policy for noise is to minimise emissions and reduce ambient noise levels to an acceptable standard. Noise Action Plans, drawn up by the Welsh Ministers in relation to Wales under the Environmental Noise Directive[4] and the Environmental Noise (Wales) Regulations 2006[5] aim to prevent and reduce environmental noise where necessary and preserve environmental noise quality where it is good. They are a planning consideration in the use and development of land.'

With regard to new transport infrastructure Paragraph 8.5.7 states that:

'Great care must be taken to minimise the adverse impacts of new transport infrastructure, or improvements to existing infrastructure, on the natural, historic and built environment and on local communities, where neighbourhood severance should especially be avoided. Routes should make the best use of existing landforms and other landscape features to reduce noise and visual effects, subject to safety and other environmental considerations. Where no other alternative routes or options are practicable, transport infrastructure schemes should provide mitigation measures to minimise the impacts caused by their construction and operation.'

2.2 Technical Advice Note (TAN) 11: Noise 1997

TAN 11[6] provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business. It outlines some of the main considerations which local planning authorities should take into account in drawing-up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources.

With regard to road traffic noise TAN 11 references the requirements of the Noise Insulation Regulations 1975[7], as amended 1988[8], the traffic noise prediction method 'Calculation of

[4] European Commission (2002), Environmental Noise Directive 2002/49/EC
[5] Welsh Government (2006), Welsh Statutory Instrument 2006 No. 2629 (W.225) The Environmental Noise (Wales) Regulations 2006
[6] Welsh Government (1997), Planning Guidance (Wales), Technical Advice Note (Wales) 11, Noise - October 1997
[7] UK Government (1975), Noise Insulation Regulations 1975
[8] UK Government (1988), Noise Insulation (Amendment) Regulations 1988

Road Traffic Noise'[9], and the traffic noise assessment methodology in the 'Design Manual for Roads and Bridges'1.

With regard to construction noise and vibration TAN11 references BS 5228, the current version of which was issued in 2014[10].

2.3 A Noise Action Plan for Wales 2013-2018 (NAP)

Under the Environmental Noise (Wales) Regulations 20065 and the Environmental Noise (Wales) (Amendment) Regulations 2009[11], the Welsh Government had an obligation, to make strategic noise maps for:

- agglomerations (large urban areas with populations of more than 100,000);
- major roads (those with more than three million vehicle passages per year); and
- major railways (those with more than 30,000 train passages per year).

The area around St Athan Northern Access Road does not fall into any of these categories; therefore no noise mapping has been carried out in the vicinity of the Scheme.

The Welsh Government also has an obligation to draw up action plans for locations near major roads and major railways, and for agglomerations. Instead of producing a number of individual noise action plans, a single consolidated noise action plan for Wales has been developed.

The NAP[12] explains how different sources of noise, including road, are being managed across Wales and by whom, provides summaries of evidence to support noise policy, and gives examples of positive initiatives that have taken place in Wales.

Regarding road traffic noise, Section 4 –Road Noise Management, states:

> *'The best way to deal with unacceptable levels of road traffic noise is to prevent them from occurring in the first place through good planning, while at the same time recognising the essential social and economic functions of the road network.'*

Section 4 provides details about who is responsible for roads in Wales, the management of road traffic noise, noise mapping and the priority areas, including ways to reduce noise through the installation of low noise surfacing or noise barriers.

The NAP identifies 220 priority areas for road noise. The priority areas have been identified from the 2012 noise maps and information provided by trunk road agents, local authorities and people who responded to the noise action plan consultation in 2013.

The priority areas focus upon locations where the top 1% of all the people predicted to be exposed to an $L_{A10,18h}$ of 50 dB or greater reside, according to the results of the noise mapping, and the $L_{A10,18h}$ is at least 68 dB. No priority areas are located in the vicinity of the Scheme.

[9] Department of Transport and Welsh Office (1988) Calculation of Road Traffic Noise
[10] British Standards Institution (2014), BS 5228:2009+A1:2014 Code of practice for noise and vibration on construction and open sites
[11] Welsh Government (2009), Welsh Statutory Instrument 2009 No. 47 (W.15) The Environmental Noise (Wales) (Amendment) Regulations 2009
[12] Welsh Government (2013), A noise action plan for Wales 2013–2018

2.4 Control of Pollution Act 1974

Sections 60 and 61 of Control of Pollution Act 1974 (CoPA)[13] provide the main legislation regarding demolition and construction site noise and vibration. If noise complaints are received, a Section 60 notice may be issued by the local planning authority with instructions to cease work until specific controls to reduce noise have been adopted.

Section 61 of CoPA provides a means to apply for prior consent to carry out noise generating activities during construction. Once prior consent has been agreed under Section 61, a Section 60 notice cannot be served provided the agreed conditions are maintained on-site.

The CoPA requires that 'Best Practicable Means' (as defined in Section 72 of CoPA) be adopted for construction noise on any given site. CoPA makes reference to BS 5228 as Best Practicable Means.

2.5 Environmental Protection Act 1990

Noise and vibration from construction works also fall under the remit of the Environmental Protection Act 1990 (EPA) Part 3[14]. Road traffic noise is not covered by the EPA.

The EPA prescribes noise (and vibration) emitted from premises (including land) so as to be prejudicial to health or a nuisance as a statutory nuisance.

Local Authorities are required to investigate any public complaints of noise and vibration if they are satisfied that a statutory nuisance exists, or is likely to occur or recur; they must serve a noise abatement notice. A notice is served on the person responsible for the nuisance. It requires either simply the abatement of the nuisance or works to abate the nuisance to be carried out, or it prohibits or restricts the activity. Contravention of a notice without reasonable excuse is an offence. Right of appeal to the Magistrates Court exists within 21 days of the service of a noise abatement notice.

In determining if a noise complaint amounts to a statutory nuisance the Local Authority can take account of various guidance documents and existing case law, no statutory noise limits exist. Demonstrating the use of best practicable means to minimise noise levels is an accepted defence against a noise abatement notice.

2.6 Land Compensation Act 1973

In general, noise and vibration are recognised as both a common law nuisance (either private or public) and a statutory nuisance. However, this does not apply to noise and vibration from road traffic. As a result, the UK Government Land Compensation Act 1973[15] and the UK Government Noise Insulation Regulations 19757 (as amended 19888) are used in respect of road traffic noise.

The Land Compensation Act 1973 Part I provides a means by which compensation can be paid to owners of land or property which has experienced a loss in value caused by the use of public works, such as new or altered roads. Noise and vibration are two of the factors which would be considered in any claims for compensation; however the claim should consider all changes and effects, including betterment.

2.7 Noise Insulation Regulations 1975 (as amended 1988)

The Noise Insulation Regulations 1975 were made under Part II of the Land Compensation Act 1973. Regulation 3 imposes a duty, and Regulation 4 a power, on the relevant Highway

[13] UK Government (1974), Control of Pollution Act 1974 (CoPA)
[14] UK Government (1990), Environmental Protection Act 1990 (EPA) Part 3
[15] UK Government (1973), Land Compensation Act 1973

Authority to undertake or make a grant in respect of the cost of undertaking noise insulation work in eligible buildings affected by a new or altered highway. This is subject to meeting a range of criteria on road traffic noise levels as specified in the regulations. Regulation 5 also provides discretionary powers to undertake or make a grant in respect of the cost of undertaking noise insulation work in eligible buildings with respect to construction noise.

2.8 Local Planning Policy

2.8.1 *Vale of Glamorgan Unitary Development Plan (UDP) 1996-2011*

The following policy in the UDP[16] is relevant to this assessment:

'Policy Env 29- Protection of Environmental Quality

Development will not be permitted if it would be liable to have an unacceptable effect on either people's health and safety or the environment:

(i) By releasing pollutants into water, soil or air, either on or off site; or

(ii) From smoke, fumes, gases, dust, smell, noise, vibration, light or other polluting emissions.'

2.8.2 *Vale of Glamorgan Local Development Plan (LDP) 2011-2026*

The LDP as amended by the Matters Arising Changes Schedule was published in September 2016[17] and the following policy is relevant to this assessment:

'Policy MD 8 - environmental protection

Development proposals will be required to demonstrate they will not result in an unacceptable impact on people, residential amenity, property and / or the natural environment from either:

1. Pollution of land, surface water, ground water and the air;
2. Contaminated land;
3. Hazardous substances;
4. Noise, vibration, odour nuisance and light pollution;
5. Flood risk and consequences;
6. Coastal erosion or land stability
7. The loss of the best and most versatile agricultural land; or
8. Any other identified risk to public health and safety.
Where impacts are identified the council will require applicants to demonstrate that appropriate measures can be taken to minimise the impact identified to an acceptable level. Planning conditions may be imposed or legal obligation entered into, to secure any necessary mitigation and monitoring processes.'

3. METHODOLOGY

3.1 Construction Noise

The noise levels generated by construction activities and experienced by nearby sensitive receptors, such as the occupants of residential properties, depend upon a number of variables, the most significant of which are:

[16] Vale of Glamorgan (2006), Vale of Glamorgan Unitary Development Plan (UDP) 1996-2011
[17] Vale of Glamorgan (2016), Local Development Plan 2011-2026 Deposit Plan Written Statement as amended by the Matters Arising Changes Schedule

- The noise generated by plant or equipment used on site, generally expressed as a sound power level;
- The periods of operation of the plant on the site, known as its 'on-time';
- The distance between the noise source and the receptor; and
- The attenuation due to ground absorption and barrier effects.

Part 1 of BS 5228: 2009+A1: 2014 'Code of Practice for Noise and Vibration Control on Construction and Open Sites[10] provides a methodology for the estimation of likely construction noise levels as an equivalent continuous noise level averaged over a suitable assessment period, for example a one-hour period ($L_{Aeq,1h}$).

BS 5228 contains a database of the noise emission from individual items of equipment and routines which can be used to predict noise from construction activities at identified receptors. The prediction method gives guidance on the effects of different types of ground, barrier attenuation and how to assess the impact of fixed and mobile plant.

Thresholds for the onset of potentially significant effects for construction noise have been defined by reference to the ABC Method described in Annex E of BS 5228-1. The ABC Method provides thresholds at residential building façades based on prevailing ambient noise levels as shown in Table 1.

Table 1. Construction Noise Thresholds at Residential Dwellings

Assessment Category	Threshold Value ($L_{Aeq,T}$ dB facade)		
	Category A	Category B	Category C
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends (19:00 –23:00 weekdays; 13:00 – 23:00 Saturdays; 07:00 – 23:00 Sundays)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

NOTE 1: A potential significant effect is indicated if the L_{Aeq} noise level arising from the site exceeds the threshold value for the category appropriate to the ambient noise level.

NOTE 2: If the ambient noise level exceeds the Category C threshold values given in the table, then a potential significant effect is indicated if the total noise level for the period increases by more than 3dB due to site noise.

NOTE 3: Applied to residential receptors only.

Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as Category A values.

Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than Category A values.

The magnitude of the impact of construction noise has been classified in accordance with the descriptors in Table 2.

Table 2. Magnitude of Impact for Construction Noise (Residential Dwellings)

Magnitude of Impact	Construction Noise Level minus Threshold Value or Increase in Total Noise Level ($L_{Aeq,T}$ dB façade)
Major	≥ 5
Moderate	3 < 5
Minor	1 < 3
Negligible	< 1

In order to quantify the likely noise from construction works in accordance with the methods and guidance in BS 5228, it is necessary to define the various activities to be undertaken and the equipment to be used, based upon the anticipated construction works programme. At this stage details regarding construction activities and plant requirements are not available, therefore, a qualitative discussion of potential construction noise impacts is provided herein. This is based on the identification of residential properties and any other potentially sensitive receptors in the vicinity of the proposed scheme, the identification of anticipated construction activities which could have a significant noise effect, and taking account of best practice noise control measures.

Some initial indications of the likely volume of construction traffic have been provided. These have been considered in the context of existing traffic flows on the B4265 and Eglwys Brewis Road, to enable an initial indication to be provided of the potential magnitude of impact on existing traffic noise levels along local roads due to the addition of construction traffic. The magnitude of impact of construction traffic is defined using the same scale and descriptors as for short-term changes in operational traffic noise, as detailed in Table 6.

3.2 Construction Vibration

Piling, ground improvement works and compaction of earthworks using vibratory rollers can be potentially significant sources of construction vibration. Construction vibration can result in annoyance to sensitive receptors, such as occupants of a residential property, or in extreme cases building damage.

At this stage it is considered that piling works are unlikely to be required as no structures such as bridges are required as part of the Scheme. The need for ground improvement works has not been fully determined but is unlikely given the shallow nature of the underlying bedrock. The use of vibratory rollers will be required to compact earthworks and pavement foundations. Therefore, construction vibration impacts have been scoped into the assessment.

The passage of vibration through the ground is highly dependent on site-specific ground conditions. However, Part 2 of BS 5228[10] provides a range of measured historical data for a variety of different ground improvement works.

Guidance on the effects of construction vibration in terms of building damage is provided in BS 7385: 1993 'Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration'[18]. It provides guidance on transient vibration levels likely to result in cosmetic damage, and is referenced in BS 5228. Limits for transient vibration, above which cosmetic building damage could occur, are given in Table 3.

[18] British Standards Institution (1993), BS 7385: 1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration

Table 3. Transient Vibration Guide Values for Cosmetic Damage

Building Type	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mms^{-1} at 4 Hz and above	50 mms^{-1} at 4 Hz and above
Unreinforced or light framed structure Residential or light commercial buildings	15 mms^{-1} at 4 Hz increasing to 20 mms^{-1} at 15 Hz	20 mms^{-1} at 15 Hz increasing to 50 mms^{-1} at 40 Hz and above

Note 1: Values referred to are at the base of the building.
Note 2: For unreinforced or light framed structures and residential or light commercial buildings, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

BS 7385 states that the probability of building damage tends to be zero for transient vibration levels less than 12.5 mms-1 ppv. For continuous vibration the threshold is around half this value.

It is also noted that these values refer to the likelihood of cosmetic damage. ISO 4866:2010[19] defines three different categories of building damage:

- Cosmetic: formation of hairline cracks in plaster or drywall surfaces and in mortar joints of brick/ concrete block constructions;
- Minor: formation of large cracks or loosening and falling of plaster or drywall surfaces or cracks through brick/ block; and
- Major: damage to structural elements, cracks in support columns, loosening of joints, splaying of masonry cracks.

BS 7385 indicates that minor damage occurs at a vibration level twice that of cosmetic damage, and that major damage occurs at a vibration level twice that of minor damage. This guidance can be used to define the magnitude of vibration damage impact as shown in Table 4.

Table 4. Magnitude of Impact for Vibration Damage

Magnitude of Impact	Damage Risk	Continuous Vibration Level ppv mms^{-1}	Transient Vibration Level ppv mms^{-1}
Major	Major	30	60
Moderate	Minor	15	30
Minor	Cosmetic	7.5	15
Negligible	Negligible	6	12

[19] International Standards Organization (2010) ISO 4866: 2010, Mechanical vibration and shock -Vibration of fixed structures - Guidelines for the measurement of vibrations and evaluation of their effects on structures

BS 5228 provides guidance on the impact of construction vibration in terms of annoyance, focussing on occupants of residential properties. The vibration levels and associated effects stated in BS 5228, combined with the assigned magnitude of impact, are provided in Table 5.

Table 5. Magnitude of Impact for Vibration Annoyance

Magnitude of Impact	Annoyance	Continuous Vibration Level ppv mms^{-1}
Major	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	10
Moderate	It is likely that vibration of this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.	1.0
Minor	Vibration might be just perceptible in residential environments.	0.3
Negligible	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	0.14

In order to quantify the likely vibration impact from construction works in accordance with the methods and guidance outlined above, it is necessary to define the various construction activities to be undertaken and the equipment to be used, based upon the anticipated construction works programme. At this stage details regarding construction activities and plant requirements are not available, therefore a qualitative discussion of potential construction vibration impacts is provided herein. This is based on the identification of residential properties and other potentially sensitive receptors in the vicinity of the proposed scheme, the identification of construction activities which could have a significant vibration effect, and taking account of best practice vibration control measures.

3.3 Construction Blasting

At this stage the employment of blasting to create the required cutting at the western end of the Scheme is being considered. Blasting would be used to fracture the rock, allowing it to be transferred into wagons and removed from the works area. It is intended that the site-won rock will be utilised elsewhere on site.

BS 6472-2:2008, 'Guide to evaluation of human exposure to vibration in buildings Part 2 Blast induced vibration[20], BS 5228[10] and Mineral Technical Advice Note (MTAN) 1: Aggregates[21] provide advice and guidance for blasting vibration and air overpressure.

BS 6472-2 provides guidance on human exposure in buildings to blast-induced vibration and air overpressure. It is primarily applicable to blasting associated with mineral extraction but

[20] British Standards Institution (2008), BS 6472-2:2008 Guide to evaluation of human exposure to vibration in buildings Part 2 Blast induced vibration
[21] Welsh Government (2004), Mineral Technical Advice Note (MTAN) Wales 1: Aggregates

can also be applicable to explosives used within civil engineering projects such as road construction.

BS 6472-2 advises that to predict the likely vibration magnitude from a controlled blast, a series of measurements at several locations should be taken from one or more trial blasts. Using the formula provided in BS 6472-2 and extrapolation of the trial blast results, the likely vibration magnitudes at a given distance (for a given maximum instantaneous charge) can be predicted.

The standard suggests that accredited blasting contractors will appropriately design blasts to minimise effects at noise and vibration sensitive receptors.

For blast vibration occurring up to three times per day the generally accepted maximum satisfactory magnitude for residential premises is a peak particle velocity (PPV) of between 6.0 mms^{-1} and 10.0 mms^{-1}.

Should more than three blasts be required per day, BS 6472-2 provides information on the acceptable vibration limits.

BS 6472-2 states that *'Accurate prediction of air overpressure (from blasting) is almost impossible due to the variable effects of the prevailing weather conditions and the large distances often involved.'*

Whilst not providing any specific air overpressure limit, BS 6472-2 provides the following information on acceptable overpressures: *'Windows are generally the weakest parts of a structure exposed to air overpressure. Research by the United States Bureau of Mines has shown that a poorly mounted window that is pre-stressed can crack at around 150 dB(lin), with most windows cracking at around 170 dB(lin). Structural damage would not be expected at air overpressure levels below 180 dB(lin).'*

The air overpressure levels measured at properties near quarries in the United Kingdom are generally around 120 dB(lin), which is 30 dB(lin) below, or only 3% of, the limit for cracking pre-stressed poorly mounted windows.

Based on the guidance in BS 6472-2 the recommended blasting air overpressure limits are 120-150 dB(Lin). These limits are based on 3 blasts per day.

Based on the guidance in BS 6472-2, it is recommended that ground vibration as a result of any blasting operations shall not exceed 6 mms^{-1} PPV in 95% of all blasts measured over any continuous 6 months period, and no individual blast shall exceed a PPV of 10 mms^{-1} as measured at vibration sensitive receptors. The PPV measurement shall be taken to be the maximum of three mutually perpendicular directions taken at the ground surface.

As detailed above it is not possible to provide a quantitative prediction of absolute levels of noise, vibration and air overpressure from blasting works, at this stage. Therefore the assessment focuses on best practical means available to ensure that the resultant noise, vibration and air overpressure are minimised.

3.4 Operational Traffic Noise

The general principle of DMRB is to allocate an assessment method according to risk - this process uses three levels of assessment:

- Scoping;
- Simple; and
- Detailed.

The assessment presented here follows the most comprehensive detailed assessment approach.

Noise from a flow of road traffic is generated by both the vehicle engines and the interaction of tyres with the road surface. The traffic noise level at a receptor, such as an observer at the roadside or residents within a property, is influenced by a number of factors including traffic flow, speed, composition (percentage of HGVs), road gradient, type of road surface, distance from the road and the presence of any obstructions between the road and the receptor.

Noise from a stream of traffic is not constant, but to assess the noise impact a single figure estimate of the overall noise level is necessary. The index adopted by the Government in 'The Calculation of Road Traffic Noise' (CRTN9) to assess traffic noise is $L_{A10,18h}$. This value is determined by taking the highest 10% of noise readings in each of the 18 one-hour periods between 06:00 and 00:00, and then calculating the arithmetic mean. As recorded in DMRB, a reasonably good correlation has been shown to exist between this index and the perception of traffic noise by residents over a wide range of noise exposures.

CRTN provides the standard methodology for predicting the $L_{A10,18h}$ road traffic noise level. Noise levels are predicted at a point measured 1 m horizontally from the external façade of buildings.

Of relevance to a traffic noise model of fairly minor roads with low traffic flows is the CRTN low flow correction, which applies between 18 hour flows of 1,000 and 4,000, and the low flow cut off of 1,000. The low flow correction procedure enhances the impact of changes in traffic flows which are already low, in particular at receptors very close to the road. The 1,000 18 hour flow cut off is the lower limit of the CRTN prediction methodology.

DMRB also requires an assessment of night-time (i.e. between 23:00 and 07:00) traffic noise levels ($L_{night,outside}$). However, this parameter is not predicted by the standard CRTN methodology. DMRB refers to three methods for calculating night-time traffic noise levels developed by the Transport Research Laboratory[22] (TRL). The most widely used is 'Method 3' which factors the L_{night} from the $L_{A10,18h}$, based on the typical diurnal pattern of traffic flows in the UK. Method 3 has been adopted for the purposes of this assessment. A -2.5 dB correction has been applied to the night-time predicted traffic noise levels, to convert from façade to free-field levels i.e. noise levels which are unaffected by reflecting surfaces other than the ground (as advised in CRTN).

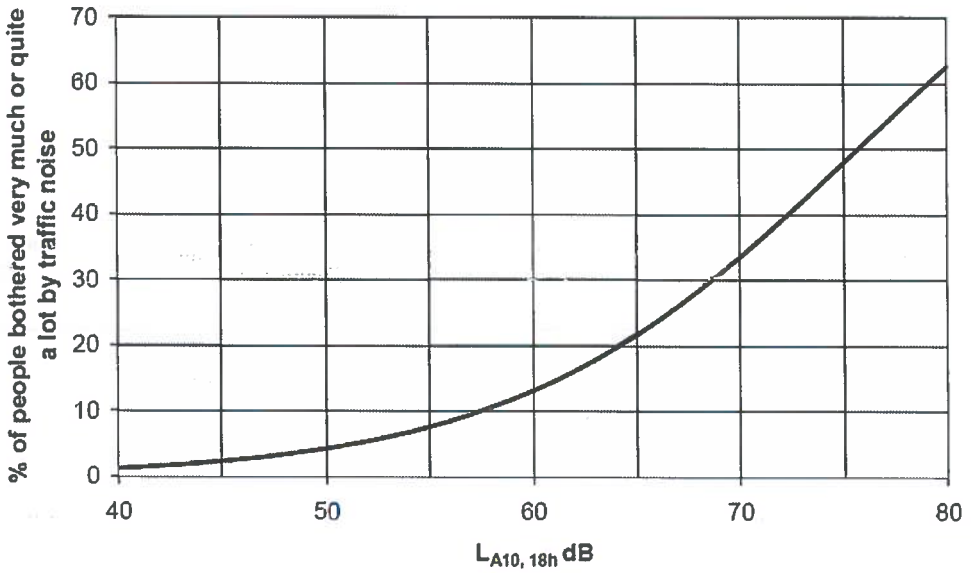
The traffic noise predictions generated by modelling are based on traffic data provided by a traffic model of the proposed scheme and surrounding area. The available traffic model is fairly limited in extent consisting of the B4265 to the north and south of Eglwys Brewis Road, and to the north of the Scheme, and Eglwys Brewis Road between the B4265 and St Athan Road/Cowbridge Road. No traffic data are available for the minor local roads off Eglwys Brewis Road, roads within Llantwit Major, St Athan Road/Cowbridge Road at the eastern end of the scheme or the B4265 north of the Llanmaes Road junction. In agreement with the traffic consultant, and consultation with Vale of Glamorgan Shared Regulatory Services Department3, the provided traffic data for the B4265 between the Scheme and the Llanmaes Road junction has also been applied to the B4265 north of the Llanmaes Road junction.

Once the traffic noise levels have been predicted, they can be used to provide an indication of the likely annoyance to residents caused by traffic noise. Individuals vary widely in their response to the same level of traffic noise. However, the average or community response from a large number of people to the same level of traffic noise is fairly stable and, therefore, a community average degree of annoyance caused by traffic noise can be related to the long-term steady state noise level. The relationship between the steady-state traffic noise level and

[22] Transport Research Laboratory (TRL) (2002), Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping

the estimated annoyance experienced, expressed as the percentage of people 'bothered very much or quite a lot', is illustrated in Figure 1 (taken from DMRB). This shows, for example, that approximately 13% of all residents would be 'bothered very much or quite a lot' at a façade road traffic noise level of 60 dB $L_{A10,18h}$.

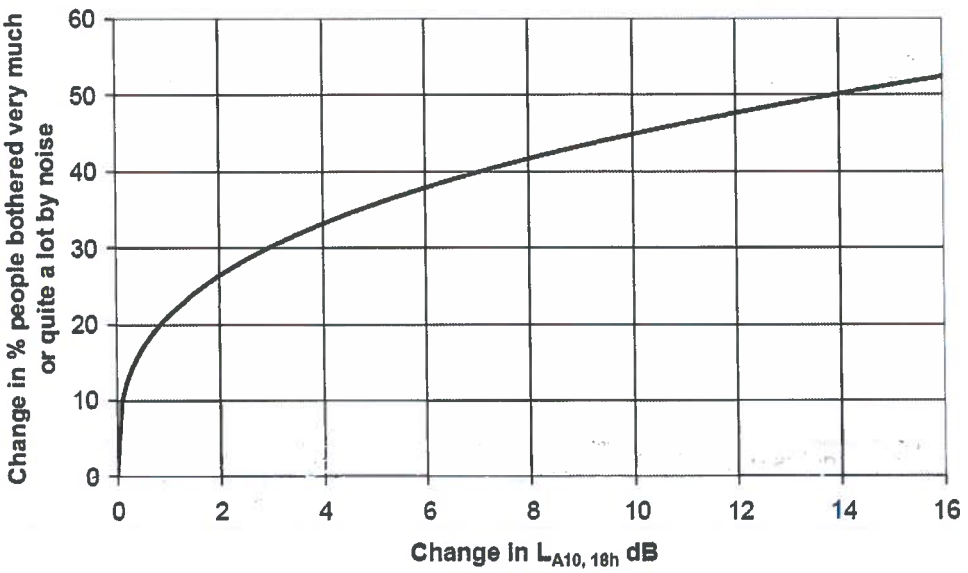
Figure 1. Estimation of Traffic Noise Annoyance- Steady State



In addition, research recorded in DMRB has shown that people are more sensitive to abrupt changes in traffic noise, for example, following the opening of a new road, than would be predicted from the steady state relationship between traffic noise and annoyance (as described above). These effects last for a number of years. However, in the longer term, the perceived noise annoyance tends towards the steady-state level due to familiarisation. The percentage change in the traffic noise annoyance due to an abrupt change in traffic noise is illustrated in Figure 2 (as taken from DMRB).

Figure 2 shows, for example, that with an abrupt (and permanent) increase of 10 dB(A) there would be a net change of 45% residents 'bothered very much or quite a lot' by road traffic noise. If the initial noise level was 60 dB $L_{A10,18h}$ (with 13% people already bothered – refer to Figure 1), then there would be a total of 58% bothered immediately after an increase to 70 dB $L_{A10,18h}$. This would eventually diminish in the long term because of familiarisation to become approximately 34% subject to annoyance (see Figure 1).

Figure 2. Estimation of Traffic Noise Annoyance – Immediate Change



The objective of the assessment, as set out in DMRB, is to gain an overall appreciation of the noise and vibration climate, both with (Do-Something) and without (Do-Minimum) the proposed scheme, to identify where noise impacts occur and to determine where mitigation to reduce these impacts is required. These conditions are assessed for the baseline year (the year of proposed scheme opening) and the future assessment year (15 years after proposed scheme opening). DMRB outlines the steps to be carried out at the detailed assessment stage:

a) Identify the study area (refer to section 3.7) and predict 18-hour (06:00 - 00:00) and night-time (23:00 - 07:00) traffic noise levels at all residential properties within 600 m of the proposed scheme and affected routes within 1 km of the proposed scheme (affected routes are defined as existing roads which would experience a potentially significant change in traffic noise level as a result of the proposed scheme). Predictions are required for the Do-Minimum and Do-Something scenarios in the year of proposed scheme opening and 15 years after proposed scheme opening. The computer noise modelling software SoundPLAN version 7.4, which implements the CRTN methodology to predict $L_{A10,18h}$ noise levels and the TRL 'Method 3' to predict $L_{night,outside}$ levels, has been used to complete the traffic noise predictions. Further details of the noise model are provided in Appendix B;

b) Carry out the following comparisons for each property in order to identify the number of properties where residents may experience an increase or decrease in traffic noise levels and annoyance:

- The Do-Minimum scenario in the baseline year against the Do-Minimum scenario in the future assessment year (long-term) (DM 2019 to DM 2034);
- The Do-Minimum scenario in the baseline year against the Do-Something scenario in the baseline year (short-term) (DM 2019 to DS 2019); and
- The Do-Minimum scenario in the baseline year against the Do-Something scenario in the future assessment year (long-term) (DM 2019 to DS 2034).

DMRB also states in paragraph A1.19 (ix) "*If any other comparisons are identified that would further demonstrate the noise and vibration impact of the project, these should*

also be calculated and reported. For example, although the comparison between Do-Minimum and Do-Something in the future assessment year is not required in the decision making process of whether to move from a Simple to a Detailed Assessment, this comparison may be useful when comparing options or explaining potential impacts to stakeholders".

For night-time traffic noise levels, comparisons are only required for the two long-term scenarios and for properties where the $L_{night,outside}$ level is 55 dB(A) or more in the relevant scenarios;

c) Assess the impact on sensitive receptors, other than residential properties, within the 600 m study area. This is based on 18 hour (06:00 - 00:00) traffic noise levels and considers the same three comparisons as outlined in (b) above for residential properties. Other sensitive receptors include hospitals, educational buildings, community facilities (such as places of worship), designated ecological areas such as Areas of Outstanding Natural Beauty (AONB), National Parks, Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Sites of Special Scientific Interest (SSSI), public open spaces, designated scheduled monuments and public rights of way (PRoW);

d) Complete a qualitative assessment of sensitive receptors which are within 1 km of the proposed scheme, but more than 600 m from the proposed scheme and affected routes; and

e) For affected routes which are outside the 1 km boundary from the proposed scheme, complete an assessment by estimating the CRTN Basic Noise Level on these roads (the traffic noise level at 10 m) with and without the proposed scheme. Count the number of dwellings and other sensitive receptors within 50 m of these routes.

Different façades of the same property can experience different changes in traffic noise level depending on their orientation to the noise source. DMRB requires that each of the above comparisons of traffic noise levels is based on the façade which experiences the worst-case change i.e. the largest increase, or, if all façades undergo a decrease, the smallest decrease. Additionally, DMRB requires that the above comparisons of annoyance use the highest levels of annoyance in the first 15 years. For properties which experience an increase in noise due to the proposed scheme, the greatest annoyance is likely to be immediately after proposed scheme opening (see Figure 2). For properties which experience a decrease in noise (and also in the Do-Minimum comparison), the greatest annoyance is the steady-state level of annoyance in the long term (see Figure 1).

DMRB provides two classifications for the magnitude of the noise impact of a proposed road scheme, as shown in Tables 6 and 7 (taken from DMRB). These relate to short-term changes in noise levels and long-term changes in noise levels. Paragraph 3.36 of DMRB HD 213/11 states that HA 205/08[23] *'provides a method for the classification of the magnitude of impact and the significance of an effect, in order to arrive at an overall level of significance. In terms of road traffic noise, a methodology has not yet been developed to assign significance according to both the value of the resource and the magnitude of an impact. However, the magnitude of traffic noise impact from a road project should be classified into levels of impact in order to assist with the interpretation of the road project. Therefore for the assessment of traffic noise that is covered by [DMRB] a classification is provided for the magnitude of impact.'*

In light of the advice in DMRB set out above, Tables 6 and 7 have been used to assess changes in operational traffic noise.

[23] Highways Agency (2008), Design Manual for Roads and Bridges, Volume 11 Environmental assessment, Section 2 environmental impact assessment, Part 5, HA 205/08, Assessment and Management of Environmental Effects

Table 6. Classification of Magnitude of Noise Impacts – Short-term

Noise Change $L_{A10,18h}$ dB	Magnitude of Impact
0	No change
0.1 - 0.9	Negligible
1.0 - 2.9	Minor
3.0 - 4.9	Moderate
≥5.0	Major

Table 7. Classification of Magnitude of Noise Impacts – Long-term

Noise Change $L_{A10,18h}$ dB	Magnitude of Impact
0	No change
0.1 - 2.9	Negligible
3.0 - 4.9	Minor
5.0 - 9.9	Moderate
≥10.0	Major

The predicted noise levels at each façade of each residential property have also been used to carry out an initial assessment of the likelihood of any properties qualifying under the Noise Insulation Regulations (NIR) for noise mitigation. A complete assessment under the NIR is beyond the scope of the assessment at this stage. However, the results presented herein provide a useful initial indication of the number of potentially qualifying buildings.

3.5 Operational Traffic Vibration

Vibration from traffic can be transmitted through the air or through the ground. Airborne vibration is produced by the engines and exhausts of road vehicles, with dominant frequencies typically in the range of 50 - 100 Hz. Ground borne vibration is produced by the interaction of the vehicle tyres and the road surface with dominant frequencies typically in the range of 8 - 20 Hz. The passage of vehicles over irregularities in the road surface can also be a source of ground borne vibration.

Traffic vibration can potentially affect buildings and disturb occupiers. DMRB reports that extensive research on a wide range of buildings has found no evidence of traffic induced ground borne vibration being a source of significant damage to buildings and no evidence that exposure to airborne vibration has caused even minor damage (Watts, G. R. Traffic Induced Vibration in Buildings, TRRL RR246[24]).

[24] Watts, G. R. (1990), Traffic Induced Vibration in Buildings, TRRL RR246, Transport and Road Research Laboratory

Airborne vibration is noticed by occupiers more often than ground borne vibration, as it may result in detectable vibrations in building elements such as windows and doors.

On the basis of a subjective assessment carried out during the baseline noise survey (refer to Section 6), ground borne vibration due to traffic on the existing Eglwys Brewis Road and B4265 has not been identified as a potential issue. DMRB states that perceptible vibration only occurs in rare cases and identifies that the normal use of a building, such as closing doors and operating domestic appliances, can generate similar levels of vibration to that from traffic in most circumstances.

It is a requirement of new highway constructions that the highway surface be smooth and free from any discontinuities. Paragraph A5.26 of DMRB HD213/11 states, in relation to ground borne vibration: *'Such vibrations are unlikely to be important when considering disturbance from new roads and an assessment will only be necessary in exceptional circumstances'.* Hence, no impacts or effects from traffic induced ground borne vibration due to the passage of vehicles over irregularities in the surface of the proposed scheme.

To assess the magnitude of the impact of traffic induced airborne vibration on residents, a parameter is needed which reflects a person's subjective rating of vibration disturbance. DMRB recommends the use of the $L_{A10,18h}$. The relationship between the $L_{A10,18h}$ and annoyance due to vibration is similar to that for annoyance due to steady state traffic noise, as shown in Figure 1, except that the percentage of people bothered by vibration is lower. For a given level of noise exposure, the percentage of people bothered very much or quite a lot by vibration is 10% lower than the corresponding figure for annoyance due to traffic noise. Below 58 dB(A) the percentage of people bothered by traffic induced vibration is assumed to be zero.

The potential for vibration impacts is limited to the immediate vicinity of a road, and the relationship between annoyance due to vibration and traffic noise level is based on properties located within 40 m of a road. Therefore, at each property within 40 m of the proposed scheme, and at which traffic noise levels are predicted to be 58 dB, $L_{A10,18h}$ or more, the percentage of people likely to be bothered very much or quite a lot by vibration is calculated, based on the annoyance levels in Figure 1, with a reduction of 10%.

3.6 Significance of Effect

The significance of effect is a function of the value or sensitivity of the receptor and the magnitude of the impact. Table 8 details the sensitivity of receptors, whilst Table 9 presents the significance of effect, based on the magnitude of impact (as detailed in the previous sections) and the sensitivity of receptors (as per Table 8).

As a general rule, large and moderate effects are considered to be significant, whilst slight and neutral effects are considered to be not significant. Other project-specific factors such as the number of receptors affected and the timing, duration and character of the impact should also be considered when determining if there is a potentially significant effect.

Table 8. Sensitivity of Receptors

Sensitivity/ Value of Receptor	Description
Very High	Concert halls/ theatres, specialist vibration sensitive equipment
High	Residential properties, educational buildings, medical facilities
Medium	Community facilities such as Places of worship
Low	Commercial and industrial premises, public rights of way

Table 9. Significance of Effect

Magnitude of impact	Value/ Sensitivity of Receptor			
	Very High	High	Medium	Low
Major	Very Large	Large	Large	Moderate
Moderate	Large	Moderate	Moderate	Slight
Minor	Moderate	Slight	Slight	Neutral
Negligible	Slight	Slight	Neutral	Neutral
No Change	Neutral	Neutral	Neutral	Neutral

3.7 Study Area

The study area for the qualitative assessment of construction phase noise impacts comprises the closest identified potentially sensitive receptors to the Scheme.

The study area for the assessment of operational phase noise impacts comprises an area extending to 1 km from the proposed scheme and the existing Eglwys Brewis Road which would be replaced by the proposed scheme. Within this 1 km area, a 600 m zone has been subject to detailed traffic noise modelling. This is explained further below:

a) The study area consists of the proposed scheme and all surrounding existing roads that are predicted to be subject to a change in traffic noise level as a result of the proposed scheme of:

- 1 dB(A) or more in the short term (DM 2019 vs DS 2019); or
- 3 dB or more in the long term (DM 2019 vs DS 2034), subject to a minimum change of 1 dB between DM 2034 and DS 2034.

These roads are defined as' affected routes'. Analysis of the provided traffic data indicates that the section of the B4265 between Eglwys Brewis Road and the Scheme meets the criteria to be defined as an affected route;

b) The study area for the detailed quantitative assessment of noise impacts comprises a corridor 600 m either side of the proposed scheme, 600 m either side of the extent of Eglwys Brewis Road replaced by the proposed scheme, and a 600 m corridor either side of the identified affected route within the wider 1 km study area;

c) For dwellings and other sensitive receptors that are within the 1 km wider study area, but more than 600 m from an affected route, the proposed scheme or existing Eglwys Brewis Road replaced by the proposed scheme, a qualitative assessment of the traffic noise impacts has been carried out; and

d) The DMRB methodology also includes consideration of affected routes which are outside the 1 km wider study. However analysis of the provided traffic data indicates that no existing roads outside the 1 km boundary meet the criteria to be defined as an affected route.

The proposed scheme, the 1 km wider study area around the proposed scheme and extent of Eglwys Brewis Road replaced by the proposed scheme, and sensitive receptors within the 1 km wider study area are shown on Figure 3. The smaller 600 m study area for the detailed quantitative assessment of noise impacts is also shown on Figure 3.

As noted in Section 3.4, the extent of the available traffic data is limited and does not include roads within Llantwit Major, minor roads off Eglwys Brewis Road or St Athan Road/Cowbridge Road beyond the eastern end of the scheme. Therefore, the traffic noise predictions around the edges of the 600 m study area, and remote from the roads included in the traffic noise model (B4265, Eglwys Brewis Road and the scheme) are likely to be an underestimate of traffic noise levels, both with and without the scheme.

4. CONSULTATION

Vale of Glamorgan Shared Regulatory Services were consulted in October 2016 with regard to the baseline monitoring survey, the construction assessment, the existing ambient noise climate in the area and local potentially noise sensitive receptors[25].

The proposed baseline noise monitoring locations and methodology were agreed as acceptable. Local noise sensitive receptors including Rose Cottage, Old Froglands, Froglands Farm and Millands mobile home park were identified. In addition, the former Moonshine pub on Eglwys Brewis Road was identified as being used as hostel accommodation and a recent planning application for residential development at the 'Old Brewery' on Eglwys Brewis Road noted.

In terms of existing local noise sources, other than road traffic, the RAF base was identified as a potentially significant source in terms of aircraft and use of a shooting range. The shooting range was noted as having been the source of local complaints in the past, though usage is fairly infrequent. The volume of aircraft movements at the RAF base was stated as much reduced from what it has been in the past but could increase in the future with the development of the Aerospace Business Park. The railway to the west was identified as having frequent passenger services but no freight trains.

Regarding construction, the Vale of Glamorgan Council's preferred standard hours were noted as 08:00-17:00 Monday-Friday and 08:00-13:00 on Saturday, with no working on Sundays or Bank Holidays. The Council have no specific noise/vibration construction limits, each development is considered individually.

Further consultation with Vale of Glamorgan Shared Regulatory Services was carried out in November 20163 with regard to the extent of the available traffic data and the other developments included in the traffic data in each assessment scenario as discussed in Sections 1 and 3.4.

A meeting was held with Vale of Glamorgan Shared Regulatory Services on 11th January 2017 to discuss the operational traffic noise impacts of the Scheme. The magnitude of the traffic noise changes due to the scheme were discussed and the results with a number of different barrier options considered.

5. VALUE (SENSITIVITY) OF RESOURCE

Figure 3 illustrates the potentially sensitive receptors identified within 1 km of the proposed scheme and the extent of the existing Eglwys Brewis Road that would effectively be replaced by the proposed scheme.

The vast majority of potentially sensitive receptors are residential properties, which are classed as being of high sensitivity to road traffic noise. A total of over 2,500 residential properties have been identified within the 1 km study area based on Ordnance Survey (OS) address base data.

[25] Correspondence between Suzanne Scott Aecom and Sue Brown Vale of Glamorgan Shared Regulatory Services Department 27/10/16

The majority of the residential properties are located within Llantwit Major to the west of the scheme. Residential properties are also concentrated in the village of Llanmaes to the north-west of the scheme and to the south of Eglwys Brewis Road at the western end of the scheme, and to the north of Eglwys Brewis Road beyond the eastern end of the scheme.

Smaller groupings and individual properties are also located in the study area, including Froglands Farm, Rose Cottage, Old Froglands, Millands Farm and Millands Mobile Home Park in close proximity to the scheme.

The area between the scheme and Eglwys Brewis Road is allocated in the emerging local development plan for residential development. As no proposed layout plans are currently available it is not possible to include these developments in the quantitative traffic noise assessment, either as noise sensitive receptors or as buildings that would affect the propagation of traffic noise from the scheme to the south. However, as detailed in Section 1 it should be noted that traffic volumes generated by these residential developments have been included in the transport assessment and are therefore included in the traffic volume figures used in the 2034 quantitative traffic noise assessment. These developments would potentially shield the residential area to the south of Eglwys Brewis Road from the scheme. The design of the residential developments, in terms of the layout/orientation of the proposed properties and the choice of glazing/ventilation would need to take account of the operation of the scheme.

With regard to non-residential potentially sensitive receptors, a total of four schools have been identified within the 1 km study area, all of which are located in Llantwit Major. Three places of worship have been identified, located in Llanmaes village and off Eglwys Brewis Road. A total of six community facilities have been identified consisting of: Llantwit Major Library; Llantwit Major Leisure Centre; Llantwit Major Rugby/Football Club; Boverton Hall in Llantwit Major; St Cattwg's Village Hall in Llanmaes and Starling Road Community Centre south of Eglwys Brewis Road. Two scheduled monuments are located in the 1 km study area: Bedford Castle and Boverton Place. A range of public rights of way pass through the study area as illustrated on Figure 3.

No other non-residential potentially sensitive receptors such as hospitals, designated ecological areas such as Areas of Outstanding Natural Beauty (AONB), National Parks, Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Sites of Special Scientific Interest (SSSI), or public open spaces have been identified in the 1 km study area.

6. LIMITATIONS OF ASSESSMENT

The following limitations were encountered in the completion of the assessment:

- The construction methodology is yet to be confirmed;
- No details regarding the potential layout of buildings within the allocated housing sites positioned between the scheme and Eglwys Brewis Road is currently available. Such developments are likely to provide considerable shielding of traffic noise from the scheme, in particular to existing residential properties to the south of Eglwys Brewis Road. The impact of the scheme on these existing properties is therefore likely to be over-estimated.
- As detailed in Section 3.4 the extent of the available traffic data is very limited;
- The traffic data for 2034, both with and without the scheme in operation, is considered to represent a worst case scenario based on assumptions regarding future jobs at the business park and housing developments which are not committed;
- The predicted night time traffic noise levels are simply factored from the 18 hour daytime levels. In reality the business park traffic assumed to be present in 2034 will not occur at

night, therefore the results are likely to be an overestimate of the actual change in traffic noise levels at night; and

- Building height and building usage information available in the OS mastermap and OS addressbase premium datasets was incomplete and contained some inaccuracies. As a general principle 1 storey buildings have been assumed to be 4m in height and 2 storey buildings 6m, small outbuildings such as garages have been assumed to be 2m. Some manual checking of building usage and heights has been completed based on publically available data sources such as Bing aerial photography and Google Streetview.

7. BASELINE CONDITIONS

7.1 Baseline Noise Survey 2016

A baseline noise survey was completed in November 2016. The purpose of the baseline noise survey was to assist with developing an understanding of the general noise climate along the proposed scheme. For example, to identify if any other local noise sources (other than road traffic) are present and contribute significantly to the local noise climate.

The results of the baseline survey are also used in the assessment of noise impacts during the construction phase of the works. As detailed in Section 3.1, the method of determining the threshold for potentially significant construction noise effects is based on the existing ambient noise levels.

The results of the baseline noise survey are also used as part of a verification exercise for the traffic noise prediction modelling. The traffic noise model has been used to predict traffic noise levels at the monitoring locations, with the predicted and measured levels being compared. The aim of this process is to demonstrate that the noise model is giving a sensible range of results across the whole of the study area. An exact match would not be expected for a variety of reasons, for example, the noise predictions are based on typical weekday traffic conditions over a year, not the exact traffic conditions during the short term noise monitoring; and the prediction method is designed to be conservative in terms of the effect of wind direction; in addition, the noise predictions only consider road traffic noise, whereas the measurements include all ambient noise sources.

The six selected noise monitoring locations are detailed on Figure 3, the locations were chosen to focus on some of the very closest receptors to the proposed scheme.

Short-term daytime 3 hour monitoring was completed at all six locations on the 25/11/16 between 10:00 and 17:00. The monitoring procedures conformed to BS 7445: 2003 'Description and Measurement of Environmental Noise'[26] and the CRTN 'shortened measurement procedure'. The calibration levels of the instrumentation were checked prior to and following the measurements with a field calibrator No significant drift was noted. Full calibration details are available upon request.

Weather conditions during the survey were suitable for noise monitoring with no rain or high winds. Average wind speeds observed on site were low, less than 2 m/s generally from a north-easterly direction.

A summary of the noise monitoring results is provided in Table 10. Measurements in the morning (AM) were taken 10:00-13:00, measurements in the afternoon (PM) were taken 14:00-17:00. Further details of the monitoring survey are provided in Appendix C. The results reported are free-field i.e. more than 3.5m from a vertical reflective surface other than the ground, with the exception of M3, which was located 1m from the façade of a building. The $L_{A10,18h}$ at each location has been estimated from the arithmetic average of the three one hour

[26] British Standards Institution (2003), BS 7445: 2003 Description and Measurement of Environmental Noise

$L_{A10,1h}$ levels, minus 1 dB, in accordance with the CRTN shortened measurement procedure. The corresponding predicted traffic noise $L_{A10,18h}$ level from the noise model, and the difference from the $L_{A10,18h}$ estimated from the measured levels, has also been reported for information.

Table 10. Summary of Baseline Noise Levels

Location	Time	$L_{Aeq,3h}$ dB	L_{AFmax} dB Range	Average of $L_{A90,1h}$ dB	Average of $L_{A10,1h}$ dB	Estimated $L_{A10,18h}$ dB	Predicted Traffic $L_{A10,18h}$ dB
M1	AM	57	71-79	46	61	60	57 (-3)
M2	AM	54	77-79	41	53	52	43 (-9)
M3	PM	54	78-88	37	50	49	51 (+2)
M4	AM	64	75-94	43	60	59	52 (-7)
M5	PM	60	74-83	37	65	64	62 (-2)
M6	PM	58	72-76	41	63	63	60 (-2)

During the morning measurements (M1, M2 and M4) noise from small aircraft circling overhead and noise from the RAF firing range were noted. Noise from the firing range was not present during the afternoon measurements (M3, M5 and M6) and the number of aircraft also reduced.

At M1 to the west on the edge of Llantwit Major the firing range was not significant though the aircraft overhead made some contribution to the measured levels. Local road traffic was also noted at M1 although traffic on the adjacent B4265 (in cutting) was the dominant noise source. At this location the dominance of traffic on the B4265 ensures the measured levels and predicted traffic noise levels correspond well.

At M2, which is remote from both the B4265 and Eglwys Brewis Road, the aircraft and firing range were much more significant. This is the main reason for measured levels at M2 being higher than at M3, which is closer to Eglwys Brewis Road, and why the predicted traffic noise levels are much lower than the measured ambient levels. Some local traffic, which is not included in the traffic noise model, also occurred during the survey.

M4 is the closest site to the firing range and L_{Aeq} levels during the first two hours were around 10 dB higher than in the final hour when the firing range had ceased operation. Aircraft overhead and local road traffic on Eagle Road adjacent to the monitoring position also contributed to the measured levels. Local traffic, aircraft and the firing range are not included in the traffic noise model, which explains why the predicted traffic noise levels at M4 are rather lower than the measured ambient levels.

At M3, M5 and M6 the predicted traffic noise levels correspond well with the measured levels. Road traffic on Eglwys Brewis Road was the dominant noise source at these locations. Some contributions from other sources, such as occasional aircraft (M3, M5 and M6), a nearby stream (M6), local traffic (M3), wildlife (M3, M5 and M6), and local residents (M5) were also noted.

Overall, the noise model is considered to provide a reasonable representation of traffic noise levels in the study area. The baseline monitoring survey indicates that at some times noise sources other than road traffic can be significant in the area, in particular activities at the RAF base.

7.2 Do-Minimum 2019 and 2034

Figure 4 illustrates the absolute traffic noise levels in the 2019 Do-Minimum scenario and Figure 5 the traffic noise levels for the 2034 Do-Minimum scenario. The noise changes from DM 2019 to DM 2034 are presented as a noise difference contour plot in Figure 6. All the noise contour maps are based on free-field traffic noise levels at first floor level (4 m above ground). They are based on a 5 m x 5 m grid and are provided for illustration purposes.

Predicted Do-Minimum traffic noise levels at the closest properties to the scheme are low as they are remote from Eglwys Brewis Road, and more local roads and other ambient noise sources are not included in the traffic data. At Rose Cottage predicted 2019 DM traffic noise levels range from 44 to 52 dB $L_{A10,18h}$ at the least exposed and most exposed façade. At Froglands Farm they are slightly lower at around 39-49 dB, and at Millands Farm 42-49 dB. Further back from Eglwys Brewis Road at the Millands Mobile Home Park and Oakwood, 2019 DM traffic noise levels range from around 40 to 48 dB at the least and most exposed facades. At Old Froglands closer to Eglwys Brewis Road the range is from around 42 to 57 dB. At the western end of the scheme the 2019 DM traffic noise levels at the closest properties to the B4265 are generally in the mid to high 40 dB and mid to high 50 dB range at the least and most exposed facades.

The results of the baseline noise survey, as detailed in Section7.1 illustrate that at some times noise sources other than road traffic i.e. noise associated with activities and aircraft from the RAF base, are a significant source in the area. It is not possible to accurately include these other noise sources in the noise modelling process, therefore the low do-minimum noise levels at locations along the route of the scheme reported in the traffic noise predictions are an underestimate of the actual ambient noise climate at some times.

A large increase in traffic flow on Eglwys Brewis Road is predicted due to the housing developments in the local plan, and the 3000 business park jobs, which are not present in the 2019 Do-Minimum traffic data. In the absence of the scheme all of this development is accessed off Eglwys Brewis Road and 18 hour flows increase from just over 4000 in 2019 to almost 16,000 in 2034. Traffic flows on the B4265 also increase by over 50% north of Eglwys Brewis Road, and over 80% south of Eglwys Brewis Road. As detailed in the introduction it should be noted that the 3000 business park jobs included in the 2034 traffic data is the maximum permissible number of jobs at the business park. The actual number of jobs, and therefore associated traffic, may be less than this. Furthermore, the housing developments are not committed developments. Therefore, the actual increase in traffic volumes from 2019 to 2034 may be less than assumed and the predicted 2034DS traffic noise levels are very much a worse case.

Predicted 2034 DM traffic noise levels at Rose Cottage range from 48 to 57 dB $L_{A10,18h}$ at the least exposed and most exposed façade. At Froglands Farm they are slightly lower at around 44-54 dB, and at Millands Farm 46-54 dB. Further back from Eglwys Brewis Road at the Millands Mobile Home Park and Oakwood, 2034 DM traffic noise levels range from around 43 to 53 dB at the least and most exposed facades. At Old Froglands closer to Eglwys Brewis Road the range is from around 47 to 62 dB. At the western end of the scheme the 2019 DM traffic noise levels at the closest properties to the B4265 are generally in the high 40 dB and low 60 dB range at the least and most exposed facades

A summary of overall Do-Minimum traffic noise levels and the change from the proposed scheme opening year (DM 2019) to the future assessment year (DM 2034) is provided in Table 11.

An estimated total of 1878 residential buildings are located within 600 m of the proposed scheme, Eglwys Brewis Road replaced by the proposed scheme and the B4265 affected route. However, only 32 properties meet the DMRB criterion of 55 dB $L_{night,outside}$ at one or more façades in one or more scenarios for inclusion in the night-time traffic noise assessment. These are located very close to the B4265 or Eglwys Brewis Road.

A total of six non-residential sensitive buildings are located within the 600 m study area for the detailed quantitative predictions, consisting of three places of worship, one school and two community hall/centres. In addition, the results at the site of two scheduled monuments are included in the assessment. A number of public rights of way pass through the 600 m study area, though as it is not possible to assign a single noise level change to a linear public right of way they are not included in the tables of results below.

Table 11 is based on the façade at each building which undergoes the worst change in traffic noise level from the DM 2019 scenario to the DM 2034 scenario. The results are provided for the top floor of each building, for example, 1.5 m for a 1 storey house, 4 m for a 2 storey house.

Table 11. Long-term Change in Do-Minimum Traffic Noise Levels (DM 2019 to DM 2034)

Change in Noise Level		Daytime		Night-time
		Number of Residential Buildings	Number of Other Sensitive Receptors	Number of Residential Buildings
Increase in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1 - 2.9	1283	6	2
	3.0 - 4.9	456	1	0
	5.0 - 9.9	139	1	30
	≥10	0	0	0
No change	0	0	0	0
Decrease in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1 - 2.9	0	0	0
	3.0 - 4.9	0	0	0
	5.0 - 9.9	0	0	0
	≥10	0	0	0

Table 12 presents a summary of the corresponding change in traffic noise annoyance at residential properties from the proposed scheme opening year to the future assessment year, as required by DMRB.

Table 12. Long-term Change in Do-Minimum Traffic Noise Annoyance (DM 2019 to DM 2034)

Change in % Annoyed		Daytime Number of Residential Buildings
Increase in annoyance level	<10%	1826
	10 <20%	52
	20 <30%	0
	30 <40%	0
	≥40%	0
No change	0	0
Decrease in annoyance level	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0

Over half of the residential properties (68%) are expected to experience a negligible (0.1 to 2.9 dB) increase in daytime traffic noise levels between 2019 and 2034 in the absence of the scheme. 24% are expected to experience a minor increase (3.0 to 4.9 dB) and 7% a moderate increase (5.0 to 9.9 dB). Figure 6 illustrates that the moderate increases in traffic noise are concentrated along Eglwys Brewis Road, and extend northwards to the closest properties to the scheme around Froglands Farm etc. The moderate increases in traffic noise are due to the large increase in traffic flows from 2019 to 2034, in particular on Eglwys Brewis Road.

The predicted changes in daytime traffic noise levels translate into the majority of properties experiencing an increase in annoyance of <10%, with 3% experiencing an increase of 10-20%, from 2019 to 2034 in the absence of the scheme.

30 of the 32 residential properties considered in the night time traffic noise assessment are located on Eglwys Brewis Road, and therefore are predicted to experience a moderate increase. The remaining two properties are located on the B4365 and experience a negligible increase in the long term in the absence of the scheme. It should be noted that the predicted night time traffic noise levels are simply factored from the 18 hour daytime levels. In reality the business park traffic assumed to be present in 2034 will not occur at night, therefore the results are likely to be an overestimate of the actual change in traffic noise levels at night.

The majority of the identified non-residential sensitive receptors experience a negligible increase in traffic noise from 2019 to 2034 in the absence of the scheme. The Starling Road Community Centre is predicted to experience a minor increase and Bethesda Chapel, which is directly on Eglwys Brewis Road, a moderate increase.

A summary of the change in annoyance due to airborne vibration from road traffic between the two Do-Minimum scenarios is provided in Table 13. A total of 9 residential properties have been identified within 40 m of the proposed scheme, these consist of Froglands Farm, Rose Cottage and seven properties on the eastern edge of Llantwit Major which are just within 40m of the realigned B4265 at the junction with the scheme.

Table 13. Long-term Change in Do-Minimum Traffic Vibration Annoyance (DM 2019 to DM 2034)

Change in % Annoyed		Daytime Number of Residential Buildings
Increase in annoyance level	<10%	7
	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0
No change	0	2
Decrease in annoyance level	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0

Froglands Farm and Rose Cottage are predicted to experience no change in vibration annoyance from 2019 to 2034 in the absence of the scheme as the absolute traffic noise levels in this area, well over 100 m from Eglwys Brewis Road, are below the lower cut off of the assessment methodology of 58 dB $L_{A10,18h}$ in both 2019 and 2034. At the remaining seven

properties within 40m of the western end of the scheme on the B4365 a <10% increase in annoyance is predicted in the absence of the scheme.

8. IMPACT AVOIDANCE AND DESIGN MEASURES

Environmental considerations have been taken into account during the development of the proposed scheme design. Actions that have been taken that have contributed to avoiding and/ or reducing potential noise effects have included the following:

- Alternative options to the proposed scheme were considered when proposals for the scheme were first developed[27]. These included upgrading the existing Eglwys Brewis Road, but also looked at various other options. Environmental impacts were one of the factors considered in the choice of the proposed scheme and the vertical and horizontal alignment of the scheme.

- Mitigation has been incorporated into the proposed scheme design in the form of low-noise surfacing across the extent of the proposed scheme. Current guidance in DMRB advises that an additional benefit from low noise surfacing should only be assumed in the noise predictions where speeds are 75 km/hr or above. The anticipated traffic speed for the scheme is slightly lower than this at 64 km/hr, therefore, the operational traffic noise predictions do not include any assumed benefit from a low noise surface. However, unpublished research for Highways England[28],[29] and from the Netherlands[30] has shown that around 80% of the measured benefit, in decibels, of a low-noise surface may be realised at 64 km/hr (when the percentage of HGVs is around 10% as it is for this scheme). Therefore, for example, if a low-noise surface with a measured benefit of 3.5 dB was to be laid a benefit of around 2.8 dB would be expected for the scheme.

- A number of noise barriers have been incorporated into the scheme design to reduce the noise impact of the scheme, as illustrated in Figure 3:

    - 2.5 m noise barrier located to the north of the scheme in the vicinity of Froglands Farm, Millands Farm and Millands Mobile Home Park;

    - 2.5 m noise barrier located to the south of the scheme in the vicinity of Rose Cottage and Old Froglands; and

    - 2.5m noise barrier located to the west of the scheme at the top of the B4265 cutting to protect the closest properties in Llantwit Major.

The detailed design of the noise barriers will include consideration of the materials to be used, such as timber barriers or stone walls.

A Construction Environmental Management Plan (CEMP) would be prepared and implemented by the selected construction contractor. The CEMP would include a range of best practice measures associated with mitigating potential noise and vibration impacts - such measures are described below:

- Selection of quiet and low vibration equipment;

[27] Aecom (2017), Eglwys Brewis Road Options Report, ref. 60509148/CFRP0001
[28] PG Abbott and PM Nelson (2001), Revising CRTN Road Surface Correction for Medium and High - Speed Roads, PR/SE/289/2001 (unpublished), Transport Research Laboratory
[29] M Muirhead (2013), CRTN revision – technical note (unpublished), Transport Research Laboratory
[30] B Peeters and GJ van Blokland (2007). The Noise Emission Model for European road Traffic (IMA55TR-060821-MP10). Aalsmeer, The Netherlands: M+P Noise and Vibration Consultants

- Review of construction programme and methodology to consider low noise/ low vibration methods (including non-vibratory compaction plant and low vibration piling methods, where required);
- Optimal location of equipment on site to minimise noise disturbance;
- The provision of acoustic enclosures to static plant, where necessary;
- Use of less intrusive reversing alarms, such as broadband vehicle reversing warnings; and
- Local screening of equipment and employment of perimeter hoarding.

It should be noted that the proposed noise barrier located to the west of the scheme at the top of the B4265 cutting (as detailed above) shall be installed as part of a phase of advance works programmed for construction during the winter 2017/2018 prior to construction of the road starting in May 2018. This will help to mitigate the noise impact to nearby residents during construction and will also allow vegetation affected by the works to re-establish prior to the road opening.

If blasting is taken forward as the preferred construction method for the western end of the scheme, a detailed assessment of the proposed blasting methods will be undertaken. The appointed blasting contractor will monitor the blasts and blast designs will be developed with the aid of regression lines determined from a logarithmic plot of PPV against scaled distances.

Any blasting will be carried out using best practicable means to ensure that the resultant noise, vibration and air overpressure are minimised in accordance with current British Standards[20] and Mineral Guidelines[21];

Based on the current programme night-time and weekend working is not anticipated. Standard daytime working hours as recommended by the Vale of Glamorgan Council would be adhered to.

During the proposed scheme construction phase appropriate mechanisms to communicate with local residents would be set up to highlight potential periods of disruption (e.g. web-based, newsletters, newspapers, radio announcements etc. and provision of site contact details). For example, an information web-page could be provided on the Welsh Government website to reflect construction and community liaison requirements.

Effective communication with the local community is especially important with regard to blasting, including advance warning of blasts. The Welsh Mineral Technical Note 2: Coal[31] highlights that even though vibration levels from blasting rarely approach the levels that would induce even hairline cracks, damage or the fear of damage is people's major concern. People are very sensitive to vibration and some people become aware of vibration as low as 0.5mms^{-1} PPV. Once the threshold of perception is exceeded, the likelihood of complaints is largely independent of vibration magnitude but greatly influenced by the relationship between an operator and the local community.

9. MAGNITUDE OF IMPACTS

9.1 Construction

At this stage of the proposed scheme design development, details regarding likely construction programming and sequencing are yet to be confirmed but it is expected that the total duration of the works will be 14 months. Works such as site clearance, drainage, earthworks, carriageway surfacing and landscaping will be required. As discussed in Section

[31] Welsh Government (2009), The Welsh Mineral Technical Note 2: Coal

3.3 there is the potential for blasting to be used to create the cutting at the western end of the scheme.

At this stage it is considered that piling works are unlikely to be required as no structures such as bridges are required as part of the Scheme. The need for ground improvement works has not been fully determined but is unlikely given the shallow nature of the underlying bedrock. The use of vibratory rollers will be required to compact earthworks and pavement foundations. Therefore, construction vibration impacts have been scoped into the assessment.

The risk of vibration induced building damage from the use of vibratory rollers to compact earthworks is considered to be very low. The magnitude of impact in terms of vibration induced building damage is classed as negligible. The risk of annoyance due to construction vibration from standard construction works would be limited to the very closest receptors such as Froglands Farm, Rose Cottage and the very closest properties in Llantwit Major at the western end of the scheme. There is the potential for temporary vibration annoyance impacts of minor magnitude at the closest receptors.

Construction noise impacts are likely to extend over a larger area. Approximately 100 residential properties are located within 100 m of the scheme. Given the close proximity of receptors to the proposed scheme construction works, there would be the potential for major adverse impacts at some receptors due to construction noise.

With regard to construction traffic, the limited information available indicates that the likely volume of construction traffic generated by works would be up to around 20 vehicles per day. This would result in no more than a negligible (0.1 - 0.9 dB) increase in road traffic noise on the B4265 and Eglwys Brewis Road.

With regard to blasting, it is inevitable that air overpressure and vibration effects will be produced from any controlled blasting. At this stage of the project, the detail of blasting (mass of charge, frequency of blasts, site location, hole spacing, detonation delay, etc.) is currently unknown.

Note that BS 5228 provides the following guidance regarding noise from blasting operations and the effects of screening and weather conditions:

'The attenuation effects due to the topography, either natural or manufactured, between the blast and the receiver are much greater on the audible component of the pressure wave, whereas the effects are relatively slight on the lower frequency concussive component. The energy transmitted in the audible part of the pressure wave is much smaller than that in the concussive part and therefore baffle mounds or other acoustic screening techniques do not significantly reduce the overall air overpressure intensity.'

'Meteorological conditions, over which an operator has no control, such as temperature, cloud cover, humidity, wind speed, turbulence and direction, all affect the intensity of air overpressure at any location and cannot be reliably predicted. These conditions vary in time and position and therefore the reduction in air overpressure values as the distance from the blast increases might be greater in some directions than others.'

As such it is not possible at this time to provide a quantitative prediction of absolute levels of air overpressure from blasting works. In lieu of this it is preferential to carry out blasting operations using the best practicable means available to ensure that the resultant noise, vibration and air overpressure are minimised. At this stage, assuming the blast design can be developed to meet the criteria detailed in section 3.3, then the magnitude of impact due to blasting is classed as minor.

It should also be noted that the disturbance caused by blasting is likely to be transient, with perhaps three blasts per day, whereas alternative mechanical methods would cause a more

continuous disturbance. Furthermore, given the strength of the rock, mechanical removal may not be possible.

9.2 Operation

Figures 7 and 8 illustrate the absolute traffic noise levels in the 2019 Do-Something scenario, with and without the proposed 2.5m noise barriers. Figures 9 and 10 illustrate the corresponding absolute traffic noise levels in the 2034 Do-Something scenario, with and without the proposed 2.5m noise barriers. The noise contour plots are provided both with and without the noise barriers to illustrate the benefit provided by the barriers. In the vicinity of Froglands Farm, Millands Farm, Rose Cottage and Old Froglands in particular the higher noise level contours are clearly 'pulled in' towards the scheme on Figures 8 and 10 with the barriers in place.

Figure 8 also illustrates the low absolute traffic noise levels along the scheme in 2019, with the noise barriers in place. The 2019 Do-Minimum flows on Eglwys Brewis Road are just over 4000 vehicles (18 hour flow). With the scheme in place this is split roughly half and half, with just over 2000 remaining on Eglwys Brewis Road and just under 2000 transferring onto the scheme. Therefore, on opening traffic flows on the scheme are estimated to be less than half that currently experienced on Eglwys Brewis Road.

2019 Do-Something traffic noise levels at the closest properties to the scheme are still relatively low. With the barriers in place at Rose Cottage, the very closest property, predicted traffic noise levels are around 55 dB $L_{A10,18h}$ at the most exposed façade. At Froglands Farm they are slightly lower at around 53 dB, and at Millands Farm 52 dB. Further back from the scheme at the Millands Mobile Home Park and Oakwood 2019 DS traffic noise levels are in the high 40 dB $L_{A10,18h}$ range at the most exposed facades. At Old Froglands the highest traffic noise levels remain on the south-east façades facing towards Eglwys Brewis Road at around 52-54 dB, on the north-west façades facing the scheme levels are lower at around 47-49 dB. At the western end of the scheme the 2019 DS traffic noise levels at the closest properties to the B4265 are generally in the mid 50 dB range at the most exposed facades.

The large increase in traffic flow assumed on all roads by 2034 is illustrated on Figures 9 and 10. Flows on the scheme in 2034 are around 12,000 (18 hour flow). With the scheme in place in 2034 traffic on Eglwys Brewis Road is considerably less than in the 2034 Do-Minimum scenario at around 3000 vehicles (18 hour flow) as the scheme becomes the main route to access the business park and new housing. As detailed in Section 7.2, a corresponding large increase in traffic from 2019 and 2034 is also assumed on the B4265 at over 50% north of the scheme, over 80% south of Eglwys Brewis Road, and just over 100% on the section between Eglwys Brewis Road and the scheme.

Correspondingly 2034 Do-Something traffic noise levels at the closest properties to the scheme are higher than in 2019 Do-Something. With the barriers in place, at Rose Cottage predicted traffic noise levels are around 63 dB $L_{A10,18h}$ at the most exposed façade. At Froglands Farm they are slightly lower at around 61 dB, and at Millands Farm 58 dB. Further back from the scheme at the Millands Mobile Home Park and Oakwood 2034 Do-Something traffic noise levels are in the mid 50 dB $L_{A10,18h}$ range at the most exposed facades. At Old Froglands the traffic noise on the south-east façades facing towards Eglwys Brewis Road and the north-west façades facing the scheme are broadly similar in the mid 50 dB range. At the western end of the scheme the 2034 Do-Something traffic noise levels at the closest properties to the B4265 are generally in the high 50 to low 60 dB range at the most exposed facades.

Table 14 summarises the short-term change in predicted traffic noise levels in 2019 between the Do-Minimum and Do-Something scenarios at both residential buildings and other sensitive receptors within the 600 m study area. The Table is based on the results which include the benefit of the proposed noise barriers.

Table 15 summarises the long-term change between the 2019 Do-Minimum and 2034 Do-Something scenarios, whilst Table 16 outlines the worst case change in annoyance due to the proposed scheme. The Table is based on the results which include the benefit of the proposed noise barriers.

All the comparisons are based on the façade which would experience the worst case change in traffic noise levels for that comparison. The results are provided for the top floor of each building, for example, 1.5 m for a 1 storey house, 4 m for a 2 storey house.

The short term noise changes from Do-Minimum 2019 to Do-Something 2019 without the proposed noise barriers are presented in Figure 11, and with the proposed noise barriers in Figure 12. The long term noise changes from Do-Minimum 2019 to Do-Something 2034 without the proposed noise barriers are presented in Figure 13, and with the proposed noise barriers in Figure 14. All the noise contour maps are based on free-field traffic noise levels at first floor level (4 m above ground). They are based on a 5 m x 5 m grid and are provided for illustration purposes.

Table 14. Short-term Change in Traffic Noise Levels (DM 2019 to DS 2019)

Change in Noise Level		Daytime	
		Number of Residential Buildings	Number of Other Sensitive Receptors
Increase in noise level Daytime $L_{A10,18h}$ dB	0.1 - 0.9	1399	7
	1.0 - 2.9	54	0
	3.0 - 4.9	4	0
	≥5	3	0
No Change	0	291	0
Decrease in noise level Daytime $L_{A10,18h}$ dB	0.1 - 0.9	97	0
	1.0 - 2.9	30	1
	3.0 - 4.9	0	0
	≥5	0	0

Table 15. Long-term Change in Traffic Noise Levels (DM 2019 to DS 2034)

Change in Noise Level		Daytime		Night-time
		Number of Residential Buildings	Number of Other Sensitive Receptors	Number of Residential Buildings
Increase in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1 - 2.9	794	3	31
	3.0 - 4.9	905	5	0
	5.0 - 9.9	173	0	0
	≥10	5	0	0
No Change	0	0	0	0
Decrease in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1 - 2.9	1	0	1
	3.0 - 4.9	0	0	0
	5.0 - 9.9	0	0	0
	≥10	0	0	0

Table 16. Worst Case Change in Traffic Noise Annoyance

Change in % Annoyed		Daytime
		Number of Residential Buildings
Increase in annoyance level	<10%	981
	10 <20%	806
	20 <30%	83
	30 <40%	6
	≥40%	1
No Change	0	0
Decrease in annoyance level	<10%	1
	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0

An estimated total of 1878 residential buildings are located within 600 m of the proposed scheme, Eglwys Brewis Road replaced by the proposed scheme and the B4265 affected route. However, only 32 properties meet the DMRB criterion of 55 dB $L_{night,outside}$ at one or more façades in one or more scenarios for inclusion in the night-time traffic noise assessment.

A total of six non-residential sensitive buildings are located within the 600 m study area of the detailed quantitative predictions, consisting of three places of worship, one school and two community halls. In addition, the results at the site of two scheduled monuments are included in the assessment. A number of public rights of way pass through the 600 m study area, though as it is not possible to assign a single noise level change to a linear public right of way they are not included in the Tables of results above.

In the short term (2019 DM to 2019 DS) the majority of residential properties (74%) experience a negligible increase in daytime traffic noise levels, 3% a minor increase (1.0 to 2.9 dB) and <1% (7 properties) a moderate (3.0 to 4.9 dB) or major (≥ 5 dB) increase. 15% experience no change and 7% a negligible or minor reduction. As would be expected the major increases are predicted at the very closest properties to the scheme: Rose Cottage, Froglands Farm, and Old Froglands. The moderate increases occur to the north of the scheme at Millands Farm, Oakwood and two properties at the Millands Mobile Home Park.

It is worth noting the assessment is based on the façade with the worst case change. For example, at Old Froglands the south-east facade facing towards Eglwys Brewis Road experiences a reduction of 1 to 2 dB while the north-west façade facing the scheme experiences an increase of 3 to 5 dB, in the short term. At Oakwood and the Millands Mobile Home Park the majority of facades and properties experience an increase of around 1.5 dB or less in the short term. At Millands Farm the increase ranges from around 1 to 4 dB in the short term, 3 to 7 dB at Froglands Farm and 1 to 11 dB at Rose Cottage.

The properties experiencing a minor reduction in traffic noise levels in the short term are concentrated around the centre of Eglwys Brewis Road, away from the B4265, due to the transfer of traffic onto the scheme. The north-east façades of the closest properties to the B4365, which face the eastern end of the scheme, also experience a minor reduction in traffic noise levels in the short term due to the noise barrier proposed in the scheme. Without the barrier some facades of properties in this area would experience a moderate increase in traffic noise in the short term.

In the short term all the non-residential sensitive receptors are predicted to experience a negligible increase in traffic noise levels, with the exception of Bethesda Chapel which is directly on Eglwys Brewis Road, and therefore experiences a minor reduction in the short term.

In the long term (2019 DM to 2039 DS) just over 90% of residential properties are predicted to experience a negligible (0.1 to 2.9 dB) or minor (3.0 to 4.9 dB) increase in traffic noise. 9% experience a moderate increase (5.0 to 9.9 dB) and five properties a major increase (≥10%). A single property on Eglwys Brewis Road is predicted to experience a negligible reduction in the long term.

The moderate increases at 173 properties are concentrated in the residential area south of Eglwys Brewis Road, away from the immediate vicinity of Eglwys Brewis Road. A small number of properties at the western end of the scheme on the B4365 also experience a moderate increase at the worst affected façade. It should be noted that, as detailed in Section 7.2, 139 properties are predicted to experience a moderate increase in traffic noise in the long term in the absence of the scheme, due to the large growth in traffic between 2019 and 2034.

As would be expected the major increases in the long term are predicted at the very closest properties to the scheme Rose Cottage, Froglands Farm, Old Froglands, Millands Farm and one property at the Millands Mobile Home Park. As for the short term changes discussed above it is worth noting that the assessment is based on the façade which experiences the worst case change. For example, at Old Froglands the long term increase at the south-east facades is negligible at < 3 dB, whereas on the north-west facades facing the scheme the increases are around 11-12 dB. At Millands Mobile Home Park the majority of facades experience an increase of around 6-8 dB in the long term. At Millands Farm the increase ranges from around 7 to 10 dB in the long term, 10 to 14 dB at Froglands Farm and 6 to 19 dB at Rose Cottage.

At night in the long term 31 of the 32 properties considered in the night time assessment experience a negligible increase, with one on Eglwys Brewis Road experiencing a negligible decrease.

In the long term all the non-residential sensitive receptors are predicted to experience a negligible or minor increase in traffic noise levels.

The worst case increase in annoyance is over 40% at a single property Rose Cottage. At a further 6 properties the worst case increase in annoyance is 30-40% consisting of Froglands Farm, Old Froglands, Millands Farm, Oakwood and two properties at the mobile home park.

As detailed in the introduction and the baseline Section 7.2 it should be noted that the 3000 business park jobs included in the 2034 traffic data is the maximum permissible number of jobs at the business park. Furthermore the housing developments included in the traffic data are not committed developments. This assessment is therefore considered to be a worst case scenario and the actual increase in traffic volumes from 2019 to 2034 may be less than assumed, either with or without the scheme. In addition, the presence of the housing developments may also provide very effective shielding of some receptors such as the Millands Mobile Home Park.

The results of the baseline noise survey, as detailed in Section 7.1 illustrate that at some times noise sources other than road traffic i.e. noise associated with activities and aircraft from the RAF base, are a significant source in the area. It is not possible to accurately include these other noise sources in the noise modelling process, therefore the low do-minimum noise levels at locations along the route of the scheme reported in the traffic noise predictions are an underestimate of the actual ambient noise climate at some times. This means the reported traffic noise changes due to the operation of the scheme are likely to be a worst case at receptors along the scheme as overall do-minimum noise levels are not always as low as predicted in the traffic noise model.

9.2.1 *Airborne Vibration Annoyance*

A summary of the change in annoyance due to airborne vibration from road traffic in the long term from the DM 2019 to DS 2034 is provided in Table 17. A total of 9 residential properties have been identified within 40 m of the proposed scheme, these consist of Froglands Farm, Rose Cottage and seven properties on the eastern edge of Llantwit Major which are just within 40m of the realigned B4265 at the junction with the scheme.

Table 17. Long-term Change in Traffic Vibration Annoyance (DM 2019 to DS 2034)

Change in % Annoyed		Daytime
		Number of Residential Buildings
Increase in annoyance level	<10%	9
	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0
No Change	0	0
Decrease in annoyance level	<10%	0
	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0

Due to the relatively low absolute traffic noise levels in the study area all nine properties fall within the <10% increase in annoyance band for vibration

9.2.2 *Buildings Qualifying for Noise Insulation*

A preliminary assessment of residential buildings which may qualify for noise insulation under the NIR has not identified any properties which are likely to qualify under the regulations. However, as detailed in Section 3.4, a complete assessment under the NIR is beyond the scope of the assessment at this stage.

9.2.3 *Impacts Upon Priority Areas*

There are no priority areas located in the vicinity of the Scheme.

10. SIGNIFICANCE OF EFFECTS

10.1 Construction

Given the very close proximity of receptors of high sensitivity to the proposed scheme, there is the potential for major adverse construction noise impacts at the closest receptors. The significance of the effect would, therefore, be classed as large adverse (in accordance with Table 9).

There is the potential for construction vibration annoyance impacts, due to the compaction of earthworks using vibrating rollers, at the very closest residential receptors of moderate magnitude, therefore, the significance of the temporary effect is classed as moderate adverse.

The risk of construction vibration induced building damage due to such works is considered to be very low, therefore the significance of the effect is classed as neutral.

Based on the currently available information on construction traffic volumes, the magnitude of the likely impact on existing traffic noise levels along the B4265 and Eglwys Brewis Road is negligible, therefore, the significance of the temporary effect at nearby residential properties is classed as slight adverse.

On the basis of the information available at this time it is not possible to provide a quantitative prediction of absolute levels of noise, vibration and air overpressure from blasting works. In lieu of this it is preferential to carry out blasting operations using the best practical means available to ensure that the resultant noise, vibration and air overpressure are minimised.

With appropriate design by suitably qualified blasting contractors, the guideline values detailed in Section 3.3 should be achievable. On this basis, the magnitude of impact due to blasting is classed as minor and the significance of effects is classed as temporary slight adverse for all affected receptors.

10.2 Operation

In the short term (2019 DM to 2019 DS) the magnitude of the impact of the scheme at the majority of residential properties (77%) is negligible or minor. At residential properties, which are ranked as of high sensitivity, the significance of the effect is therefore classed as slight adverse. At four properties the magnitude of the impact is moderate, resulting in a moderate adverse effect and at three properties major, resulting in a large adverse effect. A negligible or minor reduction in traffic noise levels in the short term is predicted at 7% of residential properties, resulting in a slight beneficial effect. 15% of properties experience no change in traffic noise levels and therefore a neutral effect. The majority of non- residential sensitive receptors experience a slight adverse effect in the short term.

In the long term (2019 DM to 2034 DS) the magnitude of the impact at the majority of residential properties (just over 90%) is negligible or minor, resulting in a slight adverse effect. At 9% of properties a moderate increase in traffic noise levels is predicted in the long term resulting in a moderate adverse effect. At four properties a major increase in traffic noise is predicted resulting in a large adverse effect in the long term. At a single property a negligible reduction in traffic noise levels is predicted in the long term, resulting in a slight beneficial effect. All the non- residential sensitive receptors experience a slight adverse effect in the long term.

11. MITIGATION REQUIREMENTS

11.1 Construction

At this stage there is insufficient information available regarding the construction phase to undertake a quantitative assessment of construction noise and vibration impacts. Therefore, specific mitigation measures beyond standard best practice (as outlined in Section 8) have not been proposed.

It should be noted that the proposed noise barrier located to the west of the scheme at the top of the B4265 cutting (as detailed in Section 8) shall be installed as part of a phase of advance works programmed for construction during the winter 2017/2018 prior to construction of the road starting in May 2018. This will help to mitigate the noise impact to nearby residents during construction and will also allow vegetation affected by the works to re-establish prior to the road opening.

The requirement for further additional construction phase mitigation measures will be considered once a contractor is appointed. If required by the Vale of Glamorgan Council,

conditions could be applied to any planning permission which would provide an effective means of controlling construction noise and vibration effects.

11.2 Operation

Mitigation in the form of low noise surfacing and noise barriers has been incorporated into the scheme design as detailed in Section 8.

12. SIGNIFICANCE OF RESIDUAL EFFECTS

12.1 Construction

Given that no further construction phase mitigation measures have been defined, residual effects remain as described in Section 10.

12.2 Operation

No additional noise mitigation measures beyond the low noise surfacing and noise barriers incorporated into the scheme design are proposed. Therefore, the significance of residual noise effects remains as described in Section 10.

13. SUMMARY OF KEY EFFECTS

13.1 Construction

Given the very close proximity of receptors of high sensitivity to the proposed scheme, there is the potential for large temporary adverse effects at such properties due to construction noise.

There is the potential for moderate construction vibration annoyance effects, due to the compaction of earthworks using vibrating rollers, at the very closest residential receptors. The risk of construction vibration induced building damage due to such works is considered to be very low.

Based on the currently available information on construction traffic volumes, the significance of the temporary effect at nearby residential properties is classed as slight adverse.

It is not possible to provide a quantitative prediction of absolute levels of noise, vibration and air overpressure from blasting works at this time. In lieu of this it is preferential to carry out blasting operations using the best practical means available to ensure that the resultant noise, vibration and air overpressure are minimised.

With appropriate design by suitably qualified blasting contractors, the guideline values detailed in Section 3.3 should be achievable. On this basis, the significance of effect is classed as temporary slight adverse for all affected receptors.

13.2 Operation

In the short term (2019 DM to 2019 DS) a slight adverse effect is predicted at the majority of the 1878 residential receptors in the study area due to the operation of the scheme. At seven properties located in close proximity to the scheme the adverse effect is moderate or large. A slight beneficial effect is predicted at 7% of properties, concentrated along Eglwys Brewis Road as traffic transfers to the scheme. 15% of properties experience no change in traffic noise levels and therefore a neutral effect.

The absolute traffic noise levels in 2019 at the closest properties to the scheme are low, both with and without the scheme. With the scheme in place traffic noise levels at the most exposed facades are generally in the high 40 to mid 50 dB $L_{A10,18h}$ range at these properties.

In the long term (2019 DM to 2034 DS) a slight adverse effect is predicted at the majority of receptors. At 173 properties a moderate adverse effect is predicted, though it is noted that even in the absence of the scheme (2019 DM to 2034 DM) 139 properties are predicted to experience a moderate adverse effect in the long term. A large increase in traffic flows from 2019 to 2034 is assumed in the traffic data both with and without the scheme. At four properties at the closest approach to the scheme a major adverse effect is predicted in the long term due to the scheme.

The long term traffic noise changes should be treated with caution for a number of reasons including:

- the inclusion in the 2034 traffic data of the maximum permissible 3000 jobs in the business park and the inclusion of non-committed housing developments, whereby the actual increase in traffic volumes from 2019 to 2034 may be significantly less than the assumed increase ;
- the shielding which would potentially be provided by these housing developments; and
- the influence of other non-traffic noise sources in the area associated with the RAF base which cannot be included in the do-minimum noise predictions and therefore ensure the reported traffic noise changes are a worst case.

The assessment includes the benefit of a number of noise barriers located along the scheme in the vicinity of the closest receptors and at the western end of the scheme where the B4265 is realigned. A low noise surface is also proposed for the scheme. In accordance with current guidance no benefit from a low noise surface is included in the predictions due to the traffic speed on the scheme, however some benefit is likely to occur in reality.

APPENDIX A NOISE AND VIBRATION TERMINOLOGY

Noise

Between the quietest audible sound and the loudest tolerable sound there is a million to one ratio in sound pressure (measured in pascals, Pa). Because of this wide range a noise level scale based on logarithms is used in noise measurement called the decibel (dB) scale. Audibility of sound covers a range of approximately 0 to 140 dB.

The human ear system does not respond uniformly to sound across the detectable frequency range and consequently instrumentation used to measure noise is weighted to represent the performance of the ear. This is known as the 'A weighting' and annotated as dB (A). Table A.1 below lists the sound pressure level in dB (A) for common situations. Unweighted levels are annotated as dB or dB(lin) and are commonly used with regard to air overpressure from blasting.

Table A.18. Sound Pressure Levels for a Range of Situations

Typical Noise Levels dB(A)	Example
0	Threshold of hearing
30	Rural area at night, still air
40	Public library Refrigerator humming at 2 m
50	Quiet office, no machinery Boiling kettle at 0.5 m
60	Normal conversation
70	Telephone ringing at 2 m Vacuum cleaner at 3 m
80	General factory noise level
100	Pneumatic drill at 5m
120	Discotheque - 1m in front of loudspeaker
140	Threshold of pain

The noise level at a measurement point is rarely steady, even in rural areas, and varies over a range dependent upon the effects of local noise sources. Close to a busy road, the noise level may vary over a range of 5 dB(A), whereas in a suburban area this may increase up to 40 dB(A) and more due to the multitude of noise sources in such areas (cars, dogs, aircraft etc.) and their variable operation. Furthermore, the range of night time noise levels will often be smaller and the levels significantly reduced compared to daytime levels.

The equivalent continuous A-weighted sound pressure level, L_{Aeq}, is the single number that represents the average sound energy measured over that period. The L_{Aeq} is the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period.

With regards to road traffic noise the parameter L_{A10} is prescribed by the relevant guidance and legislation. L_{A10} is the noise level exceeded for 10% of the measurement period. The

$L_{A10,18h}$ is defined in the Calculation of Road Traffic Noise as the arithmetic average of the individual 1 hour $L_{A10,1h}$ levels between 06:00 - 00:00.

A parameter that is widely accepted as reflecting human perception of the ambient noise is the background noise level, L_{A90}. This is the noise level exceeded for 90 % of the measurement period and generally reflects the noise level in the lulls between individual noise events. Over a one hour period, the L_{A90} will be the noise level exceeded for 54 minutes.

The L_{AFmax} noise level is a measure of the maximum noise level during the monitoring period.

Measurements using a sound level meter can be Fast (F), Slow (S), or Impulse (I) time weighted. These weightings date back to when sound level meters had analogue meters and defined the speed at which the meter moved. Fast corresponds to a 125 ms time constant. Slow corresponds to a 1 second time constant. Impulse has a time constant of 35 milliseconds. For the vast majority of environmental noise monitoring situations the standard approach is to use the Fast time weighting.

Human subjects are generally only capable of noticing changes in steady levels of no less than 3 dB(A). It is generally accepted that a change of 10 dB(A) in an overall, steady noise level is perceived to the human ear as a doubling (or halving) of the noise level. (These findings do not necessarily apply to transient or non-steady noise sources such as changes in noise due to variation in road traffic flows, or intermittent noise sources).

Most environmental noise measurements and assessments are undertaken for 'free-field', away from any existing reflecting surfaces (other than the ground). However, it is sometimes necessary to consider noise levels immediately external to a façade when considering the impact on residents inside properties and this requires the addition of 3 dB(A) to the predicted (or measured) free-field level due to noise reflection from the façade.

Vibration

BS 5228-2 advises that vibrations, even of very low magnitude can be perceptible to people. It is often assumed that if vibration can be felt then building damage will occur, however much higher levels of vibration are required to damage buildings. Therefore vibration from construction works can cause anxiety as well as annoyance. Some individual are more sensitive to vibration than others.

Vibration from construction is commonly described in terms of the Peak Particle Velocity (PPV) measured in mms^{-1}. This is a measurement of the maximum ground particle movement speed during a given time interval. If measurements are made in 3-axis then the resultant ppv is the vector sum = the square root of the summed squares of the maximum velocities, regardless of when in the time history those occur.

Air Overpressure

Vibration in the atmosphere is generated as a pressure wave, heard as noise (at above 20Hz) and felt as concussion. Both the noise and the concussion can cause a structure to vibrate.

APPENDIX B NOISE MODELLING

Data Used

- OS mastermap: provided by Welsh Government: file 'OSMM_TopoLine_v1_pl.dbf' 06/10/16
- OS addressbase plus land use data and building heights: provided by Welsh Government and processed by AECOM Cardiff office: file 'Addressbase_AECOM_Master.xlsx' 30/11/16
- Existing topographic survey: file 'St Athan NAR_TOPO_200 Scale_Oversized Sheet_3D.dxf' 04/10/16.
- Existing wider area ground heights: Lidar spot height provided by Welsh Government and processed by AECOM Cardiff office into 1m contours: file 'contours_1m_v2_pl.dbf' 14/10/16. Noise team filtered to 0.06m.
- 3D Scheme design: file 'St Athan Design plan for NOISE MODEL 01-03-2017 A.dwg' 01/03/17
- Road surfacing existing: assumed to be standard HRA on all roads
- Road surfacing proposed: assumed to be standard HRA on all existing roads, low noise surfacing on the scheme
- Traffic data: file 'Noise & Air Traffic Flows 11-11-2016.xlsx' provided by White Young Green 11/11/16

Modelling Assumptions

- Ground absorption: 0.75 for wider study area, 0.0 for road surfaces industrial areas and water bodies, 0.25 for suburban areas.
- Building heights generally standardized to 4 m: 1 storey 6 m: 2 storey, 9 m: 3 storey etc. based on initial information from OS building heights. Garage and small outbuildings assumed to by 2m. Some adjustments required to estimate missing and incorrect heights.
- Road surfacing existing: assumed to be standard HRA on all roads
- Road surfacing proposed: assumed to be standard HRA on all existing roads, low noise surfacing on the scheme
- Road surfacing corrections:
  - Standard HRA speed <75 km/hr -1 dB, speed ≥75 km/hr 0 dB;
  - New low noise thin surfacing speed <75 km/hr -1 dB, speed ≥75 km/hr -3.5 dB.
- 5 m x 5 m grid used to produce noise change contour plots at height of 4 m above ground

APPENDIX C BASELINE NOISE MONITORING DETAILS

Table C.19. Baseline Noise Survey Instrumentation

Location	Meter /Calibrator	Manufacturer	Type	Serial Number
M1, M5	25a	Rion	NL52	00654034
M2, M3	22	Rion	NL52	01021278
M4, M6	26	Rion	NL52	01021282
M1, M5	8	Rion	NC-74	34425536
M2, M3	10	Rion	NC-74	34425538
M4, M6	11	Rion	NC-74	34425539

Table C.20. Baseline Noise Monitoring 25/11/16 Hourly Data

Location	Time	$L_{Aeq,T}$ dB*	$L_{AF,max}$ dB	$L_{A90,T}$ dB#	$L_{A10,T}$ dB#
M1	10:00-11:00	57	71	47	61
	11:00-12:00	56	79	45	60
	12:00-13:00	58	79	45	61
	Average 3 hours	57	-	46	61
M2	10:00-11:00	55	79	42	56
	11:00-12:00	55	77	42	52
	12:00-13:00	51	77	39	52
	Average 3 hours	54	-	41	53
M3	14:00-15:00	56	88	37	50
	15:00-16:00	53	79	37	50
	16:00-17:00	51	78	37	49
	Average 3 hours	54	-	37	50
M4	10:00-11:00	65	94	44	60
	11:00-12:00	65	90	42	60

	12:00-13:00	55	75	42	59
	Average 3 hours	64	-	43	59
M5	14:00-15:00	60	83	39	65
	15:00-16:00	60	77	37	66
	16:00-17:00	60	74	36	65
	Average 3 hours	60	-	37	65
M6	14:00-15:00	58	72	43	63
	15:00-16:00	58	74	41	63
	16:00-17:00	57	76	40	63
	Average 3 hours	58	-	41	63

* Logarithmic average
# Arithmetic Average

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Contact
Rhys Mander
Associate
T +44 (0)29 2067 4600
E rhys.mander@aecom.com

1 Callaghan Square
Cardiff
CF10 5BT
United Kingdom