8 Noise and Vibration

This chapter considers the potential noise and vibration impacts of the proposed scheme on noise sensitive receptors (NSRs).

The study area and calculation area were determined using Design Manual for Roads and Bridges (DMRB) guidance. Noise modelling was undertaken for all NSR, noise sensitive committed developments and noise sensitive amenity areas within the defined calculation area.

As part of the assessment a baseline noise survey was undertaken at seven identified NSRs to gain an understanding of the existing noise climate within the vicinity of the proposed scheme.

For the purposes of this assessment and when identifying mitigation requirements, impacts were considered to be 'significant' where the significance of impact was assessed to be Slight/Moderate adverse or higher and where the predicted absolute noise level exceeds 59.5dB $L_{A10,18h}$ at ground floor level. For night-time noise levels impacts were considered to be 'significant' where the significance of impact was assessed to be Slight/Moderate adverse or higher significance and where the predicted absolute noise level exceeds 55.0dB $L_{night,outside}$ at ground and/or first floor level.

In the Do-Minimum scenario (i.e. if the proposed scheme were not to go ahead), the operational noise assessment indicates that in the long-term during daytime there are no NSRs predicted to experience a noise impact of Slight/Moderate Adverse significance or higher, and therefore no NSRs were considered to be significantly affected.

In the Do-Something scenario (i.e. if the proposed scheme were to go ahead), the operational noise assessment indicates that in the short-term at ground floor level there are 347 dwellings and two other NSRs predicted to have a residual impact of Slight/Moderate Adverse significance or higher based on the receptor point with the least beneficial change in noise level. When considering all receptor points around the NSR, 11 were considered to be significantly affected as the absolute noise level was greater than 59.5dB $L_{A10,18h}$. In addition, a committed development under construction at the time of writing (Culloden House Care Home) was considered to be significantly affected as a residual impact of Slight/Moderate Adverse significance or higher, and absolute noise level greater than 59.5dB $L_{A10,18h}$, were predicted within the development site.

In the Do-Something scenario, the operational noise assessment indicates that in the long-term during daytime, at ground floor level there are 11 dwellings predicted to have a residual impact of Slight/Moderate Adverse significance or higher. Of these NSRs, one was considered to be significantly affected (Drumossie Cottage) as the absolute noise level was greater than 59.5dB $L_{A10,18h}$.

In the Do-Something scenario, the operational noise assessment indicates that in the long-term during night-time, at ground floor level there is one NSR (Drumossie Cottage) predicted to have a residual impact of Slight/Moderate Adverse significance or higher and an absolute noise level of greater than 55.0dB $L_{night,outside}$, and is therefore considered to be significantly affected.

As the significantly affected NSRs are not directly adversely affected by noise from the proposed scheme and mitigation was not considered to be reasonably practicable, receptor specific mitigation has not been proposed for these NSRs.

An indicative assessment of potential eligibility for noise insulation for all existing residential properties under the Noise Insulation (Scotland) Regulations (NISR) was also undertaken. The results indicated that 10 NSR may meet the eligibility requirements. A full NISR noise impact assessment is required within 12 months of the proposed scheme opening and again in the fifth, tenth and fifteenth year after the year of opening to determine whether any residential properties qualify for statutory noise insulation.

In addition, results for the predicted noise impacts at first floor level for all NSR are reported in full within the chapter. As required by DMRB the results of the noise nuisance and vibration nuisance are also reported.

8.1 Introduction

8.1.1 This chapter presents the Design Manual for Roads and Bridges (DMRB) Stage 3 Environmental Impact Assessment Report (EIAR) of potential noise and vibration impacts as a result of construction and operation of the A9/A96 Inshes to Smithton scheme (hereafter referred to as the proposed scheme). The chapter is supported by the following appendices, which are cross-referenced in the text where relevant:

- Appendix A8.1: Noise and Vibration Terminology;
- Appendix A8.2: Detailed Baseline Noise Survey Results and Notes;

- Appendix A8.3: Predicted Noise Levels at Noise Sensitive Receptors;
- Appendix A8.4: Wider Road Network Assessment;
- Appendix A8.5: Noise Impacts on Committed Developments;
- Appendix A8.6: Noise Impacts on Amenity Areas; and
- Appendix A8.7: Noise Sensitive Receptors Nearest to Construction Works.

8.1.2 The assessment of potential noise and vibration impacts associated with the proposed scheme has been undertaken in accordance with the Detailed Assessment Methodology of DMRB Volume 11, Section 3, Part 7 HD 213/11 Revision 1 Noise and Vibration (Highways Agency Transport Scotland, Welsh Government and The Department for Regional Development Northern Ireland 2011) (hereafter referred to as DMRB Noise and Vibration). Road traffic noise levels were predicted in accordance with the guidance contained in the Department of Transport Welsh Office publication: Calculation of Road Traffic Noise (CRTN, The Department of Transport 1988) and supplemented with the additional guidance contained in Annex 4 of DMRB Noise and Vibration.

8.1.3 To assist in the understanding of the noise assessment it is useful to consider the units of noise and how noise is described quantitatively.

8.1.4 The World Health Organisation (WHO 1999) defines noise as unwanted sound, and sound is measured in terms of decibels (dB). The decibel is not an absolute unit of measurement; it is a ratio between a measured quantity and an agreed reference level. The measured quantity is the variation in atmospheric pressure and the reference level is taken as the lowest pressure to which a healthy ear is able to hear as sound, i.e. 2 x 10^{-5} Pascal's (20μPa). It should be appreciated that whilst the audible range of hearing extends from 20 Hertz (Hz) to 20,000Hz, human hearing is not equally sensitive to sound across this range of frequencies and therefore corrections or 'weightings' are applied to the measured linear levels to simulate the response of the ear. The A-weighting is most often used to represent the response of the ear to environmental noise. When considering noise levels, it may be of assistance to note that doubling or halving of the traffic flow is equivalent to a change of approximately 3dB(A), and a subjective impression of a doubling of loudness generally corresponds to a 10dB(A) sound level increase. Given that noise is assessed as a logarithmic ratio of pressure levels it is often useful to consider the relationship between the subjective evaluations of objective noise levels as shown in Table 8.1.

Table 8.1: Typical Noise Levels and Subjective Evaluation

A-weighted Noise Level L_A (dB)	Description
120	Threshold of Pain
100	Diesel drop hammer at 10m distance
95	Pneumatic drill (unsilenced) at 7m distance
85	Heavy diesel lorry (travelling at 40km/h) at 7m distance
85	Jet aircraft take-off at 150m distance
70	Passenger car (travelling at 60km/h) at 7m distance
65	Train (travelling at 40km/h) at 25m distance
60	Busy general office
55	Communication starts becoming difficult
40	Quiet library
35	Typical bedroom
20	Leaves rustling lightly
0	Threshold of hearing

Road Traffic Noise

8.1.5 In terms of road traffic noise, it is useful to understand the causes of noise associated with a flow of road traffic vehicles.

8.1.6 Road traffic noise can be separated into two main components. The first is generated by the engine, exhaust system and transmission, and is the dominant noise source when traffic is not freely flowing. This is particularly apparent from heavy good vehicles (HGV), when accelerating, braking or changing gears and this contributes a significant proportion of low frequency noise. The second noise source component is generated from the interaction of tyres with the road surface and is the dominant noise source under free flow traffic conditions at moderate to high road speeds and contributes a significant proportion of higher frequency noise.

8.1.7 The noise from a stream of traffic at a receptor point is an aggregation of noise from each of a number of vehicles at various distances. There are several factors that influence the noise level experienced at a receptor point and these can be separated into two categories. Firstly, there are factors that affect the noise emissions at source, such as traffic volume, speed and composition (i.e. the percentage of HGVs), the gradient of the carriageway and the surface characteristics of the carriageway. Secondly there are those factors affecting the propagation characteristics, such as the distance of the receptor from the source, the topography and characteristics of the ground between the source and receptor, the presence of any screening or barrier effects and the wind strength and direction.

Measurement of Road Traffic Noise

8.1.8 Noise from traffic on a road will change as traffic flows alter during the day and will also fluctuate within shorter time periods as vehicles pass the reception point. In order to compare situations with different traffic noise levels it is necessary to use an index to produce single figure estimates of overall noise levels. The metric used for road traffic noise is $L_{A10,18h}$ which is the arithmetic mean value of the A-weighted noise levels, which are exceeded for 10% of the time in each of the 18 one-hour periods between 06:00 hours and 00:00 hours. Paragraph A3.11 of DMRB Noise and Vibration advises that a reasonably good correlation has been shown to exist between traffic noise levels expressed in $L_{A10,18h}$ and residents' dissatisfaction with the noise over a wide range of values.

Road Traffic Vibration

8.1.9 Traffic induced vibration is a low frequency disturbance which can be transmitted through the air or ground. Air-borne vibration from traffic is produced by the engine and exhaust of the vehicle, whereas ground-borne vibration is produced by the interaction between rolling wheels and the road surface.

8.1.10 There are two potential effects of traffic vibration that need to be considered: the effects on buildings, and the disturbance caused to occupiers of properties. Extensive research has been carried out on a range of buildings of various ages and types, and no evidence has been found to support the theory that traffic-induced ground-borne vibration is a source of significant damage to buildings (Watts 1990). As such, ground-borne vibration is not assessed in this chapter. Ground-borne vibration is much less likely to be the cause of disturbance to occupiers than airborne vibration (Baughan & Martin 1981; Watts 1984). DMRB Noise and Vibration states (paragraph 3.32):

> *'Normal use of a building such as closing of doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to those from road traffic'.*

8.1.11 In addition, there is no evidence that traffic induced airborne vibration can cause even minor damage to buildings. However, it can be a source of annoyance to nearby residents, causing vibrations of flexible built elements within the building (such as doors, windows and, on occasions, floors) of properties close to the carriageway. Accordingly, the issue of DMRB Noise and Vibration defined nuisance at properties caused by road traffic induced airborne vibration has been evaluated.

Legislative and Policy Background

8.1.12 The assessment of potential noise and vibration impacts has been carried out with reference to the following documents:

- DMRB Volume 11 Section 3 Part 7 (HD 213/11 – Revision 1 Noise and Vibration) (Highways Agency et al 2011);
- CRTN (Department of Transport Welsh Office 1988);
- The Noise Insulation (Scotland) Regulations (NISR);

- Memorandum on the Noise Insulation (Scotland) Regulations (NISR Memorandum);
- The Environmental Noise (Scotland) Regulations;
- Control of Pollution Act 1974;
- Planning Advice Note (PAN) 1/2011– Planning and Noise (The Scottish Government 2011a);
- Technical Advice Note (TAN) – Assessment of Noise (The Scottish Government 2011b);
- BS 5228:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' Part 1 - Noise and Part 2 – Vibration (BSI 2014);
- WHO Guidelines for Community Noise (WHO 1999);
- WHO Night Noise Guidelines (NNG) for Europe (WHO 2009); and
- WHO Environmental Noise Guidelines for the European Region (WHO 2018) (discussed further in paragraph 8.2.38).

8.1.13 In addition, a review of relevant national, regional and local planning policies and guidance relevant to noise and vibration are identified in Chapter 18 (Policies and Plans).

8.2 Methodology

Scope of Assessment (Study Area)

8.2.1 The assessment study area has been determined in accordance with paragraph A1.11 of DMRB Noise and Vibration, which sets out the procedure for defining the 'study area' and 'calculation area'. Figure 8.1 details both the study area and calculation area used for the noise and vibration impact assessment of the proposed scheme.

8.2.2 To define the calculation area and study area, a boundary is defined which extends 1km from the proposed new route and from existing routes that are being improved or bypassed (for example on the A9 Perth – Inverness Trunk Road and A96 Aberdeen – Inverness Trunk Road between Raigmore Interchange and where the A9 and A96 connect to the proposed scheme), between the start and end points of the physical works associated with the proposed scheme. Within the 1km boundary the calculation area is then defined as being the area that extends:

- 600m from existing and bypassed and/or improved routes or new routes; and
- 600m from any affected routes within the 1km boundary.

8.2.3 An affected route is defined as a road where there is a possibility of a 1dB $L_{A10,18h}$ or more change in noise levels as a consequence of the proposed scheme in the short-term or a 3dB $L_{A10,18h}$ or more change in the long-term. Roads where a change of at least 1dB is predicted to occur can be determined by considering changes in traffic flow; a 25% increase equates to an increase in noise of 1dB and a 20% decrease in the traffic flow equates to a decrease in noise of 1dB, assuming other factors such as speed, road surface, gradient and percentage of HGVs remain unchanged. Similarly, a change in noise level of 3dB $L_{A10,18h}$ would be equivalent to an increase in traffic flows of 100% or a decrease of 50%, assuming other factors remain unchanged.

8.2.4 The study area for the noise assessment is defined as the calculation area combined with a boundary 50m from the carriageways of affected roads beyond the calculation area.

8.2.5 Noise levels are calculated at all identified noise sensitive receptors (NSRs) within the calculation area. In addition, the predicted change in noise levels has also been assessed for:

- all identified noise sensitive committed developments (committed developments are extant planning applications that have been received or determined by the local planning authority in the last three years), which are also assessed in Chapter 15 (People and Communities – Community and Private Assets) and Appendix A15.5 (Planning Application and Development Land Assessment); and

- amenity areas (which include Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), core paths, National Parks, golf courses etc).

8.2.6 DMRB Noise and Vibration also requires an assessment of noise impacts be undertaken for the wider road network, based on calculation of Basic Noise Levels. The Basic Noise Level as defined in CRTN is *'The basic noise level at a reference distance of 10m away from the nearside carriageway edge is obtained from the traffic flow, the speed of the traffic, the composition of the traffic, the gradient of the road and the road surface*' (Department of Transport Welsh Office 1988). The wider road network relates to those roads beyond the calculation area but within the study area and the assessment is undertaken for affected roads (which are defined in paragraph 8.2.3).

8.2.7 DMRB Noise and Vibration also requires a qualitative assessment of any possible noise impacts for NSRs within the initial 1km boundary discussed in paragraph 8.2.2, but outwith the study area.

8.2.8 To obtain an overview of the existing ambient noise environment at NSRs within the vicinity of the proposed scheme, seven monitoring locations were identified for undertaking baseline noise level measurements. Ambient noise monitoring allows existing road traffic noise sources in addition to other sources of noise to be measured and observed prior to construction and operation of the proposed scheme. The measured noise levels are used to validate the noise model predictions. The monitoring locations were agreed with the Environmental Health Department of The Highland Council. These locations were considered to be representative of their surrounding locale.

Requirements of a DMRB Stage 3 Noise and Vibration Detailed Assessment

8.2.9 The assessment follows the detailed assessment methodology set out in DMRB Noise and Vibration and requires consideration of permanent impacts including traffic noise, traffic nuisance and traffic induced vibration, together with temporary and cumulative impacts of the proposed scheme.

8.2.10 To assess the potential permanent noise and vibration impacts, it is necessary to make comparisons of noise levels in the 'short-term' (the baseline year, which for this proposed scheme is 2022) and in the 'long-term' (the future assessment year, which for this proposed scheme is 2037).

8.2.11 When referring to the short-term and long-term, DMRB Noise and Vibration uses the terminology 'Do-Minimum' to refer to the existing road network should the proposed scheme not be built and 'Do-Something' when referring to the road network if the proposed scheme is built. The comparisons are as follows:

- Do-Minimum scenario in the baseline year (DM 2022) versus Do-Minimum scenario in the future assessment year (DM 2037);
- Do-Minimum scenario in the baseline year (DM 2022) versus the Do-Something scenario in the Baseline Year (DS 2022); and
- Do-Minimum scenario in the baseline year (DM 2022) versus the Do-Something scenario in the future assessment year (DS 2037).

Assessment of Construction Noise and Vibration Impacts

8.2.12 Guidance on the approach to control construction noise is contained within British Standard BS 5228:2009+A1:2014: Noise and Vibration Control on Construction and Open Sites – Part 1: Noise and Part 2: Vibration. It should be noted that previous versions of BS 5228 (Part 1:1997 and Part 4:1992) are still officially approved under Section 71 of the Control of Pollution Act 1974 via The Control of Noise (Codes of Practice for Construction and Open Sites) (Scotland) Order 2002. BS 5228-1:2009+A1:2014 states that '*Good relations with people living and working in the vicinity of site operations are of paramount importance*'. It suggests that the early establishment and maintenance of these relations throughout the contract would go some way to allaying people's concerns.

8.2.13 The standard also advises that it is not possible to provide detailed guidance for determining whether or not noise from a site would constitute a problem in a particular situation as a number of factors would affect the acceptability of the site noise and vibration. These factors are:

- site location;

- existing ambient noise and vibration levels;
- duration of site operations;
- hours of work;
- attitude to site operator; and
- noise and vibration characteristics.

8.2.14 The level of noise experienced by inhabitants in the vicinity would vary according to the following factors:

- sound power outputs of processes and plant;
- periods of operation of processes and plant;
- distance from source(s) to receiver(s);
- presence of screening by barriers;
- reflection of sound associated with topographical features;
- phasing/programming of demolition works;
- soft ground attenuation; and
- meteorological factors.

8.2.15 To facilitate accurate prediction of noise levels it is necessary to know working methods, timing and phasing of the works and the quantity and type of plant likely to be used. At this stage in the design development process such information is not available.

8.2.16 However, should the proposed scheme proceed and a contractor be appointed, a construction noise and vibration assessment is usually required. The provisions of Sections 60 and 61 of the Control of Pollution Act 1974 offer some protection to those living near the construction. Section 60 enables a local authority to serve a notice specifying its noise control requirements covering:

- plant or machinery that is or is not to be used;
- hours of working; and
- levels of noise or vibration that can be emitted.

8.2.17 Section 61 relates to prior consent and is for situations where a contractor or developer takes the initiative and approaches the local authority before work starts to obtain approval for the methods to be used and any noise and vibration control techniques that may be required.

8.2.18 With regard to construction noise impacts Annex E of BS 5228-1:2009+A1:2014 provides examples of criteria for the assessment of the potential significance of noise effects and the adoption of any of these examples should be fully justified.

8.2.19 BS 5228-2:2009+A1:2014 provides recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels, including industry specific guidance. With consideration to the nature and size of the proposed scheme as well as the likely construction processes, it is considered that any required blasting, piling or heavy earthmoving processes are the key construction activities that have the potential to give rise to significant vibration impacts.

8.2.20 In cognisance of the above, a qualitative assessment of potential construction noise and vibration impacts has been undertaken in order to determine the likely significance of noise impact associated with the construction of the proposed scheme based on the guidance above and using professional judgement.

8.2.21 Based on the principles of the Scottish Government's Technical Advice Note (TAN) (The Scottish Government 2011b) which accompanies PAN 1/2011 (The Scottish Government 2011a), the significance of noise impacts during construction was determined as follows:

- construction noise 10.0dB below ambient noise level = Neutral;
- construction noise between 9.9 to 0.1dB below ambient noise level = Slight adverse;
- construction noise between 0.0 to 4.9dB above ambient noise level = Slight/Moderate adverse;
- construction noise between 5.0 to 9.9dB above ambient noise level = Moderate/Large adverse; and
- construction noise greater than 10.0dB above ambient noise level = Large/Very Large adverse.

8.2.22 It should be noted that although a NSR may have a Significance of Impact of Slight/Moderate adverse or greater, this is not necessarily an indication of a significant construction noise impact as the methods for assessing potential significant impacts from construction noise in BS5228 are subject to exceedances of a noise level limit (BS 5228-1:2009+A1:2014, Section E.3, page 118) and are also dependent on the duration of the impact.

Operational Noise Impact Assessment

Predicting Noise Levels – Noise Modelling

8.2.23 All road traffic noise levels for the base, Do-Minimum and Do-Something scenarios are predicted using the CadnaA® noise modelling software, which predicts the $L_{A10,18h}$ traffic noise level at dwellings and other NSRs in accordance with CRTN and the supplementary CRTN guidance contained in DMRB Noise and Vibration. The base scenario includes the traffic flow information for 2018 and is used to compare predicted noise levels with measured noise levels.

8.2.24 Receptor points around buildings have been modelled at 5m intervals, 1m from the façade. In accordance with DMRB Noise and Vibration, where noise levels are predicted at different façades of dwellings and other buildings, the summary of assessment results report the least beneficial change in noise level. DMRB Noise and Vibration acknowledges that the results from this assessment may often show the worst case and highlight mainly the adverse impacts.

8.2.25 All modelled calculations are based on predicted traffic flows and associated variables in the form of 18-Hour Annual Average Weekday Traffic (AAWT) using traffic data modelled for the following scenarios, based on the latest available Moray Firth Transport Model (MFTM 2018):

- Base Model Traffic Data (BMTD 2018);
- Do-Minimum in the first full year of operation (DM 2022);
- Do-Something in the first full year of operation (DS 2022);
- Do-Minimum in the design year (DM 2037); and
- Do-Something in the design year (DS 2037).

8.2.26 The prediction methodology of CRTN has a lower validity range of 1,000 vehicles per weekday (06:00 – 00:00 hours). Therefore, roads which have very low traffic flow for all scenarios have been excluded from the noise assessment. Roads which have traffic flow of greater than 1,000 vehicles in at least one scenario have been included in the noise assessment, as excluding these roads in only certain scenarios is likely to exaggerate any predicted adverse or beneficial impacts.

8.2.27 It should be noted that the terminology used when referring to the MFTM is different from the terminology used in DMRB Noise and Vibration. Accordingly, where the MFTM refers to the 'first full year of operation' this is equivalent to the term 'baseline year' in DMRB Noise and Vibration, and where the MFTM refers to a 'design year' this is the equivalent of the 'future assessment year' in DMRB Noise and Vibration.

8.2.28 Additional CadnaA® noise model input data and assumptions include:

- Road speeds in kilometres per hour (km/h).

- HGV percentages.
- Existing topography for the calculation area comprising survey data undertaken for the proposed scheme and supplemented with a 3D digital terrain model (DTM) using 5m resolution height data.
- Proposed topography (3D DTM data taken from the proposed scheme design).
- Existing road surface types for the baseline year and future assessment year are assumed to be impervious bitumen, such as hot rolled asphalt (HRA), with 2mm texture depth, with the exception of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme which is assumed to be surfaced with low noise road surfacing (LNRS).
- For the proposed scheme, it has been assumed that HRA would be used.
- Conventional HRA surfacing of 2mm texture depth is assumed to have a surface correction of 0dB(A) at speeds where the mean traffic speed is ≥ 75km/h and -1dB(A) where the mean traffic speed is <75km/h (paragraph 16 of CRTN).
- New LNRS is assumed to have a surface correction of -3.5dB(A) at speeds where the mean traffic speed is ≥75km/h and -1dB(A) where the mean traffic speed is <75km/h (paragraphs A4.26 and A4.29 of DMRB Noise and Vibration). There is a separate correction in DMRB Noise and Vibration for existing LNRS; it is assumed that the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme will have been recently opened in the baseline year, and therefore the new LNRS surface correction is more appropriate.
- Ground absorption factor: for open land and grassed areas (G=1); surfaces within residential areas (G=0.5) and roads and water (G=0).
- Existing buildings are assumed to be 8m high, equivalent of a two-storey building.
- Small buildings, defined as those which have a total footprint area of less than 25m^2 are not included in the noise model.

Significance of Impacts

8.2.29 It should be noted that whilst DMRB Noise and Vibration provides guidance for the magnitude of noise level changes, it does not provide any guidance on assessing the significance of noise impacts. Accordingly, the reported noise impacts have been assessed using the significance of noise impact scale provided in the TAN which accompanies PAN 1/2011 together with the mitigation threshold in determining an overall significant effect. The significance of impact matrix, presented in Table 8.5, is based on the predicted noise levels, the magnitude of noise level change between each scenario (based on the magnitude of impact tables of DMRB Noise and Vibration) and the sensitivity of NSRs (presented in the TAN).

Sensitivity of Noise Sensitive Receptors

8.2.30 The sensitivity of NSRs to road traffic noise has been determined based on the criteria provided in Table 8.2 (reproduced from TAN Table 2.1, Scottish Government 2011b).

Table 8.2: Criteria used to Define Noise Sensitive Receptors

Sensitivity	Description	Examples of Receptor Usage
High	Receptors where people or operations are particularly susceptible to noise	• Residential, including private gardens where appropriate • Quiet outdoor areas used for recreation • Conference facilities • Theatres/Auditoria/Studios • Schools during the daytime • Hospitals/residential care homes • Places of worship
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance	• Offices • Bars/Cafes/Restaurants where external noise may be intrusive • Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls)

Sensitivity	Description	Examples of Receptor Usage
Low	Receptors where distraction or disturbance is minimal	• Buildings not occupied during working hours • Factories and working environments with existing high noise levels • Sports grounds when spectator noise is a normal part of the event • Night Clubs

Magnitude of Noise Impacts

8.2.31 In general, when considering two sounds with similar acoustic properties, i.e. similar spectral and temporal characteristics, a change of more than 3dB(A) is regarded as being just perceptible to the human ear. However, with respect to changes in road traffic noise levels, DMRB Noise and Vibration (paragraph 3.37) advises:

'*A change in road traffic noise of 1dB $L_{A10,18h}$ in the short-term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long-term (typically 15 years after project opening), a 3dB $L_{A10,18h}$ change is considered perceptible*.'

8.2.32 This highlights that people are more sensitive to abrupt changes in traffic noise associated with new road schemes than would be predicted from steady state evidence. In the period following a change in traffic flow, people may experience adverse or beneficial effects when the noise changes are as small as 1dB.

8.2.33 Section 3 of DMRB Noise and Vibration provides guidance on the magnitude of impacts for road traffic noise. The magnitude of impacts is considered for both the short-term and long-term. As stated above, a change in road traffic noise of 1dB $L_{A10,18h}$ in the short-term, for example, when a project is opened, is the smallest that is considered perceptible. In the long-term, a change in road traffic noise levels of 3dB $L_{A10,18h}$ is considered perceptible. The classification of noise impacts is detailed in Table 8.3 and Table 8.4, below reproduced from Table 3.1 and 3.2 of DMRB Noise and Vibration.

Table 8.3: Short-term Road Traffic Noise Level Magnitude of Impacts

Noise Level Change (rounded to 0.1dB) $L_{A10, 18h}$	Magnitude of Impact
0.0	No Change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0+	Major

Table 8.4: Long-term Road Traffic Noise Level Magnitude of Impacts

Noise Level Change (rounded to 0.1dB) $L_{A10, 18h}/L_{night,outside}$	Magnitude of Impact
0.0	No Change
0.1 – 2.9	Negligible
3.0 – 4.9	Minor
5.0 – 9.9	Moderate
10.0+	Major

8.2.34 DMRB Noise and Vibration does not differentiate between adverse and beneficial impacts. It is assumed that any increase in noise level would have an adverse impact while any decrease in noise level would have a beneficial impact.

Significance of Noise Impacts

8.2.35 The short and long-term significance of operational road traffic noise impacts are then determined according to the relationship between the magnitude of noise level change and the noise sensitivity of the receptor, as shown in Table 8.5 (based on TAN Table 2.6, Scottish Government 2011b).

Table 8.5: Significance of Noise Impacts

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

8.2.36 The EIA Regulations (refer to Chapter 5: Overview of Assessment Process) require consideration of the 'likely significant effects', but do not provide a definition of what constitutes a significant environmental effect as this is determined according to the environmental parameter under consideration, and in the context in which the relevant assessment is made. For the purposes of this assessment and when identifying mitigation requirements, impacts were considered to be 'significant' where the significance of impact was assessed to be Slight/Moderate Adverse or higher and where the predicted absolute noise level exceeds 59.5dB $L_{A10,18h}$ at ground floor level. For night-time noise levels impacts were considered to be 'significant' where the significance of impact was assessed to be Slight/Moderate Adverse or higher and where the predicted absolute noise level exceeds 55.0dB $L_{night,outside}$ at ground and/or first floor level. The reasoning for these absolute noise levels is discussed in more detail below.

Noise Mitigation Threshold Criteria

8.2.37 Mitigation would be implemented, where practicable, where the noise impact is of 'Slight/Moderate Adverse' or of higher significance at ground floor for either short and long-term impacts. This is an onerous target as mitigation would therefore be considered where there is an increase of 1dB or greater in the short-term (in recognition of the sudden change effects as reported within DMRB Noise and Vibration), or 3dB or greater in the long-term irrespective of the absolute existing ambient noise level, and should be applied with caution in areas where there are existing low levels of ambient noise.

8.2.38 For guidance on the effects of noise, reference can be made to the WHO document entitled 'Community Noise' (WHO 1999). It should be noted that the WHO have recently provided the 'Environmental Noise Guidelines for the European Region' (WHO 2018), which updates some of the guideline values for effects of noise. However, at the time of writing this EIAR, no guidance on the adoption of the WHO 2018 has been provided by Transport Scotland or the Scottish Government, therefore updated guidance (WHO 2018) has not been used in this assessment. Instead, reference is made to the 'Community Noise' (WHO 1999) document.

8.2.39 The 'Community Noise' document does not contain recommendations but provides guideline values based on the precautionary principle. The 'Community Noise' document states that:

> *'To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development'.*

8.2.40 The $L_{Aeq,T}$ noise index is the equivalent continuous A-weighted sound pressure level and is further defined in Appendix A8.1.

8.2.41 For the purposes of this noise assessment mitigation is considered where the noise level exceeds 55dB $L_{Aeq,T}$. 'Community Noise' refers to a daytime time base of 16 hours ($L_{Aeq,16h}$), and CRTN predictions are in terms of $L_{A10,18h}$. To convert the 'Community Noise' $L_{Aeq,16h}$ to $L_{A10,18h}$ a correction of approximately +2dB is required (Transport Appraisal Guidance Unit A3 (Department for Transport 2015), with a further +2.5dB necessary to translate into façade levels. When this conversion is applied to 55dB $L_{Aeq,16h}$, this results in an equivalent threshold façade level of 59.5dB $L_{A10,18h}$.

8.2.42 In addition, it is necessary that in all cases where it is considered, mitigation should comply with acceptable standards in terms of traffic, safety, environmental and economic issues (DMRB Volume 11, Section 3, Part 7, Chapter 4 – Design and Mitigation, paragraph 4.10). Considerations which could preclude the use of mitigation are disproportionate cost, unacceptable visual impact and road safety.

8.2.43 Due to the increasing use of the strategic road network by long distance goods traffic during night-time hours and the associated potential to increase the level of noise and the potential for disturbance at night, a night-time noise impact assessment is now to be considered as part of the DMRB Noise and Vibration assessment process where the noise level is greater than 55.0dB $L_{night,outside}$ in any scenario. The $L_{night,outside}$ noise metric is the free-field A-weighted average sound level over the 8 hour night-time period of 23:00 – 07:00 hours.

8.2.44 The Transport Research Laboratory (TRL) report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' (Abbott & Nelson 2002) has been used to derive the night-time noise levels for each scenario using Method 3 of the TRL report which converts the predicted daytime noise levels ($L_{A10,18h}$) to equivalent $L_{night,outside}$.

8.2.45 In summary, taking into account the above WHO and DMRB Noise and Vibration guidance, mitigation is considered where the significance of impact at a NSR has been assessed as Slight/Moderate Adverse or higher, **and** where the predicted façade level exceeds 59.5dB $L_{A10,18h}$ at ground floor level. In addition, mitigation taking cognisance of the WHO Night Noise Guidelines for Europe (WHO 2009) publication has also been considered during the night-time period in the long-term where the significance of impact at a NSR has been assessed as Slight/Moderate Adverse or higher, **and** where the predicted noise level exceeds 55.0dB $L_{night,outside}$ at ground and/or first floor levels.

8.2.46 In general, mitigation will be considered in terms of NSR specific measures that could comprise acoustic screens of various forms and/or revised earthworks. This can be summarised as shown in Table 8.6.

Table 8.6: General Aim of Measures Employed to Address Potential Noise Impacts

Type of Measure	Description
Prevent	Where practicable, road aligned to avoid closely populated areas
Reduce	Construction of noise barriers, earthwork bunds to reduce the predicted road traffic noise levels
Offset	A list of properties that may be eligible for noise insulation in terms of the NISR due to the increase in noise caused by the new road will be drawn up and assessed prior to construction.

Noise Nuisance Assessment

8.2.47 The term 'nuisance' is defined in paragraph A.5.3 of DMRB Noise and Vibration as '*the percentage of people bothered by traffic noise (i.e. those who say they are 'very much' or 'quite a lot' bothered on a four point scale*)', and should not be confused with statutory nuisance. The response to noise by individuals varies widely. However, average or community response is deemed to be relatively stable, with community average degree of annoyance, associated with long-term average exposure. Consequently, change in average noise emission levels between assessed scenarios, together with estimates of population density, based on residential property counts and assumptions on the numbers of residents per property, enable changes in estimated populations annoyed to be determined.

8.2.48 DMRB Noise and Vibration advises the following noise nuisance assessments should be undertaken:

- Do-Minimum scenario in the baseline year against Do-Minimum scenario in the future assessment year; and
- Do-Minimum scenario in the baseline year against Do-Something scenario in the future assessment year.

8.2.49 DMRB Noise and Vibration (paragraph A1.29) advises that the change in DMRB Noise and Vibration defined noise nuisance should be carried out for each property where noise calculations have been undertaken. Due to variability in individual responses, DMRB Noise and Vibration recommends that community annoyance ratings are used for each noise level. It is therefore important to note that the

results of the DMRB Noise and Vibration nuisance assessment should not be related to individual annoyance responses.

8.2.50 The method of assessing traffic noise and vibration nuisance is outlined in Annex 6 of DMRB Noise and Vibration.

Noise Insulation Assessment

8.2.51 Although it is not a requirement of DMRB Noise and Vibration, consideration has also been given to the number of properties that are likely to be eligible for statutory insulation. The NISR provide for acoustic insulation to be offered for residential properties. The qualifying criteria are detailed within the NISR and within the NISR Memorandum, Regulations 3 and 6. The qualifying criteria, which all must be met, are as follows:

- the properties are situated within 300m of the new or altered carriageway;
- the properties lie within the triangular area at the terminal point of the new road, the apexes of which are 50m along the centreline of the existing road form the terminal point of the bases of which extend from points 300m on either side of the road to the nearest point on the carriageway, at right angles to the centreline of the carriageway;
- a straight line can be drawn from any point of the property to a point on the carriageway without passing another building;
- the use of the road causes, or is expected to cause, noise at a level not less than 68dB(A); and
- the property will experience noise levels exceeding the 'prevailing noise level' by at least 1.0dB(A).

8.2.52 A full NISR noise impact assessment is required within 12 months of the proposed scheme opening and again in the fifth, tenth and fifteenth year after the year of opening to determine whether any residential properties qualify for statutory noise insulation.

Vibration Assessment

8.2.53 DMRB Noise and Vibration requires an assessment of traffic induced vibration, including an assessment of the numbers of people bothered by airborne vibration (ground-borne vibration has been scoped out as stated in paragraph 8.1.10). It should be appreciated that the vibration assessments are for comparison only and, as such, are not indicative of an individual's response. Also, only properties within 40m of carriageways of all modelled roads which have predicted or measured road traffic noise levels greater than 58dB $L_{A10,18h}$ are included in the vibration assessment. This is because the DMRB Noise and Vibration, vibration-bothered relationship is only validated up to a distance of 40m from carriageways (DMRB Noise and Vibration paragraph 3.46).

8.2.54 DMRB Noise and Vibration advises that the following vibration assessments are undertaken:

- Do-Minimum scenario in the baseline year against the Do-Minimum scenario in the future assessment year; and
- Do-Minimum scenario in the baseline year against the Do-Something scenario in the future assessment year.

Consultation

8.2.55 The Highland Council Environmental Health Department was consulted regarding the baseline noise survey. Both the noise monitoring locations and the noise measurement procedure were agreed with an Environmental Health Officer (EHO) from The Highland Council via email letter and phone call during January 2018, prior to the surveys commencing. Refer to Appendix 6.1 (Summary of Consultation Responses) of Chapter 6 (Consultation and Scoping) for further information.

Limitations of Assessment

8.2.56 The road traffic noise prediction methodology on which the NISR Memorandum is based has, through the publication of CRTN, been updated and improved. However, this update has yet to be

incorporated into either the NISR or NISR Memorandum. Indeed, DMRB Noise and Vibration notes that the NISR Memorandum methodology is to be used to determine NISR eligibility in Scotland. However, the prediction methodology employed in the DMRB assessment is based on the more detailed and accurate predictive methods set out in CRTN, supplemented with the additional guidance contained in Annex 4 of DMRB Noise and Vibration.

8.2.57 Therefore, to facilitate an indicative assessment of NISR noise insulation eligibility, a CRTN predicted level of $L_{A10,18h}$ 65dB has been used as a proxy for a NISR Memorandum predicted $L_{A10,18h}$ 68dB, in conjunction with the other qualifying criteria.

8.2.58 In addition, there are limitations with undertaking a construction noise impact assessment which are discussed further in Section 8.4 (Potential Impacts).

8.3 Baseline Conditions

8.3.1 The baseline noise monitoring locations (listed in a general south-west to north-east direction) are provided in Table 8.7 and also on Figure 8.2.

Table 8.7: Baseline Noise Monitoring Locations

ID	Address	Grid Reference	
		Easting	Northing
NV0001	Elderslie, 5A Inshes Holdings, Inshes, Inverness, IV2 5BA	269285	844413
NV0002	Castlehill, Inshes, Inverness, IV2 5BA	269625	844282
NV0003	17 Castlehill Court, Inverness, IV2 5GS	269909	844523
NV0004	6 Cradlehall Meadows, Inverness, IV2 5GS	269929	844823
NV0005	Annfield, Caulfield Road North - Smithton Road, Inverness, IV2 7NH	270614	845106
NV0006	Ashton Farm Farmhouse, Caulfield Road North - Smithton Road, Inverness, IV2 7NH	270129	845437
NV0007	49 Cranmore Drive, Inverness, IV2 7FL	270902	845491

8.3.2 The baseline noise survey was undertaken from 9 March 2018 to 23 March 2018, with the intention of capturing a minimum of two days' worth of noise data in favourable weather conditions (i.e. light wind speeds and no rain). The actual period of monitoring varied between each property and this is detailed in Appendix A8.2 (Detailed Baseline Noise Survey Results and Notes). At six of the measurement locations noise monitoring equipment was left unattended within the garden area of the NSRs. Although the monitoring was unattended, survey staff did visit each location for a period of 20 to 30 minutes in the morning, afternoon and evening periods during the measurement period to subjectively characterise the noise climate and make detailed notes on meteorological conditions. Due to the lack of a secure location to leave noise monitoring equipment unattended, only attended short-term measurements were undertaken at NV0003 – 17 Castlehill Court.

8.3.3 Appendix A8.2 (Detailed Baseline Noise Survey Results and Notes) provides detailed site notes, photographs and noise levels measured at each of the monitoring locations. However, for ease of reference, the average measured $L_{A10,18h}$, $L_{Aeq,16h}$ and $L_{night,outside}$ noise levels over the survey periods are summarised in Table 8.8 and Table 8.9. Only the average $L_{A10,18h}$ level, excluding periods of rainfall, is presented for NV0003 – 17 Castlehill Court as only attended short-term measurements were undertaken here.

Table 8.8: Summary of Baseline Noise Measurements, including periods of rainfall

ID	Address/Representative Location	Average Measured Noise Levels (dB)		
		$L_{A10,18h}$	$L_{Aeq,16h}$	$L_{night,outside}$
NV0001	Elderslie	57.8	57.0	50.8
NV0002	Castlehill	55.6	53.7	48.8
NV0003	17 Castlehill Court	n/a	n/a	n/a
NV0004	6 Cradlehall Meadows	48.6	51.5	44.3
NV0005	Annfield	46.6	47.4	45.7
NV0006	Ashton Farm Farmhouse	46.4	46.3	42.4
NV0007	49 Cranmore Drive	46.6	47.8	40.9

Table 8.9: Summary of Baseline Noise Measurements, excluding periods of rainfall

ID	Address/Representative Location	Average Measured Noise Levels (dB)		
		$L_{A10,18h}$	$L_{Aeq,16h}$	$L_{night,outside}$
NV0001	Elderslie	57.8	56.9	50.3
NV0002	Castlehill	55.5	53.2	46.9
NV0003	17 Castlehill Court	51.0	n/a	n/a
NV0004	6 Cradlehall Meadows	49.0	51.3	44.7
NV0005	Annfield	46.8	47.0	43.2
NV0006	Ashton Farm Farmhouse	47.4	45.5	42.1
NV0007	49 Cranmore Drive	46.9	47.5	40.5

Comparison of Measured Noise levels with Modelled Predicted Noise Levels

8.3.4 To assist in the understanding of the existing noise levels and explain the noise climate in areas near the proposed scheme, modelled predicted noise levels were compared with the measured noise levels at the seven sample NSRs. The predicted noise levels associated with the existing road network were calculated using the assumptions previously discussed in paragraph 8.2.28 and traffic data from the MFTM model for BMTD 2018.

8.3.5 It should be noted that there will rarely be perfect agreement between predicted and measured noise levels due to the comparison of short-term measurement data against predicted noise levels using annual average traffic data. The measured noise levels are influenced by the local traffic conditions at the time of the survey, the meteorological conditions and will have contributions from other (non-road) noise sources such as trains passing, aircraft, farming activities, birdsong, etc. In addition, the CRTN prediction method assumes light downwind propagation to every prediction point in the model. This is unlikely to occur in reality. This can result in wide variations between measured noise levels and predicted baseline noise levels. Table 8.10 provides a comparison between the predicted and measured noise levels.

Table 8.10: Modelled Predicted Noise Levels versus Measured Noise Levels

ID	Address/Representative Location	Modelled Predicted Noise Level ($L_{A10,18h}$) (dB)	Measured Noise Level ($L_{A10,18h}$) (dB)	Noise Level Difference (dB)
NV0001	Elderslie	63.1	57.8	+5.3
NV0002	Castlehill	58.5	55.5	+3.0
NV0003	17 Castlehill Court	53.6	51.0	+2.6
NV0004	6 Cradlehall Meadows	48.8	49.0	-0.2
NV0005	Annfield	46.9	46.8	+0.1
NV0006	Ashton Farm Farmhouse	47.3	47.4	-0.1
NV0007	49 Cranmore Drive	46.6	46.9	-0.3

8.3.6 The results in Table 8.10 show that there is a good correlation (a difference of less than 1dB) between the modelled predicted noise levels and the measured noise levels at four of the locations and a reasonably good correlation (a difference of less than 3dB) at one location. The differences between the measured and modelled levels are discussed in further detail below:

- At NSR NV0001 the difference between the predicted and measured noise levels is +5.3dB. A stone wall runs between the pavement and gardens between the NSR and B9006 Culloden Road, and it is considered likely that this wall is providing noise attenuation to NSR NV0001. This would explain the difference in measured and predicted noise levels.
- At NSR NV0002 the difference between the predicted and measured noise levels is +3.0dB. A stone wall runs between the pavement and the Castlehill garden between the NSR and the B9006 Culloden Road, and it is considered likely that this wall is providing noise attenuation to NSR NV0002. This would explain the difference in measured and predicted noise levels.
- At NSR NV0003 the difference between the predicted and measured noise levels is +2.6dB. Given the differences expected when comparing predicted noise levels based on annual average traffic data with measured levels in conditions specific to when the monitoring was undertaken, the differences between the measured and predicted noise levels are considered reasonable.
- At NSR NV0004 to NV0007 the differences between the predicted and measured noise levels are less than 1dB and the measured and predicted noise levels are less than 50dB $L_{A10,18h}$. This suggests that the existing noise levels at these NSRs are strongly influenced by road traffic noise from roads which are relatively distant from the NSRs.

8.3.7 Based on the above, the modelled results were determined to be suitable for use and, as such, no amendments were made to the noise models.

8.4 Potential Impacts

Introduction

8.4.1 The potential impacts reported in this section are assessed in line with the approach set out in Section 8.2 (Methodology), with the NSR, including relevant committed developments and amenity areas, identified as outlined in paragraph 8.2.5.

8.4.2 It is acknowledged that the proposed scheme is within an area where large-scale development is planned, as identified in the local development plan and supplementary guidance. In the future the proposed scheme is anticipated to be located within a landscape which has undergone substantial change; the existing (mainly agricultural) land becoming urbanised as an eastern expansion of the City of Inverness. In this situation, it is expected that the potential impacts reported in this section would materially change because of the introduction of NSRs in the vicinity of the proposed scheme and the acoustic screening that new development near to the proposed scheme is likely to provide for existing NSRs further away. At this stage, it is not possible to quantify how future development would affect the potential impacts reported in this section. The potential cumulative impacts of the proposed scheme in-combination with other committed/reasonably foreseeable developments are assessed in Chapter 19 (Assessment of Cumulative Effects).

Construction

8.4.3 Temporary impacts for road schemes normally occur between the start of advance works and the end of the construction period and these temporary, construction-related noise and vibration impacts can be significant.

8.4.4 Construction work of any type that involves heavy plant activities will generate noise, which may result in complaints if sensitive scheduling and control of works is not exercised. The noise levels generated by construction activities and experienced by nearby NSRs such as residential properties depends upon a number of variables, the most notable of which are:

- the noise generated by plant or equipment used on site, generally expressed as sound power levels);
- the periods of operation of the plant on the site, known as its ‘on-time’;
- the distance between the noise source and the NSR; and
- the attenuation due to ground absorption, air absorption and barrier effects.

8.4.5 To evaluate the noise during the construction it is necessary to have knowledge of the various activities that would be undertaken. Contractors may use different working methods and plant to achieve the same ends. An accurate demolition and construction noise and vibration impact assessment is not normally possible until appointment of the approved contractor with knowledge of the exact working routine and plant schedule. During the construction phase the use of plant, and the likely noise impact thereof, would be determined following the guidance detailed in BS 5228:2009+A1:2014 and, where necessary, mitigation would be provided. Moreover, should complaints be received from local residents, the local authority would determine whether the best practicable means to reduce noise and vibration impacts are being applied. Therefore, best practicable means would be employed to ensure that noise levels are minimised. Outline mitigation measures to reduce construction impacts can be found in Section 8.5 (Mitigation).

8.4.6 It is likely that the potentially worst affected NSRs in respect of construction noise would be those located immediately adjacent to the proposed scheme, with lesser impacts at those properties located adjacent to the existing road network due to potential increase in HGV movements.

8.4.7 The 2008 version of DMRB Noise and Vibration (now superseded by the 2011 version) previously advised that construction impacts should be considered by providing an estimate of the number of dwellings within 100m of the alignment of the proposed scheme. In practice, construction noise levels and resulting impacts are likely to vary during the different construction phases of the proposed scheme depending upon the works activities, location and proximity of receptors. Furthermore, best practicable means of mitigation will be employed to minimise construction noise impacts. There are 64 NSRs within 100m of the draft CPO boundary for the proposed scheme (detailed in Appendix A8.7: Noise Sensitive Receptors Nearest to Construction Works), the nearest of which are 6, 6A and 7A Inshes Holdings and 4 Cradlehall Meadows, which are within 20m of the draft CPO boundary.

8.4.8 Although a quantitative assessment of construction noise impacts has not been undertaken, based on professional judgement it is not unreasonable to assume that, without mitigation, the significance of construction noise impacts may result in temporary, short-term impacts of Large/Very Large Adverse significance at the NSRs closest to the works.

8.4.9 Disturbance due to construction noise from a proposed scheme of this sort, although it may be significant, is usually short-term as the period of noisy construction work is relatively limited and disturbance normally ceases once the noisy parts of the construction phase are completed.

8.4.10 Concern is often expressed by local residents that vibration from construction activities could cause structural damage to their properties. However, DMRB Noise and Vibration states that:

> *'it has been shown that vibrations that can be felt indoors and which often cause occupants anxiety are an order of magnitude smaller than would be needed to activate pre-existing strains and cause cracks to propagate. It should be borne in mind that superficial cracks in plaster around openings such as doors and windows can often appear during the life of a building'.*

8.4.11 Surface plant, such as cranes, compressors and generators, are not recognised as sources of high levels of environmental vibration. Also, it is generally accepted that without a highly detailed understanding of the media, waveform and frequency distribution, ground-borne vibration prediction methods are complex and beset with uncertainties. Whilst it is considered unlikely that typical road construction working methods would generate levels of vibration at local receptors above which cosmetic damage would be expected to be sustained, given the proximity of some NSRs to the proposed scheme there is the potential that vibration impacts could cause complaints at the closest NSRs. However, the level of impact at different receptors would be dependent upon a number of factors including the precise distance between the works and NSRs, ground conditions and activities being undertaken at any given time. Based on professional judgement at this stage, as a worst case and without mitigation in place, vibration impacts of up to Moderate/Large Adverse significance might be experienced by the nearest residents to the works.

8.4.12 Where heavy earthwork, piling, or other significant vibration producing operations are proposed in the vicinity of existing NSRs, further consideration should be given to potential impacts once the main works contractor is appointed and the construction requirements are developed. Potential mitigation measures are discussed in Section 8.5 (Mitigation).

Operation

Introduction

8.4.13 The modelled noise levels and the associated significance of impact at the seven sample NSRs (identified in Table 8.7) are summarised in Tables 8.11 to 8.13, whilst the results for all 2,753 NSRs modelled are provided in Appendix A8.3 (Predicted Noise Levels at Noise Sensitive Receptors). The sample receptor at which noise measurements were undertaken to represent Cranmore Drive (NV0007 – 49 Cranmore Drive) is just outwith the noise calculation area, as defined in DMRB Noise and Vibration. Accordingly, the predicted noise levels at 43 Cranmore Drive, which is within the calculation area, are presented instead. In the following tables, where reference is made to the predicted daytime and night-time noise levels, the assessment has been undertaken at both the ground and first floors of all buildings. Noise contour change maps for the DM 2022 versus the DM 2037, the DM 2022 versus the DS 2022 and the DM 2022 versus the DS 2037 scenarios are provided in Figure 8.3 to Figure 8.8.

8.4.14 It is important to note that the methodology in DMRB Noise and Vibration requires that the least beneficial change in noise level is reported. Accordingly, the DM 2022 noise levels in each of the tables may be different for the same sample NSR. This is because, for example, in the DM 2022 versus the DM 2037 scenario the least beneficial noise impact may occur at one receptor point of a property, whereas in the DM 2022 versus the DS 2022 or DS 2037 scenario a different receptor point of a property could experience the least beneficial noise impact.

8.4.15 The assessment of noise impacts at known noise sensitive committed developments, ecological and amenity spaces (i.e. core paths, recreational areas) have been considered separately due to the nature of these spaces and impacts are reported within paragraphs 8.4.53 to 8.4.76, Appendix A8.4 (Noise Impacts on Committed Developments) and Appendix A8.5 (Noise Impacts on Amenity Areas).

Sample NSR Locations (see Figure 8.2)

Do-Minimum Scenario in the Baseline Year vs Do-Minimum Scenario in the Future Assessment Year (Long-term Assessment)

8.4.16 The predicted noise levels at the sample NSRs for the DM 2022 and the DM 2037 scenarios with the associated long-term significance of impacts for the daytime period are presented in Table 8.11.

Table 8.11: Sample NSRs – DM 2022 vs. DM 2037 – Day

ID	Address/ Representative Location	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2022	DM 2037	Significance of Impact	DM 2022	DM 2037	Significance of Impact
NV0001	Elderslie	56.0	57.6	Slight Adverse	n/a	n/a	n/a
NV0002	Castlehill	59.2	60.7	Slight Adverse	60.9	62.4	Slight Adverse
NV0003	17 Castlehill Court	51.4	53.1	Slight Adverse	52.6	54.3	Slight Adverse
NV0004	6 Cradlehall Meadows	45.8	47.2	Slight Adverse	47.5	8.9	Slight Adverse
NV0005	Annfield	43.7	45.1	Slight Adverse	45.7	47.0	Slight Adverse
NV0006	Ashton Farm Farmhouse	47.6	48.8	Slight Adverse	48.9	50.0	Slight Adverse
NV0007	43 Cranmore Drive	36.3	37.4	Slight Adverse	39.7	40.6	Slight Adverse

8.4.17 The results show that, should the proposed scheme not go ahead, no sample NSRs are predicted to be significantly affected (i.e. an impact of Slight/Moderate Adverse significance or higher and an absolute noise level in excess of 59.5dB $L_{A10,18h}$ at ground floor level) by anticipated long-term traffic growth on the existing road network. All seven sample NSRs are predicted to experience an impact of Slight Adverse significance.

8.4.18 The analysis of night-time noise levels indicates that there are no sample NSRs with night-time noise levels in excess of 55.0dB $L_{night,outside}$, in the long-term without the proposed scheme. Accordingly, the predicted night-time noise levels for the sample NSRs are not reported.

Do-Minimum Scenario in the Baseline Year vs Do-Something Scenario in the Baseline Year (Short-term Assessment)

8.4.19 The predicted noise levels at the sample NSRs for the DM 2022 and the DS 2022 scenarios with the associated short-term significance of impacts for the daytime period are presented in Table 8.12.

Table 8.12: Sample NSRs – DM 2022 vs. DS 2022 – Day (without NSR Specific Mitigation)

ID	Address/ Representative Location	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2022	DS 2022	Significance of Impact	DM 2022	DS 2022	Significance of Impact
NV0001	Elderslie	54.9	55.7	Slight Adverse	n/a	n/a	n/a
NV0002	Castlehill	46.8	49.7	Slight/ Moderate Adverse	48.7	50.9	Slight/ Moderate Adverse
NV0003	17 Castlehill Court	46.4	48.7	Slight/ Moderate Adverse	48.3	50.3	Slight/ Moderate Adverse
NV0004	6 Cradlehall Meadows	47.2	54.3	Large/ Very Large Adverse	48.2	55.1	Large/ Very Large Adverse
NV0005	Annfield	48.5	50.3	Slight/ Moderate Adverse	49.2	51.0	Slight/ Moderate Adverse
NV0006	Ashton Farm Farmhouse	47.5	53.8	Large/ Very Large Adverse	48.7	55.0	Large/ Very Large Adverse
NV0007	43 Cranmore Drive	36.3	38.6	Slight/ Moderate Adverse	39.0	41.0	Slight/ Moderate Adverse

8.4.20 The results show that without mitigation, although there are six sample NSRs (Castlehill, 17 Castlehill Court, 6 Cradlehall Meadows, Annfield, Ashton Farm Farmhouse and 43 Cranmore Drive) with an impact of Slight/Moderate Adverse significance or higher, these are predicted to have a DMRB predicted absolute noise level (i.e. at the façade with the least beneficial change in noise level) of less than 59.5dB $L_{A10,18h}$. Accordingly, based on the least beneficial change in noise, the impacts on these NSRs are not considered to be significant. One of the sample NSR (Elderslie) is predicted have an impact of Slight Adverse significance. Significant impacts at all facades, not only at the least beneficial façade are considered in Section 8.5 (Mitigation).

8.4.21 It should be noted that a short-term night-time assessment of noise impacts in the baseline year is not required by DMRB Noise and Vibration.

Do-Minimum Scenario in the Baseline Year vs Do-Something Scenario in the Future Assessment Year (Long-term Assessment)

8.4.22 The predicted noise levels at the sample NSRs for the DM 2022 and the DS 2037 scenario with the associated long-term significance of impacts for the daytime period are presented in Table 8.13.

Table 8.13: Sample NSRs – DM 2022 vs. DS 2037 – Day (without NSR Specific Mitigation)

ID	Address/ Representative Location	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2022	DS 2037	Significance of Impact	DM 2022	DS 2037	Significance of Impact
NV0001	Elderslie	54.9	57.2	Slight Adverse	n/a	n/a	n/a
NV0002	Castlehill	46.8	50.7	Slight/ Moderate Adverse	48.7	52.0	Slight/ Moderate Adverse
NV0003	17 Castlehill Court	46.4	49.6	Slight/ Moderate Adverse	48.3	51.2	Slight Adverse

ID	Address/ Representative Location	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2022	DS 2037	Significance of Impact	DM 2022	DS 2037	Significance of Impact
NV0004	6 Cradlehall Meadows	47.2	55.4	Moderate/ Large Adverse	48.2	56.1	Moderate/ Large Adverse
NV0005	Annfield	48.5	51.4	Slight Adverse	49.2	52.1	Slight Adverse
NV0006	Ashton Farm Farmhouse	47.5	55.1	Moderate/ Large Adverse	48.7	56.2	Moderate/ Large Adverse
NV0007	43 Cranmore Drive	36.3	39.7	Slight/ Moderate Adverse	39.0	42.0	Slight/ Moderate Adverse

8.4.23 The results show that at ground floor level, without mitigation, that although there are five sample NSRs (Castlehill, 17 Castlehill Court, 6 Cradlehall Meadows, Ashton Farm Farmhouse and 43 Cranmore Drive) with an impact of Slight/Moderate Adverse significance or higher, these are predicted to have a DMRB predicted absolute noise level (i.e. at the façade with the least beneficial change in noise level) of less than 59.5dB $L_{A10,18h}$. Accordingly, based on the least beneficial change in noise, the impacts on these NSRs are not considered to be significant. Two of the sample NSRs (Elderslie and Annfield) are predicted to have an impact of Slight Adverse significance at ground floor level. The results at first floor level are the same except at 17 Castlehill Court, where an impact of Slight Adverse rather than Slight/Moderate Adverse significance is predicted. Significant impacts at all facades, not only at the least beneficial façade are considered in Section 8.5 (Mitigation).

8.4.24 The analysis of night-time noise levels indicates that there are no sample NSRs with night-time noise levels in excess of 55.0dB $L_{night,outside}$, in the long-term with the proposed scheme. Accordingly, the predicted night-time noise levels for the sample NSRs are not reported.

Summary Tables for all NSRs within 600m Calculation Area

8.4.25 The tables presented in this section include the predicted noise level change at all dwellings and other NSRs (defined as 'High' sensitivity in Table 8.2) within the 600m calculation area and therefore provides a broader view of potential noise impacts than the sample NSRs assessment tables (Tables 8.11 to 8.13).

Do-Minimum Scenario in the Baseline Year vs Do-Minimum Scenario in the Future Assessment Year (Long-term Assessment)

8.4.26 In accordance with Table A1.2 in DMRB Noise and Vibration, summaries of the magnitude of noise impacts at dwellings and other NSRs for the daytime period at the ground and first floor for the DM 2022 scenario versus the DM 2037 scenario are presented in Table 8.14.

Table 8.14: Summary – DM 2022 vs. DM 2037 – Daytime

Change in Noise Level $L_{A10,18h}$ dB		Magnitude of Impact	Ground Floor		First Floor	
			No. of Dwellings	No. of Other Sensitive Receptors	No. of Dwellings	No. of Other Sensitive Receptors
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	2,711	42	2,711	42
	3.0 – 4.9	Minor	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	10.0+	Major	0	0	0	0
No Change	0	No Change	0	0	0	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	0	0	0	0
	3.0 – 4.9	Minor	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	10.0+	Major	0	0	0	0

8.4.27 Whilst the above table shows the magnitude of impacts in accordance with DMRB Noise and Vibration, the results show that during the daytime period at ground floor level without the proposed scheme, all NSRs are predicted to experience a Slight Adverse impact and, accordingly, no significant adverse impacts are predicted.

8.4.28 The corresponding summary tables for the DM 2022 scenario versus the DM 2037 scenario, for the night-time period at the ground and first floor levels are presented in Table 8.15 and Table 8.16. In addition, the tables provide information on:

- the number of dwellings with noise levels below 55.0dB $L_{night,outside}$ in the DM 2022 scenario which increase to above 55.0dB $L_{night,outside}$ in the DM 2037 scenario;
- the number of dwellings with noise levels above 55.0dB $L_{night,outside}$ in both the DM 2022 and DM 2037 scenarios; and
- the number of dwellings with noise levels above 55.0dB $L_{night,outside}$ in the DM 2022 scenario which reduce to below 55.0dB $L_{night,outside}$ in the DM 2037 scenario.

8.4.29 It should be noted that n/a is reported when a condition cannot be met e.g., dwellings that have a night-time noise level less than 55.0dB in the DM 2022 scenario cannot have a decrease in noise level if the DM 2037 noise level is greater than or equal to 55.0dB.

Table 8.15: Summary – Ground Floor DM 2022 vs. DM 2037 – Night

Change in Noise Level $L_{night,outside}$ dB		Magnitude of Impact	No. of Dwellings	No. of Dwellings (DM 2022 < 55dB, DM 2037 ≥ 55dB)	No. of Dwellings (DM 2022 ≥ 55dB, DM 2037 ≥ 55dB)	No. of Dwellings (DM 2022 ≥ 55dB, DM 2037 < 55dB)
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	2,711	17	17	n/a
	3.0 – 4.9	Minor	0	0	0	n/a
	5.0 – 9.9	Moderate	0	0	0	n/a
	10.0+	Major	0	0	0	n/a
No Change	0	No Change	0	0	0	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	0	n/a	0	0
	3.0 – 4.9	Minor	0	n/a	0	0
	5.0 – 9.9	Moderate	0	n/a	0	0
	10.0+	Major	0	n/a	0	0

Table 8.16: Summary – First Floor DM 2022 vs. DM 2037 – Night

Change in Noise Level $L_{night,outside}$ dB		Magnitude of Impact	No. of Dwellings	No. of Dwellings (DM 2022 < 55dB, DM 2037 ≥ 55dB)	No. of Dwellings (DM 2022 ≥ 55dB, DM 2037 ≥ 55dB)	No. of Dwellings (DM 2022 ≥ 55dB, DM 2037 < 55dB)
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	2,711	51	18	n/a
	3.0 – 4.9	Minor	0	0	0	n/a
	5.0 – 9.9	Moderate	0	0	0	n/a
	10.0+	Major	0	0	0	n/a
No Change	0	No Change	0	0	0	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	0	n/a	0	0
	3.0 – 4.9	Minor	0	n/a	0	0
	5.0 – 9.9	Moderate	0	n/a	0	0
	10.0+	Major	0	n/a	0	0

8.4.30 As can be seen in Table 8.15 and Table 8.16, during the night-time period there are 34 and 69 dwellings predicted to have noise levels in excess of 55.0dB $L_{night,outside}$ at ground floor and first floor levels, respectively. However, as all of these NSRs are predicted to experience a Slight Adverse impact no significant adverse impacts are predicted.

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Baseline Year (Short-term Assessment)

8.4.31 In accordance with Table A1.1 of DMRB Noise and Vibration, a summary of the magnitude of noise impacts at all dwellings and other NSRs within the 600m calculation area for the DM 2022 scenario versus the DS 2022 scenario, for the daytime period at ground and first floor are presented in Table 8.17. Note that in accordance with DMRB Noise and Vibration, assessment of night-time noise is not required for this 'short-term' assessment.

Table 8.17: Summary – DM 2022 vs. DS 2022 – Day (without NSR Specific Mitigation)

Change in Noise Level $L_{A10,18h}$ dB		Magnitude of Impact	Ground Floor		First Floor	
			No. of Dwellings	No. of Other Sensitive Receptors	No. of Dwellings	No. of Other Sensitive Receptors
Increase (Adverse) in Noise Level	0.1 – 0.9	Negligible	843	11	847	28
	1.0 – 2.9	Minor	304	2	314	3
	3.0 – 4.9	Moderate	31	0	35	0
	5.0+	Major	12	0	10	0
No Change	0	No Change	309	5	267	3
Decrease (Beneficial) in Noise Level	0.1 – 0.9	Negligible	671	21	704	1
	1.0 – 2.9	Minor	538	3	531	1
	3.0 – 4.9	Moderate	3	0	3	0
	5.0+	Major	0	0	0	0

8.4.32 The results show that at ground floor level there are 347 dwellings and two other NSRs with a magnitude of impact of minor adverse and above in the short-term, which corresponds to a potential impact of Slight/Moderate Adverse significance or higher. Further analysis of the absolute noise levels at these NSRs (refer to Appendix A8.3) show that of these, five dwellings (11, 12, 12A and 14 Castlehill Court and Drumossie Cottage) have predicted noise levels in excess of 59.5dB $L_{A10,18h}$ and are therefore considered to be potentially significantly affected. The beneficial impacts of the proposed scheme indicate that 541 dwellings and three other NSR are predicted to have an impact of Slight/Moderate Beneficial significance or better. Significant impacts at all facades, not only the least beneficial façade, are considered in Section 8.5 (Mitigation).

8.4.33 At first floor level there are 360 dwellings and three other NSRs with a potential impact of Slight/Moderate Adverse significance or higher in the short-term. The beneficial impacts of the proposed scheme indicate that 534 dwellings and one other NSR will have an impact of Slight/Moderate Beneficial significance or better.

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Future Assessment Year (Long-term Assessment)

8.4.34 In accordance with Table A1.2 of DMRB Noise and Vibration, summaries of the magnitude of noise impacts at all dwellings and other NSRs within the 600m calculation area for the DM 2022 scenario versus the DS 2037 scenario, for the daytime period at ground and first floor are presented in Table 8.18.

Table 8.18: Summary – DM 2022 vs. DS 2037 – Day (without NSR Specific Mitigation)

Change in Noise Level $L_{A10,18h}$ dB		Magnitude of Impact	Ground Floor		First Floor	
			No. of Dwellings	No. of Other Sensitive Receptors	No. of Dwellings	No. of Other Sensitive Receptors
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	2,020	39	1,999	39
	3.0 – 4.9	Minor	88	0	87	0
	5.0 – 9.9	Moderate	22	0	21	0
	10.0+	Major	1	0	1	0

Change in Noise Level $L_{A10,18h}$ dB		Magnitude of Impact	Ground Floor		First Floor	
			No. of Dwellings	No. of Other Sensitive Receptors	No. of Dwellings	No. of Other Sensitive Receptors
No Change	0	No Change	52	0	53	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	525	3	548	3
	3.0 – 4.9	Minor	3	0	2	0
	5.0 – 9.9	Moderate	0	0	0	0
	10.0+	Major	0	0	0	0

8.4.35 Where there is a resulting magnitude of impact of minor adverse and above in the long-term, the results show that at ground floor level there are 111 dwellings with a potential impact of Slight/Moderate Adverse significance or higher in the long-term. Further analysis of the absolute noise levels at these NSRs (refer to Appendix A8.3) show that of these, two dwellings (Drumossie Cottage and Balvonie Cottage) have predicted noise levels in excess of 59.5dB $L_{A10,18h}$ and are therefore considered to be potentially significantly affected. The beneficial impacts of the proposed scheme indicate that three dwellings are predicted to have an impact of Slight/Moderate Beneficial significance or better. Significant impacts at all facades, not only the least beneficial façade, are considered in Section 8.5 (Mitigation).

8.4.36 At first floor level there are 109 dwellings with a potential impact of Slight/Moderate Adverse significance or higher in the long-term. The beneficial impacts of the proposed scheme indicate that two dwellings will have an impact of Slight/Moderate Beneficial significance or better.

8.4.37 The corresponding summary tables for the DM 2022 scenario versus the DS 2037 scenario, for the night-time period at the ground and first floor are presented in Table 8.19 and Table 8.20, respectively. These tables provide the magnitude of impacts for all dwellings within the 600m calculation area.

Table 8.19: Summary – Ground Floor DM 2022 vs. DS 2037 – Night (without NSR Specific Mitigation)

Change in Noise Level $L_{night,outside}$ dB		Magnitude of Impact	No. of Dwellings	No. of Dwellings (DM 2022 < 55dB, DS 2037 ≥ 55dB)	No. of Dwellings (DM 2022 ≥ 55dB, DS 2037 ≥ 55dB)	No. of Dwellings (DM 2022 ≥ 55dB, DS 2037 < 55dB)
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	2,055	1	13	n/a
	3.0 – 4.9	Minor	69	0	1	n/a
	5.0 – 9.9	Moderate	17	0	0	n/a
	10.0+	Major	0	0	0	n/a
No Change	0	No Change	44	0	0	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	524	n/a	42	0
	3.0 – 4.9	Minor	2	n/a	0	0
	5.0 – 9.9	Moderate	0	n/a	0	0
	10.0+	Major	0	n/a	0	0

Table 8.20: Summary – First Floor DM 2022 vs. DS 2037 – Night (without NSR Specific Mitigation)

Change in Noise Level $L_{night,outside}$ dB		Magnitude of Impact	No. of Dwellings	No. of Dwellings (DM 2022 < 55dB, DS 2037 ≥ 55dB)	No. of Dwellings (DM 2022 ≥ 55dB, DS 2037 ≥ 55dB)	No. of Dwellings (DM 2022 ≥ 55dB, DS 2037 < 55dB)
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	2,023	10	14	n/a
	3.0 – 4.9	Minor	68	0	1	n/a
	5.0 – 9.9	Moderate	15	0	0	n/a
	10.0+	Major	1	0	0	n/a
No Change	0	No Change	60	0	1	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	544	n/a	45	11
	3.0 – 4.9	Minor	0	n/a	0	0
	5.0 – 9.9	Moderate	0	n/a	0	0
	10.0+	Major	0	n/a	0	0

8.4.38 As can be seen in Table 8.19 and Table 8.20, during the night-time period there are 57 and 72 dwellings predicted to have noise levels in excess of 55.0dB $L_{night,outside}$ at ground floor and first floor levels, respectively. The results show that at ground and first floor levels there is one dwelling (Drumossie Cottage) also predicted to have a potential impact of minor adverse, resulting in Slight/Moderate Adverse significance, in the long-term, and the potential impacts at night are therefore considered to be significant at this location.

Health and Education Establishments

8.4.39 Identified health and education establishments assessed and included in the summary tables above (Tables 8.14, 8.17 and 8.18. within Other Sensitive Receptors) have also been reported separately within this chapter. Figure 8.2 presents the location of identified health and educational establishments located within the calculation area. For each of the buildings, the daytime noise levels at ground and, where applicable, first floor for the DM 2022 scenario and the DM 2037 scenario, with associated significance of impacts is presented in Table 8.21. The DM 2022 scenario and DS 2022 scenario and associated significance of impacts are presented in Table 8.22. The DM 2022 scenario and the DS 2037 scenario and associated significance of impacts are presented in Table 8.23.

Table 8.21: Health and Educational Establishments – DM 2022 vs DM 2037 – Day

ID	Address	Predicted $L_{A10,18h}$(dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2022	DM 2037	Significance of Impact	DM 2022	DM 2037	Significance of Impact
NV0008	Playpen Nursery	61.9	63.9	Slight Adverse	n/a	n/a	n/a
NV0009	Cradlehall Nursery	52.0	53.7	Slight Adverse	n/a	n/a	n/a
NV0010	Inverness College	55.7	56.8	Slight Adverse	58.8	59.8	Slight Adverse
NV0011	An Lòchran	52.2	53.4	Slight Adverse	53.0	54.2	Slight Adverse
NV0012	Cradlehall Primary School	44.3	46.1	Slight Adverse	n/a	n/a	n/a
NV0013	Smithton Primary School	34.0	35.2	Slight Adverse	n/a	n/a	n/a
NV0014	Raigmore Hospital	48.5	49.9	Slight Adverse	50.6	51.9	Slight Adverse
NV0015	Inshes Dental Centre	60.3	62.0	Slight Adverse	n/a	n/a	n/a
NV0016	Stoneyfield Dental Surgery	54.8	55.6	Slight Adverse	56.3	57.2	Slight Adverse
NV0017	Maggie's Highlands	56.4	57.6	Slight Adverse	n/a	n/a	n/a
NV0018	Raigmore Primary School	48.8	450.0	Slight Adverse	50.3	51.5	Slight Adverse
NV0019	Hazel House Dentists	54.8	55.6	Slight Adverse	56.3	57.2	Slight Adverse
NV0020	Millburn Academy	51.5	53.1	Slight Adverse	53.0	54.6	Slight Adverse

Table 8.22: Health and Educational Establishments – DM 2022 vs DS 2022 – Day (without NSR Specific Mitigation)

ID	Address	Predicted $L_{A10,18h}$(dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2022	DS 2022	Significance of Impact	DM 2022	DS 2022	Significance of Impact
NV0008	Playpen Nursery	62.3	62.1	Slight Beneficial	n/a	n/a	n/a
NV0009	Cradlehall Nursery	47.6	47.6	Neutral	n/a	n/a	n/a
NV0010	Inverness College	54.5	55.1	Slight Adverse	55.4	55.9	Slight Adverse
NV0011	An Lòchran	46.0	47.8	Slight/Moderate Adverse	48.0	49.2	Slight/Moderate Adverse
NV0012	Cradlehall Primary School	49.0	49.2	Slight Adverse	n/a	n/a	n/a
NV0013	Smithton Primary School	34.0	34.9	Slight Adverse	n/a	n/a	n/a
NV0014	Raigmore Hospital	68.1	68.2	Slight Adverse	68.1	68.2	Slight Adverse
NV0015	Inshes Dental Centre	55.9	54.8	Slight/Moderate Beneficial	n/a	n/a	n/a
NV0016	Stoneyfield Dental Surgery	54.8	54.4	Slight Beneficial	55.8	55.5	Slight Beneficial
NV0017	Maggie's Highlands	61.7	61.8	Slight Adverse	n/a	n/a	n/a
NV0018	Raigmore Primary School	46.2	45.0	Slight/Moderate Beneficial	48.5	47.2	Slight/Moderate Beneficial
NV0019	Hazel House Dentists	54.8	54.4	Slight Beneficial	55.8	55.5	Slight Beneficial
NV0020	Millburn Academy	51.8	50.0	Slight/Moderate Beneficial	53.2	51.3	Slight/Moderate Beneficial

Table 8.23: Health and Educational Establishments – DM 2022 vs DS 2037 – Day (without NSR Specific Mitigation)

ID	Address	Predicted $L_{A10,18h}$(dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2022	DS 2037	Significance of Impact	DM 2022	DS 2037	Significance of Impact
NV0008	Playpen Nursery	62.1	64.0	Slight Adverse	n/a	n/a	n/a
NV0009	Cradlehall Nursery	47.6	48.7	Slight Adverse	n/a	n/a	n/a
NV0010	Inverness College	56.0	57.5	Slight Adverse	55.4	56.9	Slight Adverse
NV0011	An Lòchran	46.0	48.8	Slight Adverse	48.0	50.2	Slight Adverse
NV0012	Cradlehall Primary School	49.0	50.3	Slight Adverse	n/a	n/a	n/a
NV0013	Smithton Primary School	34.0	35.9	Slight Adverse	n/a	n/a	n/a
NV0014	Raigmore Hospital	59.0	60.1	Slight Adverse	61.4	62.5	Slight Adverse
NV0015	Inshes Dental Centre	55.9	55.5	Slight Beneficial	n/a	n/a	n/a
NV0016	Stoneyfield Dental Surgery	54.3	54.6	Slight Adverse	56.2	56.5	Slight Adverse
NV0017	Maggie's Highlands	62.4	63.5	Slight Adverse	n/a	n/a	n/a
NV0018	Raigmore Primary School	46.2	45.9	Slight Beneficial	48.5	48.1	Slight Adverse
NV0019	Hazel House Dentists	54.3	54.6	Slight Adverse	56.2	56.5	Slight Adverse
NV0020	Millburn Academy	51.8	51.1	Slight Beneficial	53.0	52.2	Slight Beneficial

8.4.40 In the long-term, without the proposed scheme in place (DM 2022 v DM 2037) at ground and first floor levels, all of the identified health and education establishments are predicted to experience an impact of Slight Adverse significance.

8.4.41 In the short-term, with the proposed scheme in place (DM 2022 v DS 2022) at ground and first floor levels, An Lòchran is predicted to have a potential impact of Slight/Moderate Adverse significance. An Lòchran is predicted to have a DMRB predicted absolute noise level (i.e. at the façade with the least beneficial change in noise level) of less than 59.5dB $L_{A10,18h}$. Accordingly, based on the least beneficial change in noise, the impact on this NSR is not considered to be significant. None of the other identified health and education establishments are predicted to experience an impact of Slight/Moderate Adverse significance or higher. Significant impacts at all facades, not only at the least beneficial façade, are considered in Section 8.5 (Mitigation).

8.4.42 In the long-term, with the proposed scheme in place (DM 2022 v DS 2037) at ground and first floor levels, none of the other identified health and education establishments are predicted to experience an impact of Slight/Moderate Adverse significance or higher. Significant impacts at all facades, not only at the least beneficial façade, are considered in Section 8.5 (Mitigation).

Noise Nuisance

8.4.43 Table 8.24 summarises the comparison of noise nuisance, between two scenarios: DM 2022 scenario versus the DM 2037 scenario and the DM 2022 scenario versus the DS 2037 scenario, which illustrates the potential noise nuisance impacts at all dwellings.

Table 8.24: Summary of Traffic Noise Nuisance (without NSR Specific Mitigation)

Change in Traffic Induced Noise Nuisance		Number of Dwellings			
		Ground Floor		First Floor	
		DM2022 vs DM2037	DM2022 vs DS2037	DM2022 vs DM2037	DM2022 vs DS2037
Increase (Adverse) in Noise Nuisance	< 10%	2,706	1,050	2,711	1,023
	10 < 20%	0	656	0	656
	20 < 30%	0	352	0	370

Change in Traffic Induced Noise Nuisance		Number of Dwellings			
		Ground Floor		First Floor	
		DM2022 vs DM2037	DM2022 vs DS2037	DM2022 vs DM2037	DM2022 vs DS2037
	30 < 40%	0	40	0	42
	> 40%	0	3	0	3
No Change	0%	5	98	0	88
Decrease (Beneficial) in Noise Nuisance	< 10%	0	512	0	529
	10 < 20%	0	0	0	0
	20 < 30%	0	0	0	0
	30 < 40%	0	0	0	0
	> 40%	0	0	0	0

8.4.44 Table 8.24 shows that without the proposed scheme at ground floor level, there are 2,706 dwellings with an adverse change in noise nuisance, with all in the <10% noise nuisance band, and five dwellings with no change in noise nuisance. With the proposed scheme 2,101 dwellings are predicted to have a potential increase in noise nuisance, with the majority experiencing an increase in noise nuisance in the <10% and 10 to 20% noise nuisance bands. Ninety-eight dwellings are predicted to experience no change in noise nuisance and 512 dwellings are predicted to have a beneficial change in noise nuisance in the <10% noise nuisance band. Similar impacts are predicted to occur at the first floor of these dwellings.

Vibration Nuisance

8.4.45 When determining vibration nuisance, Figures A6.1 and A6.2 of DMRB Noise and Vibration have been used to determine the percentage of people bothered by traffic vibration. This is based on the predicted noise levels and the percentage of people bothered (very much or quite a lot) by vibration nuisance for the DM 2022 scenario versus the DM 2037 scenario, and the DM 2022 scenario versus the DS 2037 scenario. These scenarios have been determined and summarised in Table 8.25 for all dwellings that are within 40m of all modelled roads with a predicted noise level greater than 58.0dB $L_{A10,18h}$.

Table 8.25: Summary of Traffic Induced Airborne Vibration Nuisance (without NSR Specific Mitigation)

Change in Airborne Traffic Induced Vibration Nuisance		Number of Dwellings			
		Ground Floor		First Floor	
		DM2022 vs DM2037	DM2022 vs DS2037	DM2022 vs DM2037	DM2022 vs DS2037
Increase (Adverse) in Vibration Nuisance	< 10%	484	283	507	287
	10 < 20%	0	75	0	83
	20 < 30%	0	16	0	18
	30 < 40%	0	0	0	0
	> 40%	0	0	0	0
No Change	0%	118	217	95	202
Decrease (Beneficial) in Vibration Nuisance	< 10%	0	11	0	12
	10 < 20%	0	0	0	0
	20 < 30%	0	0	0	0
	30 < 40%	0	0	0	0
	> 40%	0	0	0	0

8.4.46 Table 8.25 shows that without the proposed scheme at ground floor level, there are 484 dwellings with an adverse change in airborne vibration nuisance, all in the <10% airborne vibration nuisance band, and 118 dwellings with no change in airborne vibration nuisance. With the proposed scheme, 374 dwellings are predicted to have a potential increase in airborne vibration nuisance, with the majority experiencing an increase in airborne vibration nuisance in the <10% and 10 to 20% airborne vibration nuisance bands. No change in airborne vibration nuisance is predicted at 217 dwellings and 11

dwellings are predicted to have a beneficial change in noise nuisance in the <10% airborne vibration nuisance band. Similar impacts are predicted to occur at the first floor of these dwellings.

Noise Insulation

8.4.47 Regulation 3 of the NISR confers a duty on the roads authorities, in certain instances, to offer insulation to eligible residential properties affected by noise.

8.4.48 An indicative noise insultation assessment has been undertaken and these results are provided for information only. The assessment indicates that there are 10 NSRs which may be eligible for noise insulation:

- Firthview;
- 5, 6, 6A and 7A Inshes Holdings (seven residential addresses registered at these properties);
- Churchfield Cottage; and
- Stratton Farmhouse.

8.4.49 A full NISR noise impact assessment is required within 12 months of the proposed scheme opening and again in the fifth, tenth and fifteenth year after the year of opening.

Wider Study Area

8.4.50 DMRB Noise and Vibration guidance indicates that an assessment of the impacts upon the wider network, i.e. properties that are within 50m of roads outside the calculation area that are predicted to experience a change of 1dB or more in the short-term or 3dB or more in the long-term, is required.

8.4.51 There are 108 road links outside the noise calculation area which are predicted to meet the aforementioned criteria and full details of these roads are provided in Appendix A8.4 (Wider Road Network Assessment). In summary there are predicted to be 91 NSRs within 50m of an adversely affected road and 466 NSRs within 50m of a beneficially affected road in the short-term. In the long-term, there are predicted to be 95 NSRs within 50m of an adversely affected road and 32 NSRs within 50m of a beneficially affected road.

Qualitative Assessment (for NSRs between 600m to 1km)

8.4.52 In the short-term, the majority of NSRs within 1km of the A9 between Inshes Overbridge and A9/A82 Longman Junction but outwith the 600m calculation area would be predicted to experience a perceptible decrease in road traffic noise levels due to the reduction in speed on this section of the A9 as part of the proposed scheme. In the long-term and in other areas in both the short-term and long-term, the majority of NSRs that are located outwith the 600m calculation area, but within 1km would be predicted to experience an imperceptible change in road traffic noise levels. Whilst there may be some NSRs which would experience an increase in noise level, the majority of these would be no higher than of Slight Adverse significance and therefore would not be considered significant. Furthermore, given these NSRs are at least 600m from the proposed scheme then absolute noise levels as a consequence of the proposed scheme would be predicted to be relatively low.

Committed Development

8.4.53 Committed developments are extant planning applications that have been received or determined by the local planning authority in the last three years. It should be noted that four of the committed developments assessed are currently under construction: Phase 1A of the Stratton Development, Culloden House Care Home and the houses under construction in Resaurie and Dell of Inshes. These are discussed in further detail below.

8.4.54 With regards to committed developments, the potential noise impact on 17 noise sensitive committed developments within the noise calculation area have been assessed. Full details of the potential noise impacts are provided in Appendix A8.5 (Noise Impacts on Committed Developments). This appendix

provides tables reporting the percentage of the committed development area subject to a change in free-field noise level.

8.4.55 In the long-term without the proposed scheme, all committed developments are predicted to experience a potential significance of impact of Slight Adverse.

8.4.56 In the short-term with the proposed scheme, one committed development (PA15: Land at Stratton and East Seafield (planning application number (16/02161/S42)) is predicted to experience a potential significance of Large/Very Large Adverse (1% of development site), Moderate/Very Large Adverse (1% of development site) and Slight/Moderate Adverse (7% of development site). Six other committed developments are predicted to experience a potential significance of Slight/Moderate Adverse across 3% to 83% of the development site areas. All other committed developments are not predicted to experience a potential significance of impact of Slight/Moderate Adverse or worse.

8.4.57 In the long-term, with the proposed scheme, one committed development (PA15: Land at Stratton and East Seafield (planning application number (16/02161/S42)) is predicted to experience a potential significance of Large/Very Large Adverse (1% of development site), Moderate/Very Large (1% of development site) and Slight/Moderate Adverse (2% of development site). Two other committed developments are predicted to experience a potential significance of Slight/Moderate Adverse across 1% and 6% of their development site areas. All other committed developments are not predicted to experience a potential significance of impact of Slight/Moderate Adverse or worse.

8.4.58 At the time of writing, four of these applications are under construction: Stratton Phase 1A (part of Land at Stratton and East Seafield (planning application number (16/02161/S42)), Culloden House Care Home (Land at Cradlehall Farm (planning application number (16/00684/FUL) and the houses under construction in Resaurie (Land 50M NE of Goodwood, Resaurie (planning application number (18/00565/FUL)) and Dell of Inshes (3A Dell of Inshes, Inshes, Inverness (planning application number (16/03864/FUL)). The potential impacts on these sites have been considered in further detail below.

Stratton Phase 1A

8.4.59 Phase 1A of the Stratton and East Seafield development has been considered in more detail. This analysis has been undertaken for only the area of Stratton Phase 1A (78%) which is within the noise calculation area.

8.4.60 In the long-term, with or without the proposed scheme, 78% of Stratton Phase 1A development land is predicted to experience a potential significance of Slight Adverse (the remaining 22% is outwith the noise calculation area). Therefore, no significant adverse noise impacts are predicted at Stratton Phase 1A in the long-term.

8.4.61 In the short-term, with the proposed scheme, 15% of Stratton Phase 1 development land is predicted to experience a potential significance of Slight/Moderate Adverse; further analysis of this area shows that noise levels are predicted to be less than 59.5dB $L_{A10,18h}$ and it is therefore not considered to be potentially significantly affected. 63% of Stratton Phase 1 development land is predicted to experience a potential significance of Slight Adverse (the remaining 22% is outwith the noise calculation area).

Culloden House Care Home

8.4.62 In the long-term, with or without the proposed scheme, 100% of the Culloden House Care Home development land is predicted to experience a potential significance of Slight Adverse. Therefore, no significant adverse noise impacts are predicted at the care home in the long-term.

8.4.63 In the short-term, with the proposed scheme, 33% of the Culloden House Care Home development land is predicted to experience a potential significance Slight/Moderate Adverse. Further analysis of the absolute noise levels across the development land shows that noise levels are predicted to be greater than 59.5dB $L_{A10,18h}$ across approximately 34% of the development land and it is therefore considered to be potentially significantly affected.

House Under Construction in Resaurie

8.4.64 In the long-term, with or without the proposed scheme, 100% of development land for the house under construction in Resaurie is predicted to experience a potential significance of Slight Adverse. Therefore, no significant adverse noise impacts are predicted at the house in the long-term.

8.4.65 In the short-term, with the proposed scheme, 75% of the development land for the house under construction in Resaurie is predicted to experience a potential significance of Slight/Moderate Adverse; further analysis of this area shows that noise levels are predicted to be less than 59.5dB $L_{A10,18h}$ and it is therefore not considered to be potentially significantly affected. The remaining 25% of the development land is predicted to experience a potential significance of Slight Adverse.

House Under Construction in Dell of Inshes

8.4.66 In the long-term, with or without the proposed scheme, 100% of development land for the house under construction in Dell of Inshes is predicted to experience a potential significance of Slight Adverse. Therefore, no significant adverse noise impacts are predicted at the house in the long-term.

8.4.67 In the short-term, with the proposed scheme, 98% of the development land for the house under construction in Dell of Inshes is predicted to experience a potential significance of Slight Beneficial. The remaining 2% of the development land is predicted to experience a neutral impact.

Amenity Areas

8.4.68 There are two amenity areas (Longman and Castle Stuart Bays SSSI/Inner Moray Firth SPA and Ramsar and Raigmore Skatepark) and 28 amenity lines (e.g. core paths, local paths, Rights of Way and the wider path network across Inverness Campus) which have been identified within the calculation area. Details of the potential noise impacts are provided in Appendix A8.6 (Noise Impacts on Amenity Areas).

8.4.69 As with the committed developments, Appendix A8.6 (Noise Impacts on Amenity Areas) provides a summary table reporting the percentage area/length of each amenity area/line subject to a change in free-field noise level.

8.4.70 In the long-term, without the proposed scheme, there is one amenity line (LP5) which is predicted to be exposed to a noise level increase of between 3dB to 4.9dB across 1% of its length. All other amenity areas and amenity lines are predicted to be exposed to a noise level change (increase or decrease) of less than 3dB.

8.4.71 The noise impacts on amenity areas/lines in the short-term, with the proposed scheme, are summarised in Table 8.26. It should be noted that this table highlights the least beneficial impacts of the proposed scheme, as the change in noise level over the total area/length will vary. Therefore, this table should be read in conjunction with the tables in Appendix A8.6 (Noise Impacts on Amenity Areas) to gain a full understanding of the potential noise impacts.

Table 8.26: Summary of Least Beneficial Noise Impacts on Amenity Areas/Lines in the Short-term with the Proposed Scheme

Amenity Area Noise Impact Assessment	Number of Amenity Areas/Lines								
	Increase in Noise Level				No Change	Decrease in Noise Levels			
	x ≥ 5dB	3 ≤ x < 5dB	1 ≤ x < 3dB	0 < x < 1dB	X = 0dB	-1 < x < 0dB	-3 < x ≤ -1dB	-5 < x ≤ -3dB	X ≤ -5dB
Amenity Areas	0	0	0	1	0	0	1	0	0
Amenity Lines	5	2	4	8	0	7	2	0	0

8.4.72 As shown in Table 8.26 in the short-term, with the proposed scheme, based on the least beneficial impact, one amenity area is predicted to be exposed to a decrease in noise of between 1dB to 2.9dB and one amenity area is predicted to be exposed to an increase in noise of less than 1dB.

8.4.73 In the short-term, with the proposed scheme, based on the least beneficial impact, 15 amenity lines are predicted to be exposed to a least beneficial change in noise level (increase or decrease) of less than 1dB. There are two amenity lines which are predicted to be at least partially exposed to a noise level decrease of between 1dB to 2.9dB. There are four amenity lines which are predicted to be at least partially exposed to a noise level increase of between 1dB to 2.9dB. There are two amenity lines which are predicted to be at least partially exposed to a noise level increase of between 3dB to 4.9dB. There are five amenity lines which are predicted to be at least partially exposed to a noise level increase of at least 5dB.

8.4.74 The potential noise impacts on amenity areas in the long-term, with the proposed scheme, are summarised in Table 8.27. As with Table 8.26, it should be noted that this table highlights the least beneficial impacts of the proposed scheme as the change in noise level over the total area/length will vary. Therefore, this table should be read in conjunction with the tables in Appendix A8.6 (Noise Impacts on Amenity Areas) to gain a full understanding of the potential noise impacts.

Table 8.27: Summary of Least Beneficial Noise Impacts on Amenity Areas/Lines in the Long-term with the Proposed Scheme

Amenity Area Noise Impact Assessment	Number of Amenity Areas/Lines								
	Increase in Noise Level				No Change	Decrease in Noise Levels			
	x ≥ 10dB	5 ≤ x < 10dB	3 ≤ x < 5dB	0 < x < 3dB	X = 0dB	-3 < x < 0dB	-5 < x ≤ -3dB	-10 < x ≤ -5dB	X ≤ -10dB
Amenity Areas	0	0	0	1	0	1	0	0	0
Amenity Lines	2	4	3	14	2	3	0	0	0

8.4.75 In the long-term, with the proposed scheme, the amenity areas assessed are predicted to be exposed to a change in noise level (increase or decrease) of less than 3dB.

8.4.76 In the long-term, with the proposed scheme, based on the least beneficial impact, 19 amenity lines are predicted to be exposed to a least beneficial change in noise level (increase or decrease) of less than 3dB. There are three amenity lines which are predicted to be at least partially exposed to a noise level increase of between 3dB to 4.9dB. There are four amenity lines which are predicted to be at least partially exposed to a noise level increase of between 5dB to 9.9dB. There are two amenity lines which are predicted to be at least partially exposed to a noise level increase of at least 10dB.

8.5 Mitigation

8.5.1 Mitigation measures for the proposed scheme in relation to noise and vibration are detailed below and take into account best practice, legislation, guidance and professional experience.

Embedded Mitigation

8.5.2 Six options, Options 1A, 1B, 2A, 2B, 3A and 3B, were considered in the route option appraisal undertaken at DMRB Stage 2. Overall, Options 3A and 3B were predicted to have the least number of perceptible adverse noise impacts, while all other options were predicted to have a similar, greater number. The proposed scheme alignment is based on Option 3B and as such, minimises the number of perceptible adverse noise impacts at NSRs.

Standard Mitigation

8.5.3 A Construction Environmental Management Plan (CEMP) will be prepared by the contractor. The CEMP will set out how the contractor intends to operate the construction site, including construction-related mitigation measures. The relevant section(s) of the CEMP will be in place prior to the start of construction work and will cover a range of aspects including noise and vibration **(Mitigation Item SM-01)**.

8.5.4 Prior to construction an Environmental Coordinator and team of suitably qualified Environmental Clerk of Works (EnvCoW) (i.e. professionally qualified in a relevant environmental discipline) will be appointed by the contractor. The EnvCoW(s) will report to the Environmental Coordinator and be present on site, as required, during the construction period to monitor the implementation of the

mitigation measures identified and ensure that activities are carried out in such a manner to prevent or reduce impacts on the environment outlined in the CEMP **(Mitigation Item SM-02)**.

8.5.5 As previously stated, at this stage of the proposed scheme, detailed methods and programming of work and type of plant to be employed during the construction phase are not known. A programme of noise and vibration monitoring will be agreed with the Environmental Health Officer (EHO) of The Highland Council, and noise and vibration limits will be contained within the CEMP (refer to **Mitigation Item SM-01**). The contractor will be required to develop and implement a Noise and Vibration Management Plan to meet these requirements. The Noise and Vibration Management Plan will include the design of any necessary Noise Sensitive Receptor (NSR) specific construction mitigation over and above the standard mitigation included within **Mitigation Item NV-02 (Mitigation Item NV-01)**.

8.5.6 The following mitigation measures, as recommended in BS 5228:2009+A1:2014, will be employed to minimise the noise impacts during the construction phase.

Community Relations **(Mitigation Item SM-03)**

8.5.7 As part of the communications strategy the contractor will appoint a Community Liaison Officer and liaison team who will:

- liaise with relevant local authorities; other statutory bodies and regulatory authorities; community councils and relevant community groups; and businesses and residents in local communities affected by the construction works;
- notify occupiers of nearby properties a minimum of two weeks in advance of the nature and anticipated duration of planned construction works that may affect them;
- support the production of project communications such as the project website and newsletters; and
- establish a dedicated freephone telephone helpline together with a dedicated email address and postal address for enquiries and complaints during the construction phase. The relevant contact numbers, email and postal addresses will as a minimum be displayed on signs around the construction site and will be published on the project website. Enquiries and complaints will be logged in a register and appropriate action will be taken in response to any complaints.

Training of Employees **(Mitigation Item SM-04)**

8.5.8 The contractor will ensure that all site workers receive adequate environmental training relevant to their role prior to working on the construction site, including specific environmental project inductions and ‘toolbox talks’ as required. This will include those relating to noise and vibration control, by employing techniques to keep site noise to a minimum. This would be effectively supervised to ensure that best working practice in respect of noise reduction is followed.

Execution of Works **(Mitigation Item NV-02)**

8.5.9 Best practicable means will be used to limit the level of noise to which operators and others in the vicinity of site operations will be exposed. This includes the following:

- the hours of working will be planned and account will be taken of the effects of noise upon persons in areas surrounding site operations and upon persons working on site, taking into account the nature of land use in the areas concerned, the duration of work and the likely consequence of any lengthening of work periods;
- any work outside of normal working hours will be agreed with The Highland Council;
- where reasonably practicable, quiet working methods will be employed, including use of the most suitable plant, reasonable hours of working for noisy operations, and economy and speed of operations;
- noise mitigation measures such as acoustic screens and earthwork bunds will be constructed as early as practical;

- noise will be controlled at source, for example, by modification of existing plant/equipment, its use and location and ensuring maintenance of all noise-generating equipment;
- the spread of noise will be limited, i.e. by distance between source and receiver and/or screening;
- on-site noise levels will be monitored regularly, particularly if changes in machinery or project designs are introduced, by a suitably qualified person appointed specifically for the purpose. A method of noise measurement will be agreed with The Highland Council prior to the commencement of site works;
- on those parts of a site where high levels of noise are likely to be a hazard to persons working on the site, prominent warning notices will be displayed and, where necessary, ear protectors will be provided;
- proper use of plant with respect to minimising noise emissions and regular maintenance in line with plant manuals;
- where practicable, vehicles and mechanical plant used for the purpose of the works will be fitted with effective exhaust silencers and will be maintained in good, efficient working order;
- where appropriate, inherently quiet plant will be selected. All major compressors would be 'sound reduced' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum;
- all ancillary plant such as generators, compressors and pumps will be positioned so as to cause minimum noise disturbance. If necessary, acoustic barriers or enclosures will be provided; and
- adherence to the codes of practice for construction working and piling given in British Standard BS 5228:2009+A1:2014 and the guidance given therein minimising noise emissions from the site.

8.5.10 The Highland Council will be consulted regarding any proposed working outwith normal working hours. The Highland Council will be the authority responsible for ensuring the contractor complies with agreed noise limits and taking action if there is an exceedance, or if best practicable means to limit noise are not being used. As discussed in paragraph 8.2.16, Section 60 of the Control of Pollution Act 1974 enables a local authority to serve a notice specifying its noise control requirements.

8.5.11 Where, following application of proposed mitigation and any Section 61 consents under the Control of Pollution Act 1974, noise levels are expected to still exceed the trigger levels defined in Annex E.4 of BS 5228:2009+A1:2014 and any Section 61 consents, a scheme for the installation of noise insulation or the reasonable costs thereof, or a scheme to facilitate temporary rehousing of occupants, as appropriate, would need to be implemented **(Mitigation Item NV-03)**.

Specific Mitigation

8.5.12 As previously discussed, mitigation will be implemented, where reasonably practicable (refer to paragraph 8.2.37), where the potential impact is of Slight/Moderate Adverse significance or higher and the predicted façade noise level exceeds 59.5dB $L_{A10,18h}$ at ground floor level during the daytime period, and/or 55.0dB $L_{night,outside}$ during the night-time period, at ground and/or first floor level. Tables 8.28, 8.29 and 8.30 show the number of residential buildings that may qualify for mitigation.

8.5.13 It should be noted that the DMRB Noise and Vibration assessment reports a single value noise level at the least beneficial façade of a property. However, mitigation is considered at all receptor points at all façades where an exceedance of the noise mitigation threshold criteria occurs.

Table 8.28: Mitigation Criteria Qualification (Short-term Day)

Number of Residential Buildings		
DS 2022 – DM 2022 Noise Level Change ≥ 1dB(A)	**DS 2022 Noise Level > 59.5dB ($L_{A10,18h}$)**	**Meets Mitigation Threshold Criteria**
315	300	6

Table 8.29: Mitigation Criteria Qualification (Long-term Day)

Number of Residential Buildings		
DS 2037 – DM 2022 Noise Level Change ≥ 3dB(A)	**DS 2037 Noise Level > 59.5dB ($L_{A10,18h}$)**	**Meets Mitigation Threshold Criteria**
102	351	2

Table 8.30: Mitigation Criteria Qualification (Long-term Night)

Number of Residential Buildings		
Ground Floor		
DS 2037 – DM 2022 Noise Level Change ≥ 3dB(A)	**DS 2037 Noise Level > 55.0dB ($L_{night,outside}$)**	**Meets Mitigation Threshold Criteria**
83	36	1
First Floor		
DS 2037 – DM 2022 Noise Level Change ≥ 3dB(A)	**DS 2037 Noise Level > 55.0dB ($L_{night,outside}$)**	**Meets Mitigation Threshold Criteria**
80	54	1

8.5.14 Where a NSR meets the mitigation criteria, additional NSR specific mitigation has been considered.

8.5.15 Overall, there are 12 dwellings (in seven residential buildings) that have exceedances of the mitigation threshold when considering all receptor points. These are:

- ten dwellings on Castlehill Court (Nos. 5 to 12, 12A and 14), to the south of the proposed scheme;
- Balvonie Cottage on the B9177, to the south of the propose scheme; and
- Drumossie Cottage on the B9177 and beside B9006 Culloden Road, to the south of the proposed scheme.

8.5.16 As discussed in paragraph 8.4.62, Culloden House Care Home, which is a committed development under construction at the time of writing, is also predicted to meet the mitigation criteria in the short-term, with the proposed scheme.

8.5.17 Further analysis of the predicted noise levels at these NSRs shows that the exceedances are being caused by strategic traffic flow changes (including traffic flow volume, speed and percentage of HGVs) on the road network beyond the proposed scheme and are not caused by road traffic noise directly from the proposed scheme. The noise level contribution from the roads passing these NSRs is more than 10dB above that from the proposed scheme, therefore any reduction in noise from the proposed scheme would have a negligible effect on the absolute noise levels experienced at these significantly affected NSR. This is due to the logarithmic relationship of decibels and how noise levels from different noise sources combine to give a resulting total noise level at a receptor.

8.5.18 At the 10 dwellings on Castlehill Court and Culloden House Care Home, the predicted exceedances are during the daytime period in the short-term only, due to predicted increases in traffic on Castlehill Road as a result of the proposed scheme. The road traffic noise levels are predicted to be less than 0.5dB above the noise mitigation threshold. Mitigation would only be effective if it reduced road traffic noise from Castlehill Road as it passes these NSRs. This would require noise barriers on the eastern boundary of Culloden House Care Home, where it abuts the Castlehill Road pavement, and between Castlehill Road and the other identified NSRs to the east of the road. Alternatively, the road traffic speed on Castlehill Road could be reduced with a lower speed limit, speed bumps or another traffic calming measure. This would require the compulsory purchase of land beyond the extent of the proposed scheme. These mitigation measures are not likely to be considered reasonably practicable for a reduction in noise which would not be perceptible and which is required in the short-term only. Accordingly, mitigation is not proposed for the 10 dwellings on Castlehill Court and Culloden House Care Home.

8.5.19 At Balvonie Cottage, the predicted exceedances are during the daytime in the long-term only, due to predicted increases in traffic on the B9177 as a result of the proposed scheme. The road traffic noise

levels are predicted to be 0.1dB above the noise mitigation threshold. There is a stone wall of approximately 1m height on the southern boundary of the property. Due to the precautionary approach to the noise assessment, local acoustic barriers such as walls on property or field boundaries are not included in the 3D noise models. When the noise attenuation provided by the wall is taken into account in both the Do-Minimum scenario in the baseline year and the Do-Something scenario in the future assessment year, no exceedances are predicted in the long-term. Therefore, no significant impacts are predicted at Balvonie Cottage and mitigation is not proposed.

8.5.20 At Drumossie Cottage, the predicted exceedances are during the daytime and night-time periods, in the short-term and long-term, due to predicted increases in traffic on the B9177 as a result of the proposed scheme. Consideration was given to proposing noise mitigation along the garden boundary facing on to the B9177. However, as the driveway of this property also shares this boundary then any additional mitigation would be ineffective due to the gap required to accommodate the driveway. Accordingly, mitigation for Drumossie Cottage is not considered to be reasonably practicable and is not proposed.

8.6 Residual Impacts

Construction

8.6.1 With appropriate noise and vibration mitigation measures employed, it is anticipated that any potentially significant adverse noise and vibration impacts associated with construction of the proposed scheme are unlikely to arise and any that do would be short-term in nature. Should the level of noise reduction required at any NSR not be practicable then the consideration of noise insulation or temporary rehousing as detailed in paragraph 8.5.11 would need to be implemented, where applicable.

Operation

8.6.2 As no receptor specific mitigation is proposed, the residual impacts remain the same as the operation impacts reported in Section 8.4 (Potential Impacts).

Residual Noise Impacts at all Noise Sensitive Receptors

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Baseline Year (Short-term Assessment)

8.6.3 The short-term assessment indicates that there are 11 NSRs which are considered to have a residual significant noise impact. These are:

- ten dwellings on Castlehill Court (Nos. 5 to 12, 12A and 14), to the south of the proposed scheme; and
- Drumossie Cottage on the B9177 and beside B9006 Culloden Road, to the south of the proposed scheme.

8.6.4 In addition, Culloden House Care Home, which is under construction at the time of writing, is considered to have a residual significant noise impact in the short-term.

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Future Assessment Year (Long-Term Assessment)

8.6.5 The daytime noise levels at ground floor level and night-time noise levels at ground and first floor levels in the long-term assessment indicate that there is one NSR which is predicted to experience a significant residual noise impact; Drumossie Cottage on the B9177 and beside B9006 Culloden Road, to the south of the proposed scheme.

8.7 Statement of Significance

8.7.1 With the proposed scheme in place, there are 11 existing NSR which are considered to have a significant residual noise impact, when considering all receptor points around the NSR.

8.7.2 These NSRs and associated noise levels and significance of residual impact are presented in Table 8.31, Table 8.32 and Table 8.33. The noise levels with the greatest exceedance of the noise threshold criteria at each NSR are presented, rather than the least beneficial chance in noise, which may not result in a significant effect (the least beneficial changes in noise for all NSRs are presented in Appendix A8.3). As has been previously stated, the reason for a significant impact being identified for these NSRs is due to road traffic flow changes on the roads beside the NSRs, and not from road traffic noise from the proposed scheme directly.

Table 8.31: NSRs with a Significant Effect (Short-term Day)

NSR ID	NSR Name	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact		
		DM 2022	DS 2022	Significance of Impact
NV0608	12A Castlehill Court	61.3	62.5	Slight/Moderate Adverse
NV0613	5 Castlehill Court*	60.7	61.9	Slight/Moderate Adverse
NV0614	6 Castlehill Court*	60.7	61.9	Slight/Moderate Adverse
NV0615	7 Castlehill Court*	61.0	62.1	Slight/Moderate Adverse
NV0616	8 Castlehill Court*	61.0	62.1	Slight/Moderate Adverse
NV0617	9 Castlehill Court*	60.8	62.0	Slight/Moderate Adverse
NV0618	10 Castlehill Court*	60.8	62.0	Slight/Moderate Adverse
NV0619	11 Castlehill Court	61.7	62.9	Slight/Moderate Adverse
NV0620	12 Castlehill Court	61.7	62.9	Slight/Moderate Adverse
NV0621	14 Castlehill Court	61.3	62.5	Slight/Moderate Adverse
NV1673	Drumossie Cottage	68.5	69.8	Slight/Moderate Adverse

*These NSRs are considered to have a significant impact when considering all receptor points around the NSRs. However, when considering the least beneficial changes in noise level they would not be considered significant. The least beneficial changes in noise levels at these NSRs are presented in Appendix A8.3 (Predicted Noise Levels at Receptors).

Table 8.32: NSRs with a Significant Effect (Long-term Day)

NSR ID	NSR Name	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact		
		DM 2022	DS 2037	Significance of Impact
NV1673	Drumossie Cottage	68.5	72.8	Slight/Moderate Adverse

Table 8.33: NSRs with a Significant Effect (Long-term Night)

NSR ID	NSR Name	Predicted $L_{night,outside}$ (dB) Noise Level (Free-field) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2022	DS 2037	Significance of Impact	DM 2022	DS 2037	Significance of Impact
NV1673	Drumossie Cottage	55.6	59.5	Slight/ Moderate Adverse	56.4	60.0	Slight/ Moderate Adverse

8.7.3 In addition, Culloden House Care Home, which is under construction at the time of writing, is predicted to experience a potential significance of Slight/Moderate Adverse and noise levels greater than 59.5 dB $L_{A10,18h}$ and is considered to have a residual significant noise impact in the short-term.

8.7.4 There are no other impacts considered to be significant in the context of the EIA Regulations.

8.8 References

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