10 Noise and Vibration

10.1 Introduction

10.1.1 This chapter presents the Design Manual for Roads and Bridges (DMRB) Stage 2 assessment of the expected noise and vibration impacts arising from each of the route options on the nearest sensitive receptors (such as residential properties, schools, hospitals and care homes).

10.1.2 The assessment includes the following:

- baseline conditions within the calculation area;
- potential impacts of each of the route options with regard to the identified baseline conditions;
- outline of the possible number of properties for which mitigation measures would be considered for each of the route options; and
- a summary of the types of mitigation that could be incorporated into the DMRB Stage 3 design for the preferred option.

10.1.3 The assessment is supported by the following appendices, which can be found in Part 6 (Appendices) of this report:

- Appendix A10.1 Noise and Vibration – Introduction and Terms;
- Appendix A10.2 Predicted Road Traffic Noise Levels at Sample Noise Sensitive Receptors (NSRs); and
- Appendix A10.3 Predicted Changes in Road Traffic Noise Levels at Noise Sensitive Outdoor Areas.

10.2 Approach and Methods

Scope and Guidance

10.2.1 The assessment of road traffic noise and vibration is carried out according to established prediction and assessment methodologies that are governed or guided by the following key documents:

- DMRB Volume 11, Section 3, Part 7, HD213/11: Noise and Vibration (Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2011) (hereafter DMRB HD213/11);
- DMRB Volume 11, Section 2, Part 5, HA205/08: Assessment and Management of Environmental Effects (Highways Agency, Scottish Government, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2008); and
- Calculation of Road Traffic Noise (CRTN) (Department of Transport Welsh Office 1988) (hereafter CRTN).

10.2.2 In consideration of mitigation, reference was made to the advice contained in the document ‘Guidance for possible measures to manage noise from road and rail’ (The Scottish Government 2016).

Study Area

10.2.3 The study area for the noise assessment was defined in accordance with DMRB HD213/11.

10.2.4 The calculation area is defined as the total area within the following 600m boundaries:

- route option;
- bypassed routes on the A96 Aberdeen – Inverness Trunk Road and A9; and

- roads, within 1km of the route options and bypassed routes, on the existing road network that are predicted to result in noise changes of 1dB in the modelled opening year or 3dB in the modelled design year.

10.2.5 DMRB HD213/11 also requires consideration beyond the calculation area, to take into account the likely noise impacts on the wider road network (considered in terms of change in basic noise level (BNL)). This is required for any roads where there is a 1dB increase or decrease in noise in the modelled opening year and/or a 3dB increase or decrease in the modelled design year in comparison with the modelled opening year. At this stage of the assessment process, BNLs have not been calculated for each of the route options and therefore the likely noise impacts on the wider road network have not been considered. This is discussed further in the limitations section (paragraphs 10.2.41 to 10.2.46).

Baseline Data

10.2.6 The future assessment year scenarios available from the Moray Firth Transport Model (MFTM) for the DMRB Stage 2 noise assessment are the modelled opening year of 2021 and the modelled design year of 2036. These are not necessarily the actual opening and design years of the scheme. Further details of the transport modelling are provided in Part 4 (Traffic and Economic Assessment).

10.2.7 Much of the area through which the route options pass is currently rural and is likely to have a relatively low existing baseline noise climate, although future development in this area is anticipated (as described in Chapter 8: Policies and Plans). However, most of the Noise Sensitive Receptors (NSRs) nearest to the route options are in residential areas, where existing baseline noise levels may be higher due to higher levels of noise generated by human activity, including road traffic noise. The significance of road traffic noise on existing baseline noise levels will be dependent on distance to trafficked roads, and the traffic flow, composition and speed on those roads.

10.2.8 Baseline noise monitoring has not been undertaken for the route options at this stage, since it is not required for the Simple Assessment (as defined in DMRB HD213/11) that has been undertaken for the DMRB Stage 2 assessment. Instead, baseline (or Do-Minimum (DM)) noise levels have been established using predicted traffic data for the modelled opening year (2021), without the route options in place. This may underestimate the overall noise levels at NSRs in more rural locations away from busy roads with free-flowing traffic. This is discussed further in the limitations section (paragraphs 10.2.41 to 10.2.46). Baseline noise monitoring will be undertaken for the DMRB Stage 3 noise and vibration assessment of the preferred option.

Impact Assessment

10.2.9 Disruption caused during the construction phase of the route options has the potential to impact residents and other sensitive receptors adjacent to the works. Both DMRB HD213/11 and the Scottish Government publication ‘Technical Advice Note (TAN) - Assessment of Noise’ (The Scottish Government 2011b) advise on the use of BS 5228 ‘Code of Practice for Noise and Vibration Control on Construction and Open Sites’ to assess and control noise and vibration from construction activities (British Standards Institution 2014a; British Standards Institution 2014b).

10.2.10 At present, there is no construction programme, nor details of likely construction plant and equipment to be used available to assist in carrying out detailed construction noise predictions. Therefore, an assessment of construction noise impacts cannot be carried out at this stage. Construction noise predictions would be carried out during the DMRB Stage 3 assessment, when a preferred option has been identified and a more detailed scheme design is available. Predicted impacts would be assessed against the criteria set out in BS 5228-1 Method 2 (British Standards Institution 2014a).

10.2.11 The assessment of noise levels during operation (e.g. road traffic noise) at various noise sensitive receivers has followed the Simple Assessment methodology outlined in DMRB HD213/11. The assessment considers the noise and vibration climate both with and without the route options, referred to as the Do-Something (DS) and DM, respectively.

Noise Model Assumptions

10.2.12 Noise levels have been calculated at NSRs (residential dwellings and other sensitive receptors) within the calculation area as defined in paragraph 10.2.4. DMRB HD231/11 provides examples of NSRs. Examples of other sensitive receptors include hospitals, schools, community facilities, designated areas (e.g. National Scenic Area, National Park, Special Area of conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Scheduled Monument) and public rights of way such as footpaths.

10.2.13 This assessment considers noise level changes at NSRs according to their existing baseline façade noise levels. It should be noted that in this context, the baseline is considered to be the DM scenario in the modelled opening year (2021).

10.2.14 The following comparisons are made:

- DM scenario in the modelled opening year (2021) against DS scenario in the modelled opening year (2021); and
- DM scenario in modelled opening year (2021) against DS scenario in the modelled design year (2036).

10.2.15 The design year is that defined as the year within the first 15 years of the modelled opening year where traffic flows are greatest. Therefore, the design year is usually 15 years after the modelled opening year, which in this assessment is 2036, which is the year considered.

10.2.16 Consideration has also been given to night-time noise levels in accordance with DMRB HD213/11. Consideration is given to those receptors that are predicted to experience a $L_{night,outside}$ noise level of 55dB or greater in any scenario.

10.2.17 In the absence of hourly traffic data, Method 3 within the Transport Research Laboratory (TRL) Report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' (Abbot and Nelson 2002) has been used to determine estimated night-time levels from daytime 18-hour Annual Average Weekday Traffic (AAWT) flows. The estimated night-time levels are dependent upon whether the road is classified as a 'Motorway' or 'Non Motorway'. In general, for 'Motorways', the estimated night-time noise levels using Method 3 are slightly lower than the daytime levels, to represent the relatively consistent use of the motorway network during all periods (day, evening and night). For 'Non Motorways', estimated night-time noise levels are considerably lower than daytime levels, which is generally consistent with traffic usage on these types of road.

10.2.18 The night-time noise predictions presented in this assessment have assumed that the proposed road is classified as a 'Non-Motorway' and the following comparison is made:

- DM scenario in modelled opening year (2021) against DS scenario in the modelled design year (2036).

10.2.19 At the time of writing, the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme has not been constructed. For the purposes of this assessment, it has been assumed that the A9/A96 Inshes to Smithton scheme will join this new road. Therefore, the design outlined in the draft orders for the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme has been included in both the DM and the DS scenarios, as it is assumed it would be operational on the modelled year of opening.

10.2.20 Noise levels at receptors have been calculated using the CadnaA® noise modelling package, which incorporates the methodology contained in the CRTN (1988). CRTN is a technical memorandum produced by the Department for Transport and Welsh Office providing a method for predicting road traffic noise in the United Kingdom.

10.2.21 Noise level predictions take account of typical weekday volumes of traffic during the eighteen-hour period from 6am to midnight (18-hour AAWT flows) and the following variables:

- percentage of Heavy Goods Vehicles (HGVs);
- traffic speeds;
- road gradient;
- local topography;
- nature of the ground cover between the road and the receptor;
- shielding effects of any intervening structures, including allowances for limited angles of view from the road and any reflection effects from relevant surfaces; and
- road surfacing type.

10.2.22 It has been assumed that the road surface on the existing road network is conventional hot rolled asphalt (HRA) with a texture depth of 2mm, in both the modelled opening and design years. For the route options, it has been assumed that a low noise road surface (LNRS) would be used for slip roads with an 18-hour AAWT vehicle speed of greater than or equal to 75kph, but not for the mainlines of the route options (where 18-hour AAWT vehicle speeds would be less than 75kph), which is modelled as HRA, or any altered local roads, such those altered to connect to the mainlines of the route options or those gaining or losing a lane, which remain as HRA. A LNRS has also been assumed for the mainline and slip roads for the A96 Dualling Inverness to Nairn (including Nairn Bypass) (Jacobs 2016). The roads which have a LNRS have been assumed to have an associated surface correction in line with the maximum allowable correction contained within DMRB HD213/11, as detailed below.

10.2.23 DMRB HD213/11 provides specific guidance in relation to the noise level correction that should be applied when using LNRS for new carriageways. It states that, '*where new carriageways are to be constructed and a thin surfacing system [low noise surfacing] used, or where an existing surface is to be replaced with a thin surfacing system, a -3.5dB(A) correction should be assumed for the thin surface system [equivalent to a Road Surface Influence (RSI) of -5dB(A)] unless any information is available regarding the specific surface to be installed. This advice applies where the mean traffic speed is >= 75kph. Where the mean speed is < 75kph, a -1dB(A) correction should be applied to a new low-noise surface*'.

10.2.24 In line with DMRB HD213/11, a minimum traffic speed of 20kph is used in the noise model where the traffic model predictions provide speeds less than this.

10.2.25 Within the traffic modelling data provided for each of the route options, there are some road links on which a traffic flow of <1,000 vehicles (18-hour AAWT flow) are detailed. CRTN paragraph 30 provides guidance on the reliability of low traffic flows and states that calculations of noise level for traffic flows below 1,000 vehicles (18-hour AAWT) are unreliable. As such, a number of assumptions have been made for this assessment:

- where, for a particular road link, the traffic flows for all years assessed are all <1,000 vehicles (18-hour AAWT flow), the flow for each scenario is assumed to be zero vehicles, i.e. the road is not included in the assessment; and
- where, for a particular road link, the traffic flows vary around the threshold level of 1,000 vehicles (e.g. DM 2021 = 900 and DS 2021 = 1,100), the traffic flows which are <1,000 vehicles (18-hour AAWT flow) are also included in the assessment. This approach is taken to avoid exaggerating any increase or reduction in noise which would occur if one of the traffic flows was assumed to be zero.

10.2.26 Horizontal and vertical alignment information of the route options and surrounding areas were derived from the three dimensional model of the DMRB Stage 2 route option designs.

10.2.27 Identification of sensitive receptors is based on Ordnance Survey (OS) MasterMap and Address Base Plus data purchased in October 2013. Existing building heights are assumed to be 8m high, except for 'small buildings' (defined as those with a building footprint area of less than 20m^2 and an area divided by the perimeter of less than 1.2[1]), which were assumed to be 3m high.

10.2.28 Existing ground (acoustic) absorption has been derived from OS MasterMap data. For the purposes of the route option comparison undertaken for this DMRB Stage 2 assessment, the ground within each route option boundary has been assumed to be hard ground. The ground absorption within the route option boundary will be modelled in more detail during the DMRB Stage 3 noise and vibration assessment of the preferred option.

10.2.29 Road traffic noise levels have been calculated at NSRs at ground floor and first floor levels, at 1.5m and 4m height, respectively.

10.2.30 Where applicable, noise levels at sensitive receptors have been predicted at a distance of 1m from the most exposed façade and include a 2.5dB façade correction. Noise levels for sensitive receptors positioned in open spaces and for the night-time period are free-field.

10.2.31 For open, outdoor space sensitive receptors, such as park and other recreational areas, the change in road traffic noise levels has been calculated across the whole of the sensitive area. The results for open, outdoor spaces are presented in terms of the proportion of each space that each magnitude of impact category is predicted to cover.

Assessment of Impact

Introduction

10.2.32 It should be noted that whilst DMRB HD213/11 provides guidance for the magnitude of noise level changes it does not provide any guidance on assessing the significance of noise effects. Accordingly, the reported noise impacts have been assessed using the significance of noise impact scale provided in the Scottish Government's TAN (The Scottish Government 2011b), which accompanies PAN 1/2011 (The Scottish Government 2011a). The significance of impact matrix is based on the predicted noise levels, the magnitude of noise level change between each scenario (based on the magnitude of impact tables) and the sensitivity of noise receptors (presented in the TAN).

Sensitivity of Noise Sensitive Receptors

10.2.33 The sensitivity of NSRs to road traffic noise has been determined based on the criteria provided in Table 10.1 (reproduced from TAN Table 2.1).

Table 10.1: Criteria Used to Define Noise Sensitive Receptors

Sensitivity	Description	Example 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	Offices

[1] As defined in 'Facilitation of Strategic Noise Mapping for the Environmental Noise Directive 2002/49/EC Implementation', Scottish Executive Environmental Group, 2005.

Sensitivity	Description	Example of Receptor Usage
	noise, where it may cause some distraction or disturbance	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)
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

10.2.34 Section 3 of DMRB HD213/11 provides guidance on the magnitude of impacts for traffic noise. Magnitude of impact is considered for both the short and long term. A change in road traffic noise of 1dB in the short term (for example when a project is opened) is the smallest that is considered perceptible. In the long term, a 3dB change is considered perceptible. The classification of noise impact magnitude is as detailed in Tables 10.2 and 10.3 and is applied to all sensitive receptors in this assessment.

Table 10.2: Classification of Magnitude of Short-Term Noise Impacts

Noise Change ($L_{A10,18h}$)	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

Table 10.3: Classification of Magnitude of Long-Term Noise Impacts

Noise Change ($L_{A10,18h}$/$L_{night,outside}$)	Magnitude of Impact
0	No change
0.1 – 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10+	Major

10.2.35 For the assessment of night-time noise impacts, DMRB HD213/11 advises that until further research is available, only noise impacts in the long term should be considered. Therefore, the classification in Table 10.3 is used in this assessment for determining night-time noise impacts. In addition, DMRB HD213/11 advises only those sensitive receptors predicted to be subject to free-field noise levels exceeding 55dB $L_{night,outside}$ should be considered.

Significance of Noise Impacts

10.2.36 In relation to the above, the Scottish Government's TAN provides details of the significance of noise impacts based on noise change and the sensitivity of the receptor. Table 10.4 reproduces Table 2.6 - Significance of Effects from the TAN.

Table 10.4: Significance of Effects (TAN)

Magnitude of Impact	Level of Significance Relative to Sensitivity of Receptor		
	Low	Medium	High
Major	Slight/Moderate	Moderate/Large	Large/Very Large
Moderate	Slight	Moderate	Moderate/Large
Minor	Neutral/Slight	Slight	Slight/Moderate
Negligible	Neutral/Slight	Neutral/Slight	Slight
No Change	Neutral	Neutral	Neutral

10.2.37 The level of significance and its relevance to the decision making process is detailed in the TAN, as follows:

- Very Large: These effects represent key factors in the decision making process. They are generally, but not exclusively, associated with impacts where mitigation is not practical or would be ineffective.
- Large: These effects are likely to be important considerations in the decision making process, but where mitigation may be effectively employed such that resultant adverse effects are likely to have a Moderate or Slight significance.
- Moderate: These effects, if adverse, while important, are not likely to be key factors in the decision making process.
- Slight: These effects may be raised but are unlikely to be of importance in the decision making process.
- Neutral: No effect, not significant, noise need not be considered as a determining factor in the decision making process.

Ground Borne Vibration and Vibration Nuisance

10.2.38 DMRB HD213/11 advises that an assessment of ground borne vibration and vibration nuisance should only be considered during a Detailed Assessment. Therefore, this should be considered during the DMRB Stage 3 noise and vibration assessment of the preferred option and is not considered in this DMRB Stage 2 assessment.

Mitigation

10.2.39 Potential mitigation measures are discussed in Section 10.6 (Potential Mitigation). This provides information on the types of mitigation that could be incorporated into the DMRB Stage 3 design for the preferred option.

10.2.40 At this stage, it is not possible to design specific mitigation measures and therefore predict the reduction of impacts for each of the route options. However, it is possible to illustrate the numbers of properties for which mitigation would be likely to be considered for each of the route options. For this purpose, for a DMRB Stage 2 options appraisal report, indicative triggers have been adopted. Taking into account WHO and DMRB guidance, mitigation is considered where the significance of impact at a receptor has been assessed as Slight/Moderate adverse or worse, and where the predicted ground floor façade level exceeds 59.5dB $L_{A10,18h}$. In addition, mitigation taking cognisance of the WHO Night Noise Guidelines, has also been considered during the night-time period in the long-term where the significance of impact at a receptor has been assessed as Slight/Moderate adverse or worse, and where the predicted noise level exceeds 55dB $L_{night,outside}$.

Limitations to Assessment

10.2.41 There are a number of consented planning applications within the study area which are likely to include additional sensitive receptors. However, due to uncertainties regarding future land use (e.g. whether consented planning applications or development land allocations will be implemented and if they are, the layout of these sites), the potential noise and vibration impacts on these receptors are considered within Chapter 17 (People and Communities: Community and Private Assets) and form part of an overall assessment of the amenity impacts on these receptors.

10.2.42 Identification of sensitive receptors is based on Ordnance Survey (OS) MasterMap and Address Base Plus data purchased in October 2013. There may in some cases be properties, such as those recently built, which are not yet present within these data sources. In comparison to the large number of receptors considered in the study area, these properties are not expected to have a great influence on the route options comparison undertaken for this DMRB Stage 2 assessment. Every endeavour will be made to identify and consider all such properties during the DMRB Stage 3 assessment.

10.2.43 Baseline noise monitoring has not been undertaken for the route options at this stage in the assessment process. Instead, baseline (or DM) noise levels have been established using predicted traffic data for the modelled opening year (2021), without the route options in place. This is likely to underestimate the baseline noise levels at rural locations, where other sources of noise are likely to contribute to baseline noise levels, but are not calculated in the noise model.

10.2.44 Traffic data is fundamental to predicting noise levels, thus facilitating the noise and vibration assessment of a scheme. Traffic flow, composition and speed data all contribute in calculating noise levels. Traffic data have been provided for the modelled opening year (2021) and design year (2036) for the DM and DS scenarios, using the DMRB Stage 2 design for the route options. The accuracy of the noise predictions performed has a direct correlation with the accuracy of the traffic data provided.

10.2.45 It is considered that all data inputs for this assessment are of an adequate level to support a Simple Assessment as defined in DMRB HD213/11.

10.2.46 BNL calculations have not been undertaken at this stage of the assessment process; instead, the route options comparisons have focussed on sensitive receptors within the noise model area. BNL changes outside the noise modelling area would be considered during the DMRB Stage 3 assessment of the noise impact of the preferred option.

10.3 Policies and Plans

10.3.1 Part 6 (Appendices), Appendix A8.1 (Planning Policy Context for Environmental Assessment) of this report describes the planning policies and guidance from national to local level which are relevant to Noise and Vibration. An assessment of the compliance of the route options against all development plan policies relevant to this environmental topic is reported in Part 6 (Appendices), Appendix A8.2 (Assessment of Development Plan Policy Compliance) and a summary overview is provided in Chapter 8 (Policies and Plans), Section 8.4 (Compliance with Policies and Plans).

10.4 Baseline Conditions

10.4.1 Baseline noise levels within the calculation area were predicted using the noise model for the DM baseline year (2021) traffic scenario as required by DMRB HD213/11, paragraph 3.8. The CRTN prediction method provides noise forecasts across the entire study area under consistent scenarios (i.e. not subject to traffic flow variations, or meteorological variations that would affect propagation scenarios). The CRTN procedure assumes a moderately adverse wind scenario, with the wind blowing from the source to the receiver (as described in CRTN paragraph 4).

10.4.2 Due to the large number of receptors within the calculation area (over 5,000), the predicted baseline noise levels have not been provided in this section, but have been used in the assessment to determine noise changes on scheme opening and in the long term. The baseline noise levels for a sample of noise sensitive receptors are provided in the DM 2021 column of the results tables in Section 10.5 (Impact Assessment).

10.4.3 The noise environment in parts of the calculation area are likely to be dominated by traffic noise (at locations close to the residential areas of Inshes, Westhill and Smithton, and close to the existing A9 Perth – Inverness Trunk Road and A96 Aberdeen – Inverness Trunk Road), and therefore predictable using the road traffic noise model.

10.4.4 From maps and satellite imagery, other locations are currently rural and appear to have relatively few sources of road traffic in the area. The noise climate at such locations are likely to be influenced by farming activities, birdsong and other local noise sources, as well as distant transportation noise. Baseline noise monitoring at representative sensitive receptors would be performed at a later stage in the assessment process, once a preferred option for the scheme has been identified.

10.4.5 In accordance with the Environmental Noise Directive 2002/49/EC (END), a series of Noise Action Plans have been prepared by the Scottish Government for the largest Scottish Cities and transport routes, published in 2014. The geographical scope for Transportation Noise Action Plans is determined by the location of roads with more than three million vehicle passages a year.

10.4.6 The sections of the A9 Perth – Inverness Trunk Road and A96 Aberdeen – Inverness Trunk Road near Inverness were included in the noise mapping exercise and subsequent Transportation Noise Action Plan. The two nearest Candidate Noise Management Areas (CNMA) are Telford Street and Bank Street in Inverness. However, both of these are outwith the calculation area for the route options under assessment.

10.5 Impact Assessment

Introduction

10.5.1 The potential impacts are reported in line with the following:

- With the exception of the inclusion of a LNRS on slip roads as described in paragraph 10.2.22, the potential impacts are described without mitigation and therefore represent a worst-case scenario. Mitigation to reduce these impacts will be developed for the preferred option during the DMRB Stage 3 assessment.
- Potential impacts are presented during operation only. Construction impacts have not been considered as part of this DMRB Stage 2 assessment as no construction programme, or details of likely construction plant and equipment to be used is available. This will be progressed as part of the DMRB Stage 3 assessment following development of the preferred option.
- A large number of factors influence predicted noise levels at nearby sensitive receptors, including traffic flows, composition, speeds, relative heights of source and receptors, road gradients, type of intervening ground and screening. With such a multitude of factors, noise impacts can be quite variable even for a given group of receptors within a single area. As such, it is expected that there will be very few impacts which are common to all (i.e. where the change in noise level will be the same). Therefore, no common to all impacts have been reported, with all impacts reported collectively for each route option.
- Due to the large number of receptors potentially impacted by each of the route options, the impacts have not been listed separately against each receptor. The assessment approach is concerned with the total numbers of receptors impacted by the route options in each impact category, and not where those receptors are specifically located within the calculation area. However, to provide examples of the predicted changes in absolute noise levels, the predicted road traffic noise levels are presented for a sample of NSRs.

- Based on the assessment methodology detailed within DMRB HD213/11, noise calculation areas have been determined individually for each of the route options. These calculation areas have been merged into a single, overall calculation area, and used in the noise assessment for each route option, so that the total numbers of receptors considered for each route option is the same.
- The methodology for calculating the noise changes for each option is based on the assessment at the least beneficial façade. DMRB HD213/11 states:

  '*It is acknowledged that the results from this assessment may often show the worst case and highlight mainly the adverse impacts of a road project. Where the road project has beneficial impacts that are not clear from the assessment these should be reported by the Overseeing Organisation's supply chain'.*

10.5.2 Therefore, the DM noise level is presented for each option, as it can change from scenario to scenario depending on which façade is the least beneficial for each option.

10.5.3 To provide context to the impact assessment, an overview of the potential impacts for road schemes in relation to noise are discussed below.

10.5.4 During operation, noise changes are experienced where there are new or removed roads, changes in horizontal or vertical alignments, changes in traffic flows, speeds or composition, increased or decreased screening and changes in road surfacing type.

10.5.5 Adverse residual operational noise and vibration impacts would be permanent in nature and in general terms, where a new road is constructed and results in road traffic being moved closer to a sensitive receptor, an adverse impact will occur (assuming no noise mitigation and all variables otherwise remain constant). The variables include (but are not limited to):

- distance between the new road and the NSRs;
- traffic flow, composition, speed, and road running surface; and
- presence of existing/proposed screening of the road noise source.

10.5.6 Beneficial operational noise impacts would be permanent in nature and are likely to occur where the road traffic is relocated further away from receptors.

Impact on Sample Noise Sensitive Receptors

<u>Location of Sample Noise Sensitive Receptors</u>

10.5.7 Predicted road traffic noise levels have been presented for the sample NSRs identified in Table 10.5. The sample NSRs were selected examples of the predicted changes in road traffic noise levels near to and along the length of the route options and bypassed routes. The locations of the sample NSRs are highlighted in Figure 10.1.

Table 10.5: Sample NSR Locations

ID	Address	Grid Reference	
		Easting	Northing
01	27 Woodgrove Crescent	268973	844126
02	7 Inshes Holdings	269075	844455
03	Thistlefield, 4B Inshes Holdings	269455	844227
04	9 Cradlehall Meadows	269977	844868
05	Annfield, Caulfield Road North - Smithton Road	270628	845113
06	Ashton Farm, Caulfield Road North - Smithton Road	270121	845429
07	49 Cranmore Drive	270912	845483
08	Stratton Farmhouse, Barn Church Road	270552	846009
09	Seafield of Raigmore, A96T A9T Raigmore Interchange - B9039 Junction	269692	846025
10	281 Mackintosh Road	268664	845520

Summary of Assessment of Impact on Sample Noise Sensitive Receptors

10.5.8 The predicted road traffic noise levels at sample NSRs for all options in the short-term and long-term are presented in Part 6 (Appendices), Appendix A10.2: Predicted Road Traffic Noise Levels at Sample Noise Sensitive Receptors (NSRs). A summary of the predicted noise impacts, in terms of significance (as defined in Table 10.4), are presented below.

27 Woodgrove Crescent (ID 01)

10.5.9 At 27 Woodgrove Crescent (ID 01) in the short-term, impacts of a Large/Very Large adverse significance are predicted for route options 1A, 1B, 2A and 2B, where the west end of the route options pass relatively near to the NSR. Impacts of a Slight adverse significance are predicted for route options 3A and 3B, as these route options do not extend towards the NSR, and road traffic noise levels in the area do not alter significantly. The same is true in the long-term for daytime.

10.5.10 In the long-term at night, impacts of a Large/Very Large adverse significance are predicted for route options 1A, 1B, 2A and 2B. No significant impacts are predicted for route options 3A and 3B, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB.

7 Inshes Holdings (ID 02)

10.5.11 At 7 Inshes Holdings (ID 02) in the short-term, impacts of a Slight beneficial significance are predicted for route options 1A, 1B, 2A and 2B because of the predicted reduction in traffic flow on the A9 Perth – Inverness Trunk Road and Culloden Road. Impacts of a Slight adverse significance are predicted for route options 3A and 3B because of the predicted increase in traffic flow on Culloden Road. In the long-term during daytime, impacts of a Slight adverse significance are predicted for all route options because of the predicted increases in traffic across the road network.

10.5.12 In the long-term at night, impacts of a Slight adverse significance are predicted for route options 1A and 1B. No significant impacts are predicted for route options 2A, 2B, 3A and 3B, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB.

10.5.13 It should be noted that there are no perceptible noise changes predicted at 7 Inshes Holdings (ID 02) for any route option.

Thistlefield (ID 03)

10.5.14 At Thistlefield (ID 03) in the short-term, impacts of a Large/Very Large adverse significance are predicted for route options 1A, 1B, 2A and 2B, where the west ends of the route options pass relatively near to the NSR. Impacts of a Slight Adverse, Neutral or Slight beneficial significance, with no perceptible noise changes, are predicted for route options 3A and 3B, as these route options do not extend towards the NSR.

10.5.15 In the long-term during daytime, impacts of a Moderate/Large adverse significance are predicted for route options 1A, 1B, 2A and 2B. Impacts of a Slight adverse significance are predicted for route options 3A and 3B, because of predicted increases in traffic across the road network.

10.5.16 In the long-term at night, no significant impacts are predicted, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB for all route options.

9 Cradlehall Meadows (ID 04)

10.5.17 At 9 Cradlehall Meadows (ID 04) in the short-term, impacts of a Large/Very Large adverse significance are predicted for route options 1A, 2A, 1B, 2B and 3B and impacts of a Moderate/Large adverse significance are predicted for route option 3A. The B variants generally result in more adverse impacts because these are located nearest to the NSR than the A variants.

10.5.18 In the long-term during daytime, impacts of a Moderate/Large adverse significance are predicted for all route options.

10.5.19 In the long-term at night, no significant impacts are predicted, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB for all route options.

Annfield (ID 05)

10.5.20 At Annfield (ID 05) in the short-term, impacts of a Slight/Moderate adverse significance are predicted for route options 1A, 1B, 2A, 2B and 3B and an impact of Slight adverse significance is predicted for route option 3A.

10.5.21 In the long-term during daytime, impacts of a Slight/Moderate adverse significance are predicted for route options 1B and 2B and impacts of a Slight adverse significance are predicted for route options 1A, 2A, 3A and 3B. The B route options generally result in more adverse impacts because these are located nearest to the NSR than the A route options.

10.5.22 In the long-term at night, no significant impacts are predicted, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB for all route options.

Ashton Farm (ID 06)

10.5.23 At Ashton Farm (ID 06) in the short-term, impacts of a Large/Very Large adverse significance are predicted for route options 1B, 2B and 3B, impacts of a Moderate/Large adverse significance are predicted for route options 1A and 2A and an impact of a Slight/Moderate adverse significance is predicted for route option 3A.

10.5.24 In the long-term during daytime, impacts of a Moderate/Large adverse significance are predicted for route options 1B, 2B and 3B and impacts of a Slight/Moderate adverse significance are predicted for route options 1A, 2A and 3A. The B route options result in more adverse impacts because these are located nearest to the NSR than the A route options.

10.5.25 In the long-term at night, no significant impacts are predicted, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB for all route options.

49 Cranmore Drive (ID 07)

10.5.26 At 49 Cranmore Drive (ID 07) in the short-term, an impact of a Slight/Moderate significance are predicted for route option 1B and impacts of Slight adverse significance are predicted for route options 1A, 2A, 2B, 3A and 3B.

10.5.27 In the long-term during daytime, impacts of a Slight adverse significance are predicted for all route options.

10.5.28 In the long-term at night, no significant impacts are predicted, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB for all route options.

Stratton Farmhouse (ID 08)

10.5.29 At Stratton Farmhouse (ID 08) in the short-term and long-term during daytime, impacts of a Slight adverse significance, with no perceptible noise change, are predicted for all route options.

10.5.30 In the long-term at night, no significant impacts are predicted, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB for all route options.

Seafield of Raigmore (ID 09)

10.5.31 At Seafield of Raigmore (ID 09) in the short-term, impacts of a Neutral significance are predicted for route options 1A, 2A and 3A, impacts of a Slight beneficial significance are predicted for route options 1B and 2B and impacts of Neutral to Slight beneficial are predicted for route option 3B.

10.5.32 In the long-term during daytime, impacts of a Slight adverse significance are predicted for all route options.

10.5.33 In the long-term at night, no significant impacts are predicted, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB for all route options.

10.5.34 It should be noted that there are no perceptible noise changes predicted at Seafield of Raigmore (ID 09) for any route option.

281 Mackintosh Road (ID 10)

10.5.35 At Mackintosh Road (ID 10) in the short-term, impacts of a Neutral to Slight Beneficial significance are predicted for all route options, though these represent changes in noise that are not perceptible.

10.5.36 In the long-term during daytime, impacts of a Slight adverse significance are predicted for all route options.

10.5.37 In the long-term at night, no significant impacts are predicted, as the predicted road traffic noise levels are below $L_{night,outside}$ 55dB for all route options.

Noise Impacts for all NSRs within 600m Calculation Area - Summary Tables

<u>Do-Minimum Scenario in the Opening Year vs. Do-Something Scenario in the Opening Year</u>

Summary of Results – Short Term – Daytime

10.5.38 In accordance with example Table A1.1 in DMRB HD213/11, summaries of the magnitude of noise impacts at NSRs have been provided for the DM 2021 scenario versus the DS 2021 scenario, for the daytime period. The levels predicted at the ground and first floors are presented in Table 10.6 and Table 10.7, respectively. These tables include the predicted noise level change at all NSRs (including schools, hospitals, etc., which are defined as 'high' sensitivity in Table 10.1) within the 600m calculation area, so provide greater detail of potential noise impacts than the sample property assessment tables shown earlier. Note, that in accordance with DMRB HD213/11, assessment of night-time noise is not required for the short-term assessment.

Table 10.6: Summary – Ground Floor DM 2021 vs. DS 2021 – Day (Without Receptor Specific Mitigation)

Change in Noise Level Day $L_{A10,18h}$ dB		Magnitude of Impact	Option					
			1A	1B	2A	2B	3A	3B
DWELLINGS								
Increase in Noise Level (Adverse)	0.1 – 0.9	Negligible	3,021	2,903	2,789	2,681	2,663	2,572
	1.0 – 2.9	Minor	529	607	623	738	228	299
	3.0 – 4.9	Moderate	119	134	146	148	24	37
	5.0+	Major	52	63	76	94	2	12
No Change	0	No change	526	473	577	567	1,243	1,198
Decrease in Noise Level (Beneficial)	0.1 – 0.9	Negligible	857	925	866	850	949	991
	1.0 – 2.9	Minor	24	23	51	50	19	19
	3.0 – 4.9	Moderate	0	0	0	0	0	0
	5.0+	Major	0	0	0	0	0	0
OTHER SENSITIVE RECEPTORS								
Increase in Noise Level (Adverse)	0.1 – 0.9	Negligible	15	16	14	15	12	12
	1.0 – 2.9	Minor	5	4	6	5	5	5
	3.0 – 4.9	Moderate	1	1	0	0	1	1
	5.0+	Major	3	3	4	4	0	0
No Change	0	No change	2	2	1	1	3	3
Decrease in Noise Level (Beneficial)	0.1 – 0.9	Negligible	5	5	6	6	10	10
	1.0 – 2.9	Minor	1	1	1	1	0	0
	3.0 – 4.9	Moderate	0	0	0	0	1	1
	5.0+	Major	0	0	0	0	0	0

Table 10.7: Summary – First Floor DM 2021 vs. DS 2021 – Day (Without Receptor Specific Mitigation)

Change in Noise Level Day $L_{A10,18h}$ dB		Magnitude of Impact	Option					
			1A	1B	2A	2B	3A	3B
DWELLINGS								
Increase in Noise Level (Adverse)	0.1 – 0.9	Negligible	3,101	2,941	2,865	2,747	2,699	2,599
	1.0 – 2.9	Minor	531	635	649	775	214	295
	3.0 – 4.9	Moderate	106	116	127	127	25	34
	5.0+	Major	49	61	66	83	2	12
No Change	0	No change	507	504	549	542	1,281	1,207
Decrease in Noise Level (Beneficial)	0.1 – 0.9	Negligible	811	849	832	815	886	961
	1.0 – 2.9	Minor	23	22	40	39	21	20
	3.0 – 4.9	Moderate	0	0	0	0	0	0
	5.0+	Major	0	0	0	0	0	0
OTHER SENSITIVE RECEPTORS								
Increase in Noise Level (Adverse)	0.1 – 0.9	Negligible	15	15	14	15	12	11
	1.0 – 2.9	Minor	4	4	4	5	5	5
	3.0 – 4.9	Moderate	1	1	1	1	1	1
	5.0+	Major	3	3	3	3	0	0
No Change	0	No change	3	3	4	2	3	5
Decrease in Noise Level (Beneficial)	0.1 – 0.9	Negligible	5	5	5	5	10	9
	1.0 – 2.9	Minor	1	1	1	1	0	0
	3.0 – 4.9	Moderate	0	0	0	0	1	1
	5.0+	Major	0	0	0	0	0	0

Option 1A – Short Term – Daytime

10.5.39 Table 10.6 shows that, for Option 1A, at ground floor level and without mitigation, 700 dwellings and nine other sensitive receptors are predicted to experience perceptible noise increases (1dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 52 are predicted to have Large/Very Large adverse significance, 119 are predicted to have Moderate/Large adverse significance and 529 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, three are predicted to have Large/Very Large adverse significance, one is predicted to have Moderate/Large adverse significance and five are predicted to have Slight/Moderate adverse significance.

10.5.40 Table 10.6 also shows that 24 dwellings and one other sensitive receptor are predicted to experience perceptible noise decreases (1dB and above), all of which are predicted to have Slight/Moderate beneficial significance.

10.5.41 Similar significance of noise impacts are predicted to occur at first floor level.

Option 1B – Short Term – Daytime

10.5.42 Table 10.6 shows that, for Option 1B, at ground floor level and without mitigation, 804 dwellings and nine other sensitive receptors are predicted to experience perceptible noise increases (1dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 63 are predicted to have Large/Very Large adverse significance, 134 are predicted to have Moderate/Large adverse significance and 607 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, three are predicted to have Large/Very Large adverse significance, one is predicted to have Moderate/Large adverse significance and four are predicted to have Slight/Moderate adverse significance.

10.5.43 Table 10.6 also shows that 23 dwellings and one other sensitive receptor are predicted to experience perceptible noise decreases (1dB and above), all of which are predicted to have Slight/Moderate beneficial significance.

10.5.44 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 2A – Short Term – Daytime

10.5.45 Table 10.6 shows that, for Option 2A, at ground floor level and without mitigation, 845 dwellings and 10 other sensitive receptors are predicted to experience perceptible noise increases (1dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 76 are predicted to have Large/Very Large adverse significance, 146 are predicted to have Moderate/Large adverse significance and 623 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, four are predicted to have Large/Very Large adverse significance and six are predicted to have Slight/Moderate adverse significance.

10.5.46 Table 10.6 also shows that 51 dwellings and seven other sensitive receptors are predicted to experience perceptible noise decreases (1dB and above), all of which are predicted to have Slight/Moderate beneficial significance.

10.5.47 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 2B – Short Term – Daytime

10.5.48 Table 10.6 shows that, for Option 2B, at ground floor level and without mitigation, 980 dwellings and nine other sensitive receptors are predicted to experience perceptible noise increases (1dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 94 are predicted to have Large/Very Large adverse significance, 148 are predicted to have Moderate/Large adverse significance and 738 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, four are predicted to have Large/Very Large adverse significance and five are predicted to have Slight/Moderate adverse significance.

10.5.49 Table 10.6 also shows that 50 dwellings and one other sensitive receptor are predicted to experience perceptible noise decreases (1dB and above), all of which are predicted to have Slight/Moderate beneficial significance.

10.5.50 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 3A – Short Term – Daytime

10.5.51 Table 10.6 shows that, for Option 3A, at ground floor level and without mitigation, 254 dwellings and six other sensitive receptors are predicted to experience perceptible noise increases (1dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, two are predicted to have Large/Very Large adverse significance, 24 are predicted to have Moderate/Large adverse significance and 228 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, one is predicted to have Moderate/Large adverse significance and five are predicted to have Slight/Moderate adverse significance.

10.5.52 Table 10.6 also shows that 19 dwellings and one other sensitive receptor are predicted to experience perceptible noise decreases (1dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise decreases, all are predicted to have Slight/Moderate beneficial significance. For the other sensitive receptor predicted to experience perceptible noise increases, this is predicted to have Moderate/Large beneficial significance.

10.5.53 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 3B – Short Term – Daytime

10.5.54 Table 10.6 shows that, for Option 3B, at ground floor level and without mitigation, 348 dwellings and six other sensitive receptors are predicted to experience perceptible noise increases (1dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 12 are predicted to have Large/Very Large adverse significance, 37 are predicted to have Moderate/Large adverse significance and 299 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, one is predicted to have Moderate/Large adverse significance and five are predicted to have Slight/Moderate adverse significance.

10.5.55 Table 10.6 also shows that 19 dwellings and one other sensitive receptor are predicted to experience perceptible noise decreases (1dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise decreases, all are predicted to have Slight/Moderate beneficial significance. For the other sensitive receptor predicted to experience perceptible noise increases, this is predicted to have Moderate/Large beneficial significance.

10.5.56 Similar significance levels of noise impacts are predicted to occur at first floor level.

<u>Do-Minimum Scenario in the Opening Year vs. Do-Something Scenario in the Design Year</u>

Summary of Results – Long Term – Daytime

10.5.57 In accordance with DMRB HD213/11 Table A1.2, summaries of the magnitude of noise impacts at NSRs for the DM 2021 scenario versus the DS 2036 scenario, for the daytime period at the ground and first floor are presented in Table 10.8 and Table 10.9, respectively.

Table 10.8: Summary – Ground Floor DM 2021 vs. DS 2036 – Day (Without Receptor Specific Mitigation)

Change in Noise Level Day $L_{A10,18h}$ dB		Magnitude of Impact	Option					
			1A	1B	2A	2B	3A	3B
DWELLINGS								
Increase in Noise Level (Adverse)	0.1 – 2.9	Negligible	4,805	4,771	4,679	4,656	5,008	4,986
	3.0 – 4.9	Minor	209	220	225	237	72	87
	5.0 – 9.9	Moderate	80	100	124	137	18	22
	10.0+	Major	10	14	10	14	0	4
No Change	0	No change	9	11	28	24	6	5
Decrease in Noise Level (Beneficial)	0.1 – 2.9	Negligible	15	12	62	60	24	24
	3.0 – 4.9	Minor	0	0	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0	0	0
	10.0+	Major	0	0	0	0	0	0
OTHER SENSITIVE RECEPTORS								
Increase in Noise Level (Adverse)	0.1 – 2.9	Negligible	25	25	26	26	30	30
	3.0 – 4.9	Minor	2	3	1	1	0	0
	5.0 – 9.9	Moderate	4	3	4	4	1	1
	10.0+	Major	0	0	0	0	0	0
No Change	0	No change	0	0	0	0	0	0
Decrease in Noise Level (Beneficial)	0.1 – 2.9	Negligible	1	1	1	1	1	1
	3.0 – 4.9	Minor	0	0	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0	0	0
	10.0+	Major	0	0	0	0	0	0

Table 10.9: Summary – First Floor DM 2021 vs. DS 2036 – Day (Without Receptor Specific Mitigation)

Change in Noise Level Day $L_{A10,18h}$ dB		Magnitude of Impact	Option					
			1A	1B	2A	2B	3A	3B
DWELLINGS								
Increase in Noise Level (Adverse)	0.1 – 2.9	Negligible	4,823	4,790	4,706	4,677	5,013	4,986
	3.0 – 4.9	Minor	199	224	220	238	69	88
	5.0 – 9.9	Moderate	71	80	108	117	16	22
	10.0+	Major	10	15	11	15	0	4
No Change	0	No change	12	6	12	18	5	4
Decrease in Noise Level (Beneficial)	0.1 – 2.9	Negligible	13	13	71	63	25	24
	3.0 – 4.9	Minor	0	0	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0	0	0
	10.0+	Major	0	0	0	0	0	0
OTHER SENSITIVE RECEPTORS								
Increase in Noise Level (Adverse)	0.1 – 2.9	Negligible	25	26	26	27	30	30
	3.0 – 4.9	Minor	3	2	1	0	0	0
	5.0 – 9.9	Moderate	3	3	4	4	1	1
	10.0+	Major	0	0	0	0	0	0
No Change	0	No change	0	0	0	0	0	0
Decrease in Noise Level (Beneficial)	0.1 – 2.9	Negligible	1	1	1	1	1	1
	3.0 – 4.9	Minor	0	0	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0	0	0
	10.0+	Major	0	0	0	0	0	0

Option 1A – Long Term – Daytime

10.5.58 Table 10.8 shows that, for Option 1A, at ground floor level and without mitigation, 299 dwellings and six other sensitive receptors are predicted to experience perceptible noise increases (3dB and above). In terms of the significance of impact (as defined in Table 10.4) for the dwellings predicted to experience perceptible noise increases, 10 are predicted to have Large/Very Large adverse significance, 80 are predicted to have Moderate/Large adverse significance and 209 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, four are predicted to have Moderate/Large adverse significance and two are predicted to have Slight/Moderate adverse significance.

10.5.59 Table 10.8 also shows that no dwellings or other sensitive receptors are predicted to experience perceptible noise decreases (3dB and above).

10.5.60 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 1B – Long Term – Daytime

10.5.61 Table 10.8 shows that, for Option 1B, at ground floor level and without mitigation, 334 dwellings and six other sensitive receptors are predicted to experience perceptible noise increases (3dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 14 are predicted to have Large/Very Large adverse significance, 100 are predicted to have Moderate/Large adverse significance and 220 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, three are predicted to have Moderate/Large adverse significance and three are predicted to have Slight/Moderate adverse significance.

10.5.62 Table 10.8 also shows that no dwellings or other sensitive receptors are predicted to experience perceptible noise decreases (3dB and above).

10.5.63 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 2A – Long Term – Daytime

10.5.64 Table 10.8 shows that, for Option 2A, at ground floor level and without mitigation, 359 dwellings and five other sensitive receptors are predicted to experience perceptible noise increases (3dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 10 are predicted to have Large/Very Large adverse significance, 124 are predicted to have Moderate/Large adverse significance and 225 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, four are predicted to have Moderate/Large adverse significance and one is predicted to have Slight/Moderate adverse significance.

10.5.65 Table 10.8 also shows that no dwellings or other sensitive receptors are predicted to experience perceptible noise decreases (3dB and above).

10.5.66 Similar significance of noise impacts are predicted to occur at first floor level.

Option 2B – Long Term – Daytime

10.5.67 Table 10.8 shows that, for Option 2B, at ground floor level and without mitigation, 388 dwellings and five other sensitive receptors are predicted to experience perceptible noise increases (3dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 14 are predicted to have Large/Very Large adverse significance, 137 are predicted to have Moderate/Large adverse significance and 237 are predicted to have Slight/Moderate adverse significance. For the other sensitive receptors predicted to experience perceptible noise increases, four are predicted to have Moderate/Large adverse significance and one is predicted to have Slight/Moderate adverse significance.

10.5.68 Table 10.8 also shows that no dwellings or other sensitive receptors are predicted to experience perceptible noise decreases (3dB and above).

10.5.69 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 3A – Long Term – Daytime

10.5.70 Table 10.8 shows that, for Option 3A, at ground floor level and without mitigation, 90 dwellings and one other sensitive receptor are predicted to experience perceptible noise increases (3dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, 18 are predicted to have Moderate/Large adverse significance and 72 are predicted to have Slight/Moderate adverse significance. The other sensitive receptor predicted to experience perceptible noise increases is predicted to have Moderate/Large adverse significance.

10.5.71 Table 10.8 also shows that no dwellings or other sensitive receptors are predicted to experience perceptible noise decreases (3dB and above).

10.5.72 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 3B – Long Term – Daytime

10.5.73 Table 10.8 shows that, for Option 3B, at ground floor level and without mitigation, 113 dwellings and one other sensitive receptors are predicted to experience perceptible noise increases (3dB and above). In terms of significance (as defined in Table 10.4), for the dwellings predicted to experience perceptible noise increases, four are predicted to have Large/Very Large adverse significance, 22 are predicted to have Moderate/Large adverse significance and 87 are predicted to have Slight/Moderate adverse significance. The other sensitive receptor predicted to experience perceptible noise increases is predicted to have Moderate/Large adverse significance.

10.5.74 Table 10.8 also shows that no dwellings or other sensitive receptors are predicted to experience perceptible noise decreases (3dB and above).

10.5.75 Similar significance levels of noise impacts are predicted to occur at first floor level.

Summary of Results – Long Term – Night-time

10.5.76 In accordance with DMRB HD213/11 Table A1.2, summaries of the magnitude of noise impacts at dwellings for the DM 2021 scenario versus the DS 2036 scenario, for the night-time period at the ground and first floor are presented in Table 10.10 and Table 10.11, respectively. Only dwellings predicted to be subject to free-field noise levels exceeding 55dB $L_{night,outside}$ have been reported, as per the night-time assessment methodology of DMRB HD213/11.

Table 10.10: Summary – Ground Floor DM 2021 vs. DS 2036 – Night (Without Receptor Specific Mitigation)

Change in Noise Level Night $L_{night,outside}$ dB		Magnitude of Impact	Option					
			1A	1B	2A	2B	3A	3B
DWELLINGS								
Increase in Noise Level (Adverse)	0.1 – 2.9	negligible	25	27	34	34	47	47
	3.0 – 4.9	minor	0	0	0	0	0	0
	5.0 – 9.9	moderate	0	0	0	0	0	0
	10.0+	major	6	6	8	8	0	0
No Change	0	no change	1	0	0	0	0	0
Decrease in Noise Level (Beneficial)	0.1 – 2.9	negligible	0	0	2	2	0	0
	3.0 – 4.9	minor	0	0	0	0	0	0
	5.0 – 9.9	moderate	0	0	0	0	0	0
	10.0+	major	0	0	0	0	0	0

Table 10.11: Summary – First Floor DM 2021 vs. DS 2036 – Night (Without Receptor Specific Mitigation)

Change in Noise Level Night $L_{night,outside}$ dB		Magnitude of Impact	Option					
			1A	1B	2A	2B	3A	3B
DWELLINGS								
Increase in Noise Level (Adverse)	0.1 – 2.9	negligible	31	33	50	49	63	61
	3.0 – 4.9	minor	0	0	0	0	0	0
	5.0 – 9.9	moderate	0	0	1	1	0	0
	10.0+	major	8	8	8	8	0	0
No Change	0	no change	0	0	0	0	0	0
Decrease in Noise Level (Beneficial)	0.1 – 2.9	negligible	0	0	1	1	0	0
	3.0 – 4.9	minor	0	0	0	0	0	0
	5.0 – 9.9	moderate	0	0	0	0	0	0
	10.0+	major	0	0	0	0	0	0

Option 1A – Long Term – Night-time

10.5.77 Table 10.10 shows that, for Option 1A, at ground floor level and without mitigation, six dwellings are predicted to experience perceptible noise increases (3dB and above) above 55dB $L_{night,outside}$, all of which are predicted to have Large/Very Large adverse significance.

10.5.78 No dwellings are predicted to experience perceptible noise decreases (3dB and above) above 55dB $L_{night,outside}$.

10.5.79 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 1B – Long Term – Night-time

10.5.80 Table 10.10 shows that, for Option 1B, at ground floor level and without mitigation, six dwellings are predicted to experience perceptible noise increases (3dB and above) above 55dB $L_{night,outside}$, all of which are predicted to have Large/Very Large adverse significance.

10.5.81 No dwellings are predicted to experience perceptible noise decreases (3dB and above) above 55dB $L_{night,outside}$.

10.5.82 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 2A – Long Term – Night-time

10.5.83 Table 10.10 shows that, for Option 2A, at ground floor level and without mitigation, eight dwellings are predicted to experience perceptible noise increases (3dB and above) above 55dB $L_{night,outside}$, all of which are predicted to have Large/Very Large adverse significance.

10.5.84 No dwellings are predicted to experience perceptible noise decreases (3dB and above) above 55dB $L_{night,outside}$.

10.5.85 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 2B – Long Term – Night-time

10.5.86 Table 10.10 shows that, for Option 2B, at ground floor level and without mitigation, eight dwellings are predicted to experience perceptible noise increases (3dB and above) above 55dB $L_{night,outside}$, all of which are predicted to have Large/Very Large adverse significance.

10.5.87 No dwellings are predicted to experience perceptible noise decreases (3dB and above) above 55dB $L_{night,outside}$.

10.5.88 Similar significance levels of noise impacts are predicted to occur at first floor level.

Option 3A – Long Term – Night-time

10.5.89 Table 10.9 shows that, for Option 3A, at ground floor level and without mitigation, no dwellings are predicted to experience perceptible noise increases or decreases (3dB and above) above 55dB $L_{night,outside}$. The same is predicted to occur at first floor level.

Option 3B – Long Term – Night-time

10.5.90 Table 10.9 shows that, for Option 3B, at ground floor level and without mitigation, no dwellings are predicted to experience perceptible noise increases or decreases (3dB and above) above 55dB $L_{night,outside}$. The same is predicted to occur at first floor level.

Noise Impact on Noise Sensitive Outdoor Areas

Identification of Noise Sensitive Outdoor Areas within Calculation Area

10.5.91 Table 10.12 presents the noise sensitive outdoor areas that have been identified within the calculation area, and indicates the geometric area of each that lies within the calculation area.

Table 10.12: Noise Sensitive Outdoor Areas within Calculation Area

Name	Description	Amenity Area within Calculation Area (m^2)
Ashton Road Football Pitch and Playground	Outdoor recreation area	8,799
Culloden House	Garden and Designed Landscape, Battlefield	31,795
Grebe Avenue Playing Field	Outdoor recreation area	5,892
Inshes District Park	Outdoor recreation area	40,506
Inverness Golf Course	Outdoor recreation area	80,056
Longman and Castle Stuart Bays	SSSI, SPA, Important Bird Area and Ramsar (Wetland of International Importance)	836,894

10.5.92 To assess the noise impact on sensitive outdoor areas, the change in noise levels across all sensitive areas within the calculation area have been assessed, and the percentage of the area impacted by each noise change category is presented in Appendix 10.3: Predicted Changes in Road Traffic Noise Levels at Noise Sensitive Outdoor Areas. DMRB HD213/11 states that the approach of reporting the least beneficial change in noise level should be used for the impact at areas within open spaces. As receptors for outdoor sensitive areas are assessed in this section, only the ground floor daytime scenario has been considered, both in the short and long term.

Summary of Assessment of Impact on Noise Sensitive Outdoor Receptors

10.5.93 A summary of the predicted least beneficial noise impact at each noise sensitive outdoor area is presented below. It should be noted that none of the least beneficial impacts at noise sensitive outdoor areas are predicted to be perceptible for any route option, in the short-term or long-term.

Ashton Road Football Pitch and Playground

10.5.94 At Ashton Road Football Pitch and Playground in the short-term, impacts of a Slight beneficial significance are predicted for all route options, because of the predicted reduction in traffic flow on the A9 Perth – Inverness Trunk Road.

10.5.95 In the long-term during daytime, impacts of a Slight adverse significance are predicted for route options 1A, 1B, 3A and 3B and impacts of a Neutral significance are predicted for route option 2A and 2B, as predicted increases in traffic across the road network as a whole partially cancel out the benefits of the reduction in traffic flow on the A9 Perth – Inverness Trunk Road due to these route options.

Culloden House

10.5.96 At Culloden House (Garden and Designated Landscape and Battlefield), impacts of a Slight adverse significance are predicted for all route options, both in the short and long-term.

Grebe Avenue Playing Field

10.5.97 At Grebe Avenue Playing Field, in the short-term, impacts of a Slight adverse significance are predicted for route options 1A, 1B, 2A and 2B. Impacts of a Neutral significance are predicted for route options 3A and 3B because the west ends of these route options do not extend as far towards the playing field as the others. In the long-term, impacts of a Slight adverse significance are predicted for all route options.

Inshes District Park

10.5.98 At Inshes District Park, impacts of a Slight adverse significance are predicted for all route options, both in the short and long-term.

Inverness Golf Course

10.5.99 At Inverness Golf Course, in the short-term, impacts of a Slight adverse significance are predicted for route options 1A, 1B, 2A and 2B. Impacts of a Neutral significance are predicted for route option 3A and Slight Beneficial significance are predicted for route option 3B because the new sections of road on these options do not extend as far west towards the golf course as in the other route options. In the long-term, impacts of a Slight adverse significance are predicted for all route options.

Longman and Castle Stuart Bays

10.5.100 At Longman and Castle Stuart Bays, in the short-term, impacts of a Slight adverse significance are predicted for route options 1A and 1B and impacts of a Neutral significance are predicted for route options 2A, 2B, 3A and 3B. In the long-term, impacts of a Slight adverse significance are predicted for all route options.

Noise Change Contours

10.5.101 The noise change contours for the short and long-term at a height of 1.5m (for outdoor receptors and indoor receptors on ground floor level) are presented in Figures 10.2 to 10.13. The noise change results at a height of 1.5m and 4m (first floor level for indoor receptors) will be presented in the DMRB Stage 3 assessment of the preferred option.

10.6 Potential Mitigation

10.6.1 At DMRB Stage 2 of the assessment process, it is not possible to accurately define likely noise mitigation measures for each of the proposed route options. As such, this section aims to identify anticipated mitigation taking into account best practice, legislation and guidance.

10.6.2 Potential mitigation measures for both the construction and operational phases are discussed below.

Construction

10.6.3 During the construction phase, potential mitigation measures for the proposed route options are likely to include:

- use of 'best practicable means' during all construction activities;
- switching off plant and equipment when it is not in use for longer periods of time;
- establishing agreement with the local authority on appropriate controls for undertaking significantly noisy works or vibration-causing operations close to receptors;
- programming works so that the requirement for working outside normal working hours is minimised;
- use of low noise emission plant where possible;
- where piling is required this should be bored to protect sensitive sites;
- use of temporary noise screens around particularly noisy activities; and
- regular plant maintenance.

Operation

10.6.4 In general terms, the greater the number of sensitive receptors experiencing perceptible noise increases (and particularly falling within the moderate and major impact categories), the greater extent of noise mitigation is likely to be considered.

10.6.5 Mitigation in the form of LNRS on slip roads, as described in paragraph 10.2.22, has already been included for the noise calculation of road traffic noise levels for the scheme for all DS options.

10.6.6 During the operational phase, potential mitigation measures for the proposed route options are likely to include:

- Siting the scheme within cuttings where the surrounding topography and constraints allow. This provides a degree of noise screening and can be an effective noise mitigation measure. During the scheme design, consideration should be given, where feasible, to increasing the extent of the scheme within cutting (or creating false cuttings), particularly where it runs near to noise sensitive receptors.
- The use of earth bunding or noise barriers as a form of screening. The required heights and extents of screening structures would be determined during the assessment of the preferred option as part of the DMRB Stage 3 assessment.

10.7 Summary of Route Options

10.7.1 Table 10.13 presents the total number of NSRs predicted to experience perceptible adverse changes in noise in the short term. This includes the least beneficial noise impacts predicted for noise sensitive outdoor areas, where perceptible impacts are predicted.

Table 10.13: Summary of Predicted Perceptible Adverse Noise Impacts in the Short Term (Daytime)

Magnitude of Adverse Impact	Significance of Adverse Impact	Option					
		1A	1B	2A	2B	3A	3B
DWELLINGS AND OTHER SENSTIVE RECEPTORS - GROUND FLOOR							
Minor	Slight/Moderate	534	611	629	743	233	304
Moderate	Moderate/Large	120	135	146	148	25	38
Major	Large/Very Large	55	66	80	98	2	12
DWELLINGS AND OTHER SENSTIVE RECEPTORS - FIRST FLOOR							
Minor	Slight/Moderate	535	639	653	780	219	300
Moderate	Moderate/Large	107	117	128	128	26	35
Major	Large/Very Large	52	64	69	86	2	12

10.7.2 It can be seen in Table 10.13 that Options 1A, 1B, 2A and 2B have similar numbers of NSRs predicted to have perceptible adverse changes in noise in the short term, while Options 3A and 3B have significantly less. Route options 3A and 3B have the lowest number of perceptible adverse impacts predicted because the other options (1A, 1B, 2A and 2B) extend the new road further south from Inshes to Inshes Retail Park, in contrast to the 3A and 3B options. Options 1B, 2B and 3B have a greater number of perceptible adverse impacts predicted than the A variants, which is likely to be a consequence of the B variants passing closer to residential dwellings to the east, such as in Cradlehall and Resaurie. Option 3A has the lowest number of NSRs predicted to have perceptible adverse changes in noise in the short term.

10.7.3 Table 10.14 presents the total number of NSRs predicted to experience perceptible adverse changes in noise in the long term during the daytime period.

Table 10.14: Summary of Predicted Perceptible Adverse Noise Impacts in the Long Term (Daytime)

Magnitude of Adverse Impact	Significance of Adverse Impact	Option					
		1A	1B	2A	2B	3A	3B
DWELLINGS AND OTHER SENSTIVE RECEPTORS - GROUND FLOOR							
Minor	Slight/Moderate	211	223	226	238	72	87
Moderate	Moderate/Large	84	103	128	141	19	23
Major	Large/Very Large	10	14	10	14	0	4
DWELLINGS AND OTHER SENSTIVE RECEPTORS - FIRST FLOOR							
Minor	Slight/Moderate	202	226	221	238	69	88
Moderate	Moderate/Large	74	83	112	121	17	23
Major	Large/Very Large	10	15	11	15	0	4

10.7.4 Table 10.14 shows that the total number of perceptible adverse changes in noise predicted in the long term are lower than in the short term for all options. The results for predicted perceptible adverse change in noise in the long term during the daytime period are similar to that for the short term in that Options 1A, 1B, 2A and 2B have similar numbers of NSRs predicted to have perceptible adverse changes in noise, while Options 3A and 3B have significantly less. Option 3A has the lowest number of NSRs predicted to have perceptible adverse changes in noise.

10.7.5 Table 10.15 presents the total number of dwellings predicted to experience perceptible adverse changes in noise in the long term during the night-time period. Only dwellings predicted to be subject to free-field noise levels exceeding 55dB $L_{night,outside}$ have been reported, as per the night-time assessment methodology of DMRB HD213/11.

Table 10.15: Summary of Predicted Perceptible Adverse Noise Impacts in the Long Term (Night-time)

Magnitude of Adverse Impact	Significance of Adverse Impact	Option					
		1A	1B	2A	2B	3A	3B
DWELLINGS - GROUND FLOOR/							
Minor	Slight/Moderate	0	0	0	0	0	0
Moderate	Moderate/Large	0	0	0	0	0	0
Major	Large/Very Large	6	6	8	8	0	0
DWELLINGS - FIRST FLOOR							
Minor	Slight/Moderate	0	0	0	0	0	0
Moderate	Moderate/Large	0	0	1	1	0	0
Major	Large/Very Large	8	8	8	8	0	0

10.7.6 It can be seen in Table 10.15 that there are a very low number of dwellings predicted to have perceptible adverse changes in noise exceeding 55dB $L_{night,outside}$ in the long term, at night-time. Options 3A and 3B have no perceptible adverse changes in noise exceeding 55dB $L_{night,outside}$ predicted.

10.7.7 Table 10.16 presents the total number of NSRs predicted to experience perceptible beneficial changes in noise in the short term.

Table 10.16: Summary of Predicted Perceptible Beneficial Noise Impacts in the Short Term (Daytime)

Magnitude of Beneficial Impact	Significance of Beneficial Impact	Option					
		1A	1B	2A	2B	3A	3B
DWELLINGS AND OTHER SENSTIVE RECEPTORS - GROUND FLOOR							
Minor	Slight/Moderate	25	24	52	51	19	19
Moderate	Moderate/Large	0	0	0	0	1	1
Major	Large/Very Large	0	0	0	0	0	0
DWELLINGS AND OTHER SENSTIVE RECEPTORS - FIRST FLOOR							
Minor	Slight/Moderate	24	23	41	40	21	20
Moderate	Moderate/Large	0	0	0	0	1	1
Major	Large/Very Large	0	0	0	0	0	0

10.7.8 It can be seen in Table 10.16 that Options 1A, 1B, 3A and 3B are predicted to have the lowest number of perceptible beneficial changes in noise in the short term. Options 2A and 2B are predicted to have the highest number of perceptible beneficial changes in noise, because of predicted reductions in traffic flow along Old Perth Road (B9006), Culloden Road (B9006), Caulfield Road and Caulfield Road North.

10.7.9 There are predicted to be no NSRs with perceptible beneficial changes in the long term, during daytime, for any option. There are also predicted to be no dwellings with perceptible beneficial changes in noise exceeding 55dB $L_{night,outside}$ in the long term, at night-time, for any option.

10.7.10 Overall, Options 3A and 3B are predicted to have the least number of perceptible adverse noise impacts, while all other options are predicted to have a similar, greater number. Options 2A and 2B are predicted to have the greatest number of perceptible short-term beneficial noise impacts, with the other route options predicted to have a similar, lower number. The number of perceptible adverse impacts is greater than the number of perceptible beneficial impacts for all options, based on the DMRB HD213/11 assessment methodology where the impact at the least beneficial façade of each NSR is reported.

10.8 Scope of DMRB Stage 3 Assessment

10.8.1 A Detailed Assessment, as defined in DMRB HD213/11, should be carried out during DMRB Stage 3. The scope of a Detailed Assessment is similar to that of a Simple Assessment, with a number of additional steps and comparisons made.

10.8.2 Baseline noise monitoring should be undertaken at representative noise sensitive receptors close to the preferred option and other roads on which traffic flows are likely to be significantly affected. This is likely to consist of both short term (three hour attended monitoring) and long term (up to 1 week) noise monitoring. Measurements of the L_{Aeq}, L_{AMax}, L_{A10} and L_{A90} would be undertaken as a minimum.

10.8.3 During DMRB Stage 3, an assessment of the potential impacts arising from construction of the preferred option should be undertaken. This should involve interrogation of the measured baseline noise data to derive anticipated noise limits using BS 5228-1 Method 2 (British Standards Institution 2014a). Predictions should then be undertaken for the likely worst case phases of construction to estimate the impact at the nearest sensitive receptors to the preferred option, and mitigation measures would be proposed, where required.

10.8.4 During DMRB Stage 3, consideration should also be given to construction vibration, making reference to the guidance and criteria in BS 5228-2 (British Standards Institution 2014b) relating to human response to vibration in buildings and damage levels from ground-borne vibration in buildings.

10.8.5 For the operational assessment, the preferred option should be modelled using computer based modelling software and appropriate noise mitigation measures proposed, where required.

10.8.6 The level of reporting of permanent traffic noise impacts should include the following three comparisons:

- DM scenario in modelled opening year against DM in the modelled design year;
- DM scenario in the baseline year against DS scenario in the baseline year; and
- DM scenario in baseline year against DS scenario in the modelled design year.

10.8.7 In addition, assessment of both the permanent traffic nuisance impacts and the permanent traffic induced vibration impacts should also be undertaken, and Tables A1.3 and A1.4, as defined in DMRB HD213/11, should be provided.

10.9 References

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The Scottish Government (2016). Guidance for Possible Measures to Manage Noise from Road and Rail. [Online] Available from https://noise.environment.gov.scot/pdf/Mitigation_Guidance.pdf [Accessed September 2017].

Transport Scotland (2014). Transportation Action Plan. [Online] Available from https://noise.environment.gov.scot/pdf/Transportation%20Noise%20Action%20Plan.pdf

EU Directives

Directive 2002/49/EC of 25 June 2002 of the European Parliament and of the Council relating to the assessment and management of environmental noise.