5 Noise and Vibration

5.1 Introduction

This chapter of the EIAR provides an assessment of the likely significant effects from the proposed development on the existing noise environment. It also considers vibration effects that could occur. The assessment is based on the characteristics of the site and surrounding area and the key parameters of the proposed development detailed in **Chapter 2 – Site and Surrounding Area** and **Chapter 3 – The Proposed Development** respectively.

This chapter has been prepared by TNEI Services Ltd, in line with best practice. A statement outlining the relevant expertise and qualifications of competent experts appointed to prepare this EIAR is provided in **Appendix 1.1**.

The aims of this chapter are to:

- Identify the closest sensitive receptors to the proposed development;
- Quantify appropriate noise and vibration limits at the nearest receptors;
- Predict levels of noise and vibration at the nearest receptors; and,
- Present appropriate mitigation measures, if required, to lessen these impacts.

This chapter is supported by the following figures and data provided in **Appendices 5.1 and 5.2**:

Appendix 5.1 – Figures includes:

- Figure 5.1 Noise Assessment Study Area;
- Figure 5.2 through to Figure 5.17 Noise Contour Plots;
- **Appendix 5.2 – Construction Noise Assessment Data** includes:
- BS5228 Threshold Levels;
- Noise Modelling Data;

Appendix 5.3 – Construction Noise Assessment includes:

- Noise Assessment Tables.

5.2 Policy Context, Legislation, Guidance and Standards

Legislation

The overarching legislative framework applicable to this EIA for the proposed development is outlined in **Chapter 5 – Legislative and Policy Context**. Over and above this there are no statutory provisions of specific relevance to this assessment.

Policy

The planning policy framework applicable to this EIA for the proposed development is outlined in **Chapter 4 – Legislative and Policy Context**. On specific relevance to this chapter are the documents Planning Advice Note (PAN) 1/2011 – 'Planning and Noise,' (The Scottish Government, 2011) and the associated Technical Advice Note (TAN) – 'Assessment of Noise' (The Scottish Government, 2011).

PAN 1/2011 provides little guidance in respect of construction noise, other than recommending that the use of planning conditions is not the preferred method for controlling temporary construction noise. Specifically, the document states:

> "*32. While planning conditions can be used to limit noise from temporary construction sites, it is most effectively controlled through the Control of Pollution Act 1974 (COPA74) and the Pollution and Prevention Control Act 1999 for relevant installations. Notice can be served in advance of works and site conditions set to control activities."*

BS 5228:1997 *'Noise and vibration control on construction and open sites. Code of practice for basic information and procedures for noise and vibration control' parts 1 to 5* (BSI, 1997) is the approved Code of Practice under COPA74, however, it is the 2009 version of the Standard that should be used for planning applications. In this regards the TAN states:

> "*However, under Environmental Impact Assessments and for planning purposes i.e. not in regard to the Control of Pollution Act 1974, the 2009 version of BS 5228 is applicable. The 2009 version of the standard consists of Parts 1 and 2 for noise and vibration respectively."*

With regards specifically to road projects, PAN1/2011 states; *"Road traffic noise impact assessments should take account of level, potential vibration, disturbance and variation in noise levels throughout the day, the pattern of vehicle movements and the configuration of the road system."*

The PAN itself does not provide any guidance as to the assessment method to be used, however, the TAN refers to '*Design Manual for Roads and Bridges*,' (DMRB).

Document *LA 111 Noise and Vibration* of DMRB "*sets out the requirements for assessing and reporting the effects of highways noise and vibration from construction, operation and maintenance projects*." A significant proportion of the assessment methods and criteria (in respect of construction impacts) that are detailed within DMRB actually refer back to BS 5228 as the appropriate method of assessment, however, there are some elements that are particular to DMRB, such as how to assess impacts arising from the use of temporary diversionary routes. Accordingly, this chapter refers to both DMRB and BS 5228 throughout.

In addition to National Planning Framework 4, the statutory Development Plan applicable to the Site presently comprises:

- Highland-wide Local Development Plan (adopted April 2012); and,
- West Highlands and Islands Local Development Plan (adopted September 2019)

Planning policy considerations from the Highland-wide Local Development Plan of specific relevance to this assessment are identified below:

- Policy 67: Renewable Energy Developments; and,
- Policy 72: Pollution.

Guidance and Relevant Technical Standards

The following guidance and technical standards have informed this assessment:

- BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Part 1 Noise (BSI, 2014);
- BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Part 2 Vibration (BSI, 2014);
- BS 7385 2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration (BSI, 1993);
- BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings (BSI, 2008); and,

- Design Manual for Roads and Bridges (DMRB) LA111 Noise and Vibration (The Crown, 2020).

5.3 Methodology

Overview

Environmental, or community, noise is a broad term that encompasses noise emitted from many sources, including road, rail, air traffic, industry, construction, public work and neighbourhood noise. All of these sources potentially contribute adversely to the overall noise environment. It is therefore reasonable to expect communities to be sensitive to any deterioration in their acoustic environment as a result of a proposed development.

The proposed Kilfinnan Road upgrade will introduce temporary new noise and vibration sources into the local area in the form of construction plant and activities. This chapter, therefore, considers the potential for adverse noise and vibration impacts to occur from the construction of the development.

Noise and vibration levels will vary continually over time as activities and plant start and stop and move around the Site. As such it is not possible to predict a single noise or vibration level for any given time or activity. Rather the assessment considers a number of scenarios that have been chosen to represent the likely noisiest activities that will occur during each month of the construction phase based on an indicative construction timeline.

Assessment Scope

The principal aspects considered within this assessment are:

- Construction noise generated from plant and activities throughout the construction period; and,
- Vibration levels that may be generated at specific locations along Kilfinnan road during particular construction activities.

This chapter presents an assessment of likely significant effects on noise and vibration from the proposed development during the construction phase only. The assessment presented in this noise and vibration chapter has been prepared in accordance with the EIA Regulations.

The assessment of likely effects makes comparison with the baseline year, 2017, during which time the baseline noise surveys were carried out. An additional site walkover was undertaken in 2023 by the lead acoustician to verify that the 2017 survey data was still relevant.

Once complete, operational use of the road will introduce new noise sources into the local area in the form of road traffic, however, this has already been addressed within the 2018 Environmental Statement for the Revised Coire Glas Pumped Storage Scheme in Chapter 17: Noise and Vibration, so is not addressed here.

Assessment Process

In undertaking the assessment presented in this EIAR chapter, the following activities have been carried out:

- An indicative construction timetable has been determined detailing when particular activities will occur during the expected 18 month construction programme.
- With reference to the indicative timetable and Chapter 3 The Proposed Development a number of scenarios have been defined, which have informed the noise modelling for each month of the construction period;

- Noise levels have been predicted for each scenario at Noise Assessment Locations (NALs) along the length of Kilfinnan Road, which have been selected as representative of all residential properties in the vicinity of the Proposed Development;
- Noise threshold levels have been identified in accordance with BS 5228, with reference to the existing baseline environment;
- The predicted noise levels have been compared to the BS 5228 threshold levels and to recommended noise limits detailed within LA111 of DMRB; and,
- Vibration levels have been predicted for activities occurring at the closest assumed distances between compaction equipment and residential receptors. The predicted levels have been compared to recommended vibration limits, as detailed within LA111 of DMRB.

Consultation

With regards to a requirement for a construction noise assessment the Scoping Response stated;

"A construction noise assessment will be required in the following circumstances:

- Where it is proposed to undertake work which is audible at the curtilage of any noise sensitive receptor, out with the hours Mon-Fri 8am to 7pm; Sat 8am to 1pm; or
- Where noise levels during the above periods are likely to exceed 75dB(A) for short term works or 55dB(A) for long term works. Both measurements to be taken as a 1hr LAeq at the curtilage of any noise sensitive receptor. (Generally, long term work is taken to be more than 6 months)."

Due to the small separation distances between some of the anticipated construction activities and the nearest sensitive receptors there is the potential for noise levels to temporarily exceed the levels noted in the Scoping Response. Accordingly, this Chapter is included to assess the potential for significant noise effects.

The Scoping Response noted that where a construction noise assessment was to be included that it should be undertaken in accordance with BS 5228. It also requested that information on and assessments related to blasting and vibration be included, as required.

EIA Screening and Scoping

An EIA Screening request was submitted in June 2022 and a response was issued in July 2022.

An EIA Scoping Request for the proposed development was submitted in November 2022 and the response was issued in January 2023 (reference: 22/05277/SCOP).

Within Section 5.7 of the Scoping Report, it was proposed that to undertake an assessment of construction noise and construction vibration.

It was also noted within Section 6.7 of the Scoping Report that noise from road traffic using Kilfinnan Road had already been considered within the 2018 EIA for the Revised Coire Glas Pumped Storage Scheme. As no significant increase in road traffic flows beyond that which have already been considered is anticipated, an assessment of operational noise and vibration was Scoped Out.

Study Area

The Study Area for the noise assessment has been defined through the identification of the nearest Noise Sensitive Receptors (NSRs).

NSRs are properties, people or fauna that are sensitive to noise and, therefore, may require protection from nearby noise sources. Residential receptors are deemed to have a high level of sensitivity, therefore, all of identified residential properties along the length of Kilfinnan Road have been assessed.

A Noise Assessment Location (NAL) has been defined for each NSR. The NAL is the point at which noise levels are calculated, and these are located a few meters in front of each receptor. The NALs are always on the side of the property facing the Proposed Development. All NALs are set to a height of 1.5 m.

The assessment considers the closest NSRs only on the assumption that if noise levels are within acceptable levels at the closest receptors, then it is reasonable to assume they will also be acceptable at more distant locations.

Table 5.1 details the NALs considered within the report.

Table 5.1: Noise Assessment Locations

Noise Assessment Location		Coordinates	
ID	**Descriptor**	**Easting**	**Northing**
NAL01	11 North Laggan	229980	798583
NAL02	12 North Laggan	229977	798574
NAL03	13 North Laggan	229968	798566
NAL04	14 North Laggan	229960	798556
NAL05	15 North Laggan	229953	798546
NAL06	16 North Laggan	229949	798533
NAL07	17 North Laggan	229945	798514
NAL08	18 North Laggan	229948	798501
NAL09	19 North Laggan	229952	798493
NAL10	20 North Laggan	229949	798482
NAL11	North Laggan Farmhouse	229327	797870
NAL12	Mogwy Cottage	229230	797649
NAL13	Mogwy Cottage (Cosy Nook)	229223	797639
NAL14	StoneyField House	228694	796966
NAL15	Linden Trees Cottage (North)	228586	796875
NAL16	Linden Trees Cottage (South)	228570	796857
NAL17	2 Balmaglaster	228458	796685

Noise Assessment Location		Coordinates	
ID	**Descriptor**	**Easting**	**Northing**
NAL18	2 Balmaglaster (Static home)	228430	796658
NAL19	Kelly's View	228360	796467
NAL20	10 Glengarry Lodges	228323	796467
NAL21	09 Glengarry Lodges	228304	796463
NAL22	08 Glengarry Lodges	228350	796442
NAL23	07 Glengarry Lodges	228338	796430
NAL24	06 Glengarry Lodges	228319	796428
NAL25	05 Glengarry Lodges	228307	796423
NAL26	04 Glengarry Lodges	228294	796413
NAL27	03 Glengarry Lodges	228284	796403
NAL28	02 Glengarry Lodges	228276	796393
NAL29	01 Glengarry Lodges	228268	796382
NAL30	Kilfinnan Burn Farmhouse	227706	795701
NAL31	Corriegour Hotel	226206	792702

Information Sources

For all modelled construction activities, source noise level data is taken from Annex C of BS 5228-1, which provides octave band sound pressure levels for a wide variety of construction plant and activities suitable for the estimation of noise emission levels.

Construction Noise Assessment Methodology

In order to predict the noise immission levels attributable to the proposed development, noise propagation models have been produced using the propriety noise modelling software CadnaA. Within the software, complex models can be used to simulate the propagation of noise according to a range of international calculation standards, including BS 5228.

The model uses the octave band sound power output of the proposed construction plant or activity as its acoustic input data, and calculates on an octave band basis, attenuation due to geometric spreading, atmospheric absorption and ground effects.

For the purposes of this assessment, the noise level predictions have been undertaken using a receiver height of 1.5 m above local ground level. Soft ground attenuation (G=1) has been used for undeveloped areas of ground, for example the surrounding fields. Hard ground attenuation (G=0) attenuation has been assumed for the construction compounds and road and other areas of developed ground, as well as for all areas of water.

Most items of plant and activities have been modelled as single point sources and it should be noted that the noise models present a snapshot in time only and cannot convey the dynamic nature of some of the activities. Notwithstanding the above, construction plant that will be moving continuously for the majority of time along a single path, e.g. road planer, have been modelled as a line source along their anticipated movement path.

The noise propagation models are intended to give a good approximation of the specific noise level and the contribution of each individual source. However, it is expected that actual levels

are unlikely to be matched exactly with modelled values and the following limitations in the model should be considered:

- The predicted barrier attenuation provided by local topography, embankments, walls, buildings and other structures in the intervening ground between source and receiver can only be approximated and not all barrier attenuation will have been accounted for;
- Unless specifically stated, the models assume all fixed noise sources are operating continuously and simultaneously, estimating a worst-case source noise level;
- All mobile plant (excavators, dozers, rollers etc) have been modelled as a fixed point within their anticipated work/movement areas. This will give an approximation of the overall noise levels from mobile plant at receptor locations for a fixed point in time; however, in reality noise levels will fluctuate as construction plant and activities move around in their activity areas; and,
- Although there is no set construction timetable or defined list of plant to be used (as this will be determined at a later date by the contractor) the noise models are based on an indicative timetable provided by the Applicant.

Construction Vibration Assessment Methodology

Annex E of BS 5228 part 2 provides methods of predicting vibration levels from piling activities, tunnelling and ground compaction. Of these activities, the prediction of ground compaction is relevant to this project, as vibratory rollers are likely to be used during the road construction.

The calculation methods are empirical predictors, as opposed to methods to calculate vibration levels with significant accuracy, however, without detailed knowledge of the exact plant specifications, local geology and test measurements (which could not be undertaken until during the construction period) it is not possible to present accurate vibration predictions. Rather, the calculations are provided to assess the likelihood of adverse impacts and to indicate the potential for mitigation measures to be required.

Other activities that may generate localised vibration could include the breaking of rock, however, there are no prediction methods available for this activity and the approaches that will be used for rock breaking will only be decided at a later stage by the appointed contractor (and when specific ground conditions are more readily understood), therefore, the method of controlling vibration from rock breaking will need to be through the application of appropriate limits and, where appropriate, vibration monitoring, as opposed to referring to initial predictions.

The empirical formulae given in BS 5228 make a number of assumptions and cannot consider local conditions, such as ground type. Therefore, the formulae include a scaling factor to determine the probability of the predicted value being exceeded by either 50%, 33% or 5%.

This assessment uses scaling factors to predict vibration levels with a probability of exceedance of 5% and 33% for all calculations, i.e. 95% and 66% certainty. The calculations presented with a 95% certainty represent highly conservative estimates to account for a worst case scenario and actual levels are likely to be lower than those predicted.

5.4 Baseline Conditions

Existing noise levels in the area of the development have already been quantified as part of the noise study for the Coire Glas Pumped Storage Scheme EIA. Specifically, a baseline survey was undertaken in 2017 at five Noise Monitoring Locations (NMLs), four of which are suitable for use in the assessment of the Kilfinnan Road upgrade. Figure 5.1 details the location of the NMLs used in the assessment.

No additional monitoring was undertaken as the levels measured in 2017 are still considered appropriate for use in 2022, as no significant changes in the local noise environment have occurred.

Detailed information regarding the baseline survey can be found in Volume 2 Chapter 17 Noise and Vibration of the Revised Coire Glas Pumped Storage Scheme. Table 5.2 details the measured ambient noise levels at each of the NMLs.

Table 5.2: Mean daytime ambient $L_{Aeq,T}$ levels

Monitoring Location		Mean LAeq,15 min		
NML ID	Descriptor	Day	Evening	Night
01	Corrigour Hotel	61	56	51
02	Kilfinnan Lodges/Robertson Farm	47	48	44
03	Cameron Farm House	45	43	40
04	11 North Laggan	52	48	43

5.5 Embedded Mitigation

There is a commitment to develop and implement a comprehensive Construction Environmental Management Plan (CEMP), inclusive of a Construction Traffic Management Plan (CTMP), Pollution Prevention Plan (PPP) and Controlled Activities Regulations (CAR) License(s). These documents will include best practice noise control measures designed to minimise noise effects throughout the construction period.

5.6 Assessment of Likely Effects

Construction Noise Assessment Criteria

Annex E, part E.3.2 of BS 5228, clearly sets criteria for assessing the significance of construction noise effects and gives examples of suitable threshold values, which can be used to assess construction noise. Table E.1 of BS 5228 (represented here as Table 5.3) contains an example of the significance criteria that can be used to assess construction activities.

Table 5.3: Example of Threshold of Potential Significant Effect at Dwellings (dB_A)

Assessment Category and Threshold Value Period	Threshold Value LAeq,T dB		
	Category A(A)	Category B(B)	Category C(C)
Night-Time (23:00 – 07:00)	45	50	55
Evenings and Weekends(D)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 to 13:00)	65	70	75

Assessment Category and Threshold Value Period	Threshold Value LAeq,T dB		
	Category A(A)	Category B(B)	Category C(C)
(A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values; (B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values; (C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values; D) 19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00 – 23:00 Sundays			

The threshold values in each category are to be used where the existing noise level at each location, rounded to the nearest 5 dB, is below the level given for a particular time of day. BS 5228 provides the following advice regarding the threshold limits:

> *"Note: 1 A potential significant effect is indicated if the LAeq,T noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.*
>
> *Note 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total LAeq,T noise level for the period increases by more than 3 dB due to site noise.*
>
> *Note 3: Applied to residential receptors only."*

Therefore, the assessment of construction noise reflects a specific noise threshold for the locality for a particular period of the day, rather than an absolute noise level.

The table below presents the threshold categories with due regard to the baseline levels presented in Tabke 5.2.

Table 5.4: Assigned BS5228 Threshold Categories

Noise Monitoring Location		Rounded Noise Level and BS5228 Category		
ID	Descriptor	Day	Evening	Night
NML01	Corrigour Hotel	60	55	50
NML02	Kilfinnan Lodges/Robertson Farm	50	50	45
NML03	Cameron Farm House	45	45	40
NML04	11 North Laggan	50	50	45

Category A	Category B	Category C

For all NALS the category A thresholds are adopted during the daytime.

For all NALs, except for NAL 32 (Corrigour Hotel) the Category A thresholds also apply for the assessment of evening and weekend time periods.

During the night-time there is a mix of Category A, B, and C thresholds. No construction activities are anticipated at night-time, therefore an assessment of night-time noise is not included in the assessment, however, a list of relevant BS 5228 threshold levels for all time periods and all receptors is included in **Appendix 5.2** and these can be incorporated in to the CEMP as required.

DMRB takes the assessment process one step further by defining a Lowest Observable Adverse Effects Level (LOAEL) and a Significant Observable Adverse Effects Level (SOAEL), which then enables a Magnitude of Impact to be determined, as follows:

- The LOAEL is defined as equal to the baseline noise levels (dB L_{AEQt}) for each of the time periods detailed in Table 5.3;
- The SOAEL is defined as the threshold levels (dB LAEQt) for each of the time periods detailed in Table 5.3; and,
- Table 3.16 of DMRB LA 111 (represented here as Table 5.5) defines the Magnitude of Impact.

Table 5.5: Magnitude of Impact and Construction Noise Level Descriptions

Magnitude of Impact	Construction Noise Level
Major	Above or equal to SOAEL +5 dB
Moderate	Above or equal to SOAEL and below SOAEL +5 dB
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

With due regards to the above, Table 5.6 sets out the derived noise levels that have been adopted to indicate the Magnitude of Impact for this assessment.

Table 5.6 Derived Noise Level Limits for Assessment

Magnitude of Impact	Construction Noise Level, dB LAeq(t)	
	Daytime & Saturday AM	**Evening & Weekends**
Major	70 +	60 +
Moderate	65 - 70	55 - 60
Minor	45 – 65	43 – 55
Negligible	Less than 45*	Less than 43
* 45 dB is the lowest level measured at all of the NMLs but is applied globally as a conservative approach		

Once the magnitude of impact has been determined it is possible to establish the Significance of Effects as detailed in 3.19 of DMRB, which states;

> *"Construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:*
>
> *1) 10 or more days or nights in any 15 consecutive days or nights;*
>
> *2) a total number of days exceeding 40 in any 6 consecutive months*
>
> *NOTE 1 It is more appropriate to use the specified timescales for highway construction, which are taken from BS 5228-1 [Ref 5.N] section E.4, rather than the '1 month or more' timescale included within E.3.3 of BS 5228-1 [Ref 5.N] due to the transient nature of most highway construction work."*

Construction Noise: Assessment of Likely Effects

In order to predict the noise immission levels attributable to the proposed development, noise propagation models have been produced using the propriety noise modelling software CadnaA. Within the software, complex models can be used to simulate the propagation of noise according to a range of international calculation standards, including BS 5228.

The model uses the octave band sound power output of the proposed construction plant or activity as its acoustic input data, and calculates on an octave band basis, attenuation due to geometric spreading, atmospheric absorption and ground effects.

For the purposes of this assessment, the noise level predictions have been undertaken using a receiver height of 1.5 m above local ground level. Soft ground attenuation (G=1) has been used for undeveloped areas of ground, for example the surrounding fields. Hard ground attenuation (G=0) attenuation has been assumed for the construction compounds and other areas of developed ground, as well as for all areas of water. Air absorption is based on a temperature of 10°C and 70% relative humidity.

All items of plant and activities have been modelled as single point sources, including activities that would occur along a linear activity area, for example, the grading of the road. As such the noise model presents a snapshot in time only and cannot convey the dynamic nature of some of the activities

The noise propagation models are intended to give a good approximation of the specific noise level and the contribution of each individual source. However, it is expected that actual levels are unlikely to be matched exactly with modelled values and the following limitations in the model should be considered:

- The predicted barrier attenuation provided by local topography, embankments, walls, buildings and other structures in the intervening ground between source and receiver can only be approximated and not all barrier attenuation will have been accounted for;
- Unless specifically stated, the models assume all fixed noise sources are operating continuously and simultaneously, estimating a worst-case source noise level;
- All mobile plant (excavators, dozers, rollers etc) have been modelled as a fixed point within their anticipated work/movement areas. This will give an approximation of the overall noise levels from mobile plant at receptor locations for a fixed point in time; however, in reality noise levels will fluctuate as construction plant and activities move around in their activity areas; and,
- At this stage there is no set construction timetable or list of plant to be used. This will be determined at a later date by the contractor. The noise models included in this assessment are indicative only and based on an assumed list of plant and timetable.

It is unavoidable that for some periods, construction activities and plant will be located directly outside a property. On these occasions, noise immission levels may be higher than predicted for a short time, however, noise levels will vary throughout the construction phase as activities, plant and locations vary and for much of the working day the noise associated with construction activities will be less than predicted - the assessment assumes all equipment is operating simultaneously, concurrently and at full power, whereas in practice, equipment load and location will vary throughout the day.

Construction noise sources for any given activity will generally comprise a mix of both moving and static sources. Mobile sources include mobile construction plant and Heavy Goods Vehicles (HGVs), while static construction plant could include generators and pumps. For both mobile and static plant, activity noise levels will be transient in nature due to changes in location, on/off periods, and fluctuations of load on any individual machine.

Because many items of plant have been modelled as if they are stationary, the predictions show a worst case scenario for those properties closest to the modelled noise source location, however, the modelled scenarios can only demonstrate likely noise levels for a snapshot in time and many construction activities, for example, the resurfacing of the road will start in one

location and gradually move along the length of the road over a number of days or weeks. As such it is important to remember that predicted noise levels are indicative only and could vary significantly over the course of a full day or week.

The assessment considers a number of construction scenarios based on the key construction activities detailed within the indicative construction timetable (shown as Table 57, overleaf).

The entire construction period is anticipated to last 18 months. 16 scenarios have been modelled, which represent the activities occurring each month 1 – 15. The final scenario considers all activities likely to occur during months 16-18 as the construction phase is winding down.

It should be noted that however, the final construction timeline and sequencing will be determined by the contractor:

Details of the activities assumed to occur in each modelled scenario, as well as noise data for each modelled item of plant, are included in **Appendix 5.2**. The following list also provides a brief description of the activities assumed to be occurring for each modelled scenario:

- Month 01: Construction compounds are being established in advance of the road construction commencing. Initial earthworks begin on the temporary active travel route located at the southern end of Kilfinnan road;
- Month 02: Site set-up and preparation is finalised. The temporary active travel route is completed. Initial earthworks start at the southern end of Kilfinnan Road (Kilfinnan Bridge) working north to CH400. Construction of the temporary bypass road begins by the A82 junction;
- Month 03 and 04: Construction of the temporary bypass road is completed. Earthworks are progressing up to CH1000. Spoil from earthworks is moved down to the storage compound by Kilfinnan bridge;
- Month 05, 06 and 07: Construction of the new Kilfinnan Bridge commences. Earthworks continue progressing up Kilfinnan road from CH1000 to CH2000. Spoil management is taking place;
- Month 08, 09 and 10: Kilfinnan Bridge construction continues. Earthworks continue between CH2000 and CH3000. Culvert installation at Allt an Oighre begins. Spoil management continues;
- Month 11: Kilfinnan Bridge construction continues. Earthworks continue between CH3000 and CH3200. Culvert installation occurring at Allt an Oighre is completed. Culvert installation at Allt Cruinneachaidh begins. Spoil management continues;
- Month 12 and 13: Kilfinnan Bridge construction continues. Earthworks continue between CH3200 and CH3800. Culvert installation is occurring at Allt Cruinneachaigh. Kilfinnan road surfacing begins. Spoil management continues;
- Month 14: Kilfinnan Bridge construction is completed. Earthworks continue from CH3800 to A82 junction where it finishes. Culvert installation at Allt Cruinneachaigh is completed. Kilfinnan road surfacing is completed. Removal of temporary bypass road begins. Management of spoil is completed;
- Month 15: Temporary bypass road removal is completed; and,
- Month 16, 17 and 18: Road finishing works are taking place.

Tables 5.8 and 5.9 presents the calculated noise immission levels at each NAL for each scenario.

Figures 5.2 through to Figure 5.17 in Appendix 5.1 detail the propagation of noise as a series of noise contour plots.

Appendix 5.3 includes the assessment tables, which compare the predicted levels to the derived noise levels detailed in Table 5.6. These tables indicate the Magnitude of Impact for each receptor across the construction period, from which it is possible to determine the Significance of Effects depending on the duration of the effect.

Table 5.7: Indicative Construction Timetable

Task	Month																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Site Set Up																		
Temporary diversion road construction																		
Kilfinnan Road Construction																		
Structures																		
Kilfinnan Road Surfacing																		
Temporary diversion road Removal																		
Kilfinnan Road Finishing Works																		

Table 5.8: Predicted noise levels during Months 1 - 8

Noise Assessment Location		Month							
ID	Descriptor	1	2	3	4	5	6	7	8
NAL01	11 North Laggan	55.6	57.9	35.4	33.3	28.9	29.2	33.7	61.0
NAL02	12 North Laggan	54.3	54.4	24.1	21.6	19.3	19.9	23.0	59.6
NAL03	13 North Laggan	55.1	58.3	32.0	33.2	29.0	29.3	33.3	60.4
NAL04	14 North Laggan	55.1	59.0	35.6	33.7	29.1	29.5	34.0	60.3
NAL05	15 North Laggan	54.4	59.4	37.1	33.7	29.2	29.6	34.0	59.7
NAL06	16 North Laggan	53.4	60.1	37.2	33.7	29.3	29.7	34.9	58.7
NAL07	17 North Laggan	51.3	61.1	37.4	33.9	29.5	29.9	34.8	56.7
NAL08	18 North Laggan	49.9	61.1	37.5	34.1	29.5	30.0	35.3	55.4
NAL09	19 North Laggan	48.5	60.6	37.5	34.1	30.0	30.8	35.2	54.0
NAL10	20 North Laggan	49.1	61.1	37.6	34.1	30.0	30.9	35.3	54.6
NAL11	North Laggan Farmhouse	53.0	53.2	56.4	36.7	26.5	27.9	48.2	62.1
NAL12	Mogwy Cottage	59.3	59.3	51.2	39.7	34.9	36.8	44.5	59.9
NAL13	Mogwy Cottage (Cosy Nook)	58.7	58.7	56.4	30.1	26.4	28.0	34.8	61.2
NAL14	StoneyField House	52.2	52.2	38.8	54.9	46.4	67.6	51.1	45.3
NAL15	Linden Trees Cottage (North)	50.8	50.8	37.6	45.8	61.0	64.0	47.5	43.2
NAL16	Linden Trees Cottage (South)	51.7	51.7	34.9	39.7	63.3	60.9	46.9	42.7
NAL17	2 Balmaglaster	52.8	52.8	40.5	58.5	67.5	55.1	33.2	32.8
NAL18	2 Balmaglaster (Static home)	53.2	53.2	35.1	43.0	67.7	43.6	41.0	38.7
NAL19	Kelly's View	49.3	50.1	53.2	64.4	58.7	57.7	42.5	42.4
NAL20	10 Glengarry Lodges	50.2	50.2	38.4	66.2	57.2	55.9	40.6	38.8
NAL21	09 Glengarry Lodges	53.9	54.1	38.4	66.7	55.3	53.5	40.5	38.8
NAL22	08 Glengarry Lodges	42.0	42.4	39.9	61.2	50.5	48.2	28.8	28.4
NAL23	07 Glengarry Lodges	46.4	47.9	53.6	52.5	48.4	47.0	43.0	42.9
NAL24	06 Glengarry Lodges	40.5	41.1	42.4	49.5	33.8	32.8	29.3	29.1
NAL25	05 Glengarry Lodges	42.7	43.1	43.6	52.2	33.4	31.9	29.3	29.2
NAL26	04 Glengarry Lodges	48.8	48.9	44.5	48.7	32.6	31.5	29.1	29.0
NAL27	03 Glengarry Lodges	51.2	51.3	44.4	52.0	32.3	30.9	28.1	28.0
NAL28	02 Glengarry Lodges	52.8	52.9	46.5	52.1	32.0	30.7	28.6	28.4
NAL29	01 Glengarry Lodges	54.9	55.1	68.5	39.8	39.1	39.0	41.6	41.6
NAL30	Kilfinnan Burn Farmhouse	50.7	52.0	44.7	44.3	52.5	52.5	53.2	53.2
NAL31	Corriegour Hotel	26.8	29.4	32.4	32.3	30.8	29.6	30.5	30.7
NAL01	11 North Laggan	55.6	57.9	35.4	33.3	28.9	29.2	33.7	61.0

Table 5.9: Predicted noise levels during Months 9 - 18

Noise Assessment Location		Month							
ID	Descriptor	9	10	11	12	13	14	15	16 to 18
NAL01	11 North Laggan	61.0	61.0	64.1	61.7	63.0	69.8	39.5	55.6
NAL02	12 North Laggan	59.6	59.6	62.6	59.6	61.1	70.3	24.5	54.2
NAL03	13 North Laggan	60.4	60.4	63.5	61.3	62.6	72.4	39.9	55.1
NAL04	14 North Laggan	60.3	60.3	63.4	61.4	62.7	72.5	40.2	55.0
NAL05	15 North Laggan	59.7	59.7	62.8	61.1	62.3	71.3	40.6	54.4

Noise Assessment Location		Month							
ID	Descriptor	9	10	11	12	13	14	15	16 to 18
NAL06	16 North Laggan	58.7	58.7	61.9	60.6	61.7	70.3	40.9	53.4
NAL07	17 North Laggan	56.8	56.8	60.1	60.0	60.8	69.3	41.3	51.3
NAL08	18 North Laggan	55.5	55.5	58.9	59.6	60.3	68.0	41.4	50.0
NAL09	19 North Laggan	54.2	54.1	57.7	59.1	59.7	66.9	41.5	48.5
NAL10	20 North Laggan	54.8	54.7	58.3	59.7	60.3	66.6	41.7	49.2
NAL11	North Laggan Farmhouse	74.5	62.0	63.0	56.9	58.7	58.9	43.4	53.1
NAL12	Mogwy Cottage	54.8	48.7	49.1	40.5	61.3	61.3	34.2	59.3
NAL13	Mogwy Cottage (Cosy Nook)	54.2	47.6	47.7	35.3	60.7	61.4	53.4	58.6
NAL14	StoneyField House	40.5	39.9	40.3	40.0	53.8	54.5	46.1	52.1
NAL15	Linden Trees Cottage (North)	38.8	38.2	38.6	38.4	50.9	51.4	41.6	50.7
NAL16	Linden Trees Cottage (South)	38.3	37.7	38.1	37.9	53.3	53.3	31.1	51.7
NAL17	2 Balmaglaster	32.4	32.3	32.4	32.3	54.6	54.6	21.0	52.8
NAL18	2 Balmaglaster (Static home)	35.3	34.6	35.1	34.8	55.2	55.3	36.2	53.
NAL19	Kelly's View	42.3	42.3	42.3	42.3	50.8	50.8	27.1	48.4
NAL20	10 Glengarry Lodges	35.8	34.2	35.6	34.7	51.7	51.7	34.4	50.1
NAL21	09 Glengarry Lodges	35.9	34.6	36.0	35.3	55.7	55.7	34.5	53.8
NAL22	08 Glengarry Lodges	28.0	27.7	27.9	27.7	43.2	43.3	18.0	41.8
NAL23	07 Glengarry Lodges	42.8	42.8	42.9	42.8	46.9	47.0	26.7	43.2
NAL24	06 Glengarry Lodges	28.9	28.7	28.9	28.8	41.3	41.3	16.9	40.0
NAL25	05 Glengarry Lodges	29.0	28.9	29.0	28.9	43.7	43.7	16.6	42.4
NAL26	04 Glengarry Lodges	28.8	28.7	28.8	28.7	50.2	50.2	16.3	48.7
NAL27	03 Glengarry Lodges	27.7	27.5	27.7	27.6	53.4	53.4	16.2	51.2
NAL28	02 Glengarry Lodges	28.2	28.1	28.2	28.1	55.0	55.0	16.0	52.8
NAL29	01 Glengarry Lodges	41.6	41.6	41.6	41.6	56.4	56.4	22.4	54.5
NAL30	Kilfinnan Burn Farmhouse	53.2	53.1	53.2	53.2	53.3	53.3	38.5	41.0
NAL31	Corriegour Hotel	29.5	27.7	30.2	29.3	30.6	31.4	24.6	23.8

The following paragraphs detail the likely Significance of Effects from construction noise, firstly due to daytime construction activities (weekday 07:00 – 19:00 and Saturday 07:00 – 13:00) and then due to evening and weekend construction activities (weekday 19:00 – 23:00, Saturday 13:00 – 23:00 & all day on Sunday).

This assessment is made with reference to the tables presented as **Appendix 5.3**.

Assessment of Daytime Construction Noise

During months 1, 2, 7, 8, 10, 11, 12, 13, 15, 16, 17 and 18 noise levels at all NSRs will result in a negligible or minor magnitude of impact. No significant effects are anticipated.

During months 3, 4, 5 and 6 the predicted noise levels indicate that a moderate magnitude of impact could occur at a small number of NSRs, however, no significant effects are anticipated as the duration of exposure to these noise levels is expected to be less than 10 days in any 15 consecutive days and less than 40 days in any 6 consecutive months.

During month 9 the predicted noise level at one location (NAL11) indicates a Major magnitude of impact, however, the duration of exposure to this level of noise is likely to be less than 10 days in any 15 consecutive days and less than 40 days in any 6 consecutive months, and no significant effects are anticipated. At all other NSRs noise levels will result in a negligible or minor magnitude of impact.

During month 14 the predicted noise level at five locations indicates a Major magnitude of impact, with another five locations predicted to experience a moderate magnitude of impact. However, the duration of exposure to this level of noise is likely to be less than 10 days in any 15 consecutive days and less than 40 days in any 6 consecutive months, and no significant effects are anticipated. At all other NSRs noise levels will result in a negligible or minor magnitude of impact.

Assessment of Evening and Weekend Construction Noise

At the beginning and end of the construction period (month 1, 16, 17 and 18) a moderate magnitude of impact is anticipated at some properties at the northern half of Kilfinnan Road up to the junction at the A82. There is the potential for this to result in significant effects unless appropriate mitigation is put into place.

From month 3 to 6, as well as month 8 to 14 a major magnitude of impact is anticipated at multiple NSRs along the length of Kilfinnan Road, starting in the south in month 3 and gradually working its way northwards. By month 14 this major magnitude of impact would occur at the NSRs located at the northern end of Kilfinnan Road. Due to the length of exposure to these noise levels a significant effect is expected. Accordingly, construction works should be avoided during weekends and evenings unless appropriate mitigation measures can be put into place.

During month 7 and 15, noise levels at all NSRs will result in a negligible or minor magnitude of impact, therefore no significant effects are anticipated.

Summary of Construction Noise Assessment

During the daytime no significant effects are anticipated**.**

If construction activities were to occur during the evening and weekends then a significant effect is expected at multiple NSRs along Kilfinnan Road. Accordingly evening and weekend working should be avoided where possible unless appropriate mitigation measures can be implemented. This includes the use of temporary noise barriers, which are discussed later in this Chapter.

Construction Vibration Assessment Criteria

A number of British Standards are available that provide guidance in respect of the measurement and assessment of vibration. With regards to environmental vibration effects (as opposed to occupational health effects) the key documents relevant to this study are;

- BS 7385-2:1993;
- BS 6472-1:2008;
- BS 5228-1:2009+A1:2014; and,
- DMRB LA 111.

BS 7385 2:1993 *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration* presents guidance in relation to the effects of vibration on buildings, whereas BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings* is concerned with the effects of vibration on humans. Both of these standards document the impacts that are associated with environmental vibration effects, regardless of the vibration source (except for blasting, which is covered in separate documents).

In contrast, BS 5228 and DMRB are for use specifically for construction activities only, though both documents draw on the data presented in BS 7385 and BS 6472.

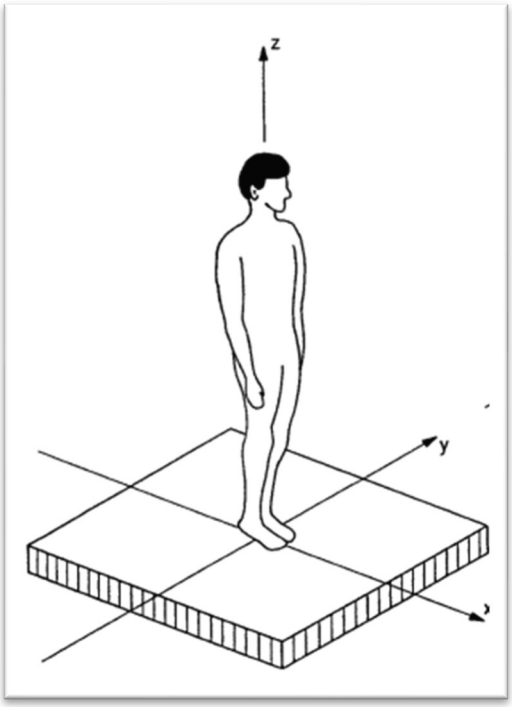
Whereas BS 5228 is intended for use with many types of construction and open sites, DMRB is relevant only for road construction activities.

Vibration Criteria Related to Effects on Buildings

Threshold values to determine the potential for damage to buildings are detailed in BS 7385-2:1993. The unit of measurement used for this assessment method is the Peak Particle Velocity (PPV), which is quantified in mm/s.

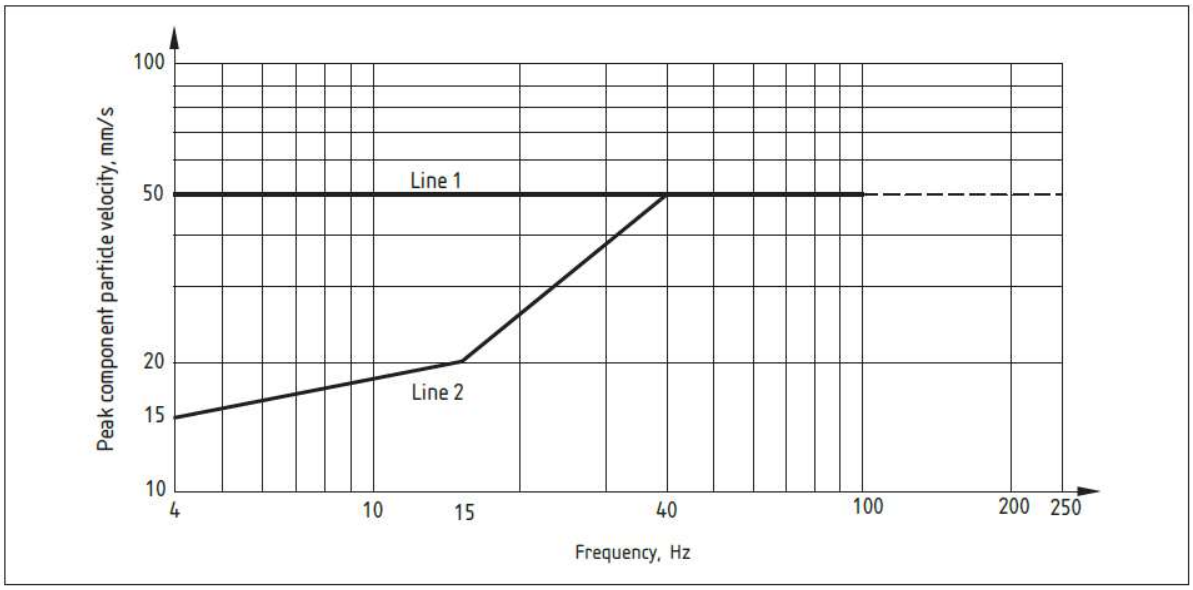
Vibration is measured in three separate axis (indicated in Figure 5.1 as x, y and z), which are known as longitudinal, transverse and vertical. The assessment is made against the *Peak* Component Particle Velocity, which is the maximum PPV measured in any one of these three axes.

Figure 5.1: The Three Axis of Vibration



The Standard provides limits for transient vibrations at which cosmetic building damage could occur and these are indicated in Figure 1 of the standard, which is replicated here as Figure 5.2.

Figure 5.2: Transient Vibration Guide Values for Cosmetic Damage to Buildings



Line 1 represents reinforced or framed structures such as industrial and heavy commercial buildings, whereas Line 2 represents "unreinforced or light framed structures. Residential or light commercial type buildings". It is the values in Line 2 that are of interest for this assessment.

Beyond cosmetic damage, minor damage may occur at twice the values shown in Figure 6.2 -and major damage may occur at four times the values. Table 5.1 presents these levels in tabular form.

Table 5.10: Transient Vibration Guide Values for Building Damage

Peak Component Particle Velocity (mm/s)	Damage Levels for Residential Buildings
15 mm/s PPV for a frequency of 4 Hz, rising to 50 mm/s PPV for a frequency of 40Hz and above	Cosmetic
30 mm/s PPV for a frequency of 4 Hz, rising to 100 mm/s PPV for a frequency of 40Hz and above.	Minor
60 mm/s PPV for a frequency of 4 Hz, rising to 200 mm/s PPV for a frequency of 40Hz and above.	Major

Vibration Criteria Related to Effects on Persons in Buildings

In contrast, BS 6472-1:2008 provides threshold values to determine the probability of adverse comment as a result of perceived vibration within buildings. Humans are particularly sensitive to vibration and can perceive vibrations at very low levels that are significantly less than those needed to cause cosmetic damage to buildings. Thresholds of perception can be in the region of 0.14 mm/s^{-1} to 0.3 mm/s^{-1}. In this regard BS5228-2 states;

> *"Vibrations, even of very low magnitude, can be perceptible to people …"*
>
> *"Vibration nuisance is frequently associated with the assumption that, if vibrations can be felt, then damage is inevitable; however, considerably greater levels of vibration are required to cause damage to buildings and structures….." and,*
>
> *"In residential accommodation, vibrations can promote anxiety lest some structural mishap might occur …. although such levels are unlikely to be encountered as a result of construction and demolition activities"*

Vibration within buildings can be either continuous, intermittent, or occasional and may or may not be impulsive (i.e. build up to a rapid peak, rather than a gradual increase). In order to provide an appropriate metric for the assessment of human response to these different types of vibration BS 6472-2 provides a method to calculate a Vibration Dose Value (VDV), which takes into account the total amount of time that vibration can occur within specific time periods.

Table 1 of the standard, replicated here as Table 5.11 Vibration Dose value ranges which might result in various probabilities of adverse comment within residential buildings **Table** 5.11: Vibration Dose Value Ranges Which Might Result in Various Probabilities of Adverse Comment Within Residential Buildings, provides a range of VDVs that might result in adverse comment.

Table 5.11: Vibration Dose Value Ranges Which Might Result in Various Probabilities of Adverse Comment Within Residential Buildings

Place and Time	Low probability of adverse comment, $ms^{-1.75}$ (i)	Adverse comment possible, $ms^{-1.75}$	Adverse comment probable, $ms^{-1.75}$ (ii)
Residential buildings 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hour night	0.1 to 0.2	to 0.4	0.4 to 0.8
Below these ranges adverse comment is not expected Above these ranges adverse comment is very likely			

Guideline Levels for Assessment

Although BS 6472-2 provides threshold values in VDV, for construction projects it is usual to only assess using the PPV metric. This is described in BS 5228-2, which states;

> *"Whilst the assessment of the response to vibration in BS 6472 is based on the VDV and weighted acceleration, for construction it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is likely to be more routinely measured based upon the more usual concern over potential building damage. Furthermore, since many of the empirical vibration predictors yield a result in terms of PPV, it is necessary to understand what the consequences might be of any predicted levels in terms of human perception and disturbance."*

Table B.1 of BS 5228-2, reproduced here as Table 5.12, provides guideline PPV levels that can be used in a construction setting, rather than having to rely on the VDV BS 6472-1 thresholds. It is important to note that the levels reported refer to internal vibration within a building, however, this report assess external vibration levels only as it is not possible to predict internal vibration levels without detailed knowledge of local factors to determine the external to internal transfer function, which can only be determined through measurement.

Table 5.12: BS 5228 Guidance on Effects of Vibration Levels

Vibration Level (A) (B) (C)	Effect
0.14 mm/s-1	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s-1	Vibration might be just perceptible in residential environments.
1.0 mm/s-1	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s-1	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.
The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient. A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available. Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these	

Vibration Level [A] [B] [C]	Effect
values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.	

For the assessment of vibration effects on buildings BS 5228-2 refers to the guideline values detailed in BS 7385-2 (as summarised in Table 5.10)

Again, DMRB LA 111 takes the assessment process one step further by defining a LOAEL and SOAEL that enables a magnitude of impact to be determined.

- The LOAEL is defined as 0.3 mm/s PPV;
- The SOAEL is defined as 1.0 mm/s PPV; and,
- DMRB LA 111 states that for the purposes of assessment it should be assumed that baseline vibration levels are zero.

Table 3.33 of DMRB LA 111 (represented here as Table 5.13) defines the Magnitude of Impact.

Table 5.13: DMRB Vibration Level Limits for Assessment

Magnitude of Impact	Construction Vibration Level
Major	Above or equal to 10 mm/s PPV
Moderate	Above or equal to 1.0 mm/s and below 10 mm/s PPV
Minor	Above or equal to 0.3 mm/s and below 1.0 mm/s
Negligible	Below 0.3 mm/s

Once the magnitude of impact has been determined it is possible to establish the Significance of Effects as detailed in 3.34 of DMRB, which states;

> *"Construction vibration shall constitute a likely significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:*
>
> *1) 10 or more days or nights in any 15 consecutive days or nights; or*
>
> *2) a total number of days exceeding 40 in any 6 consecutive months.*

Construction Vibration: Assessment of Likely Effects

The calculation method for the prediction of vibration levels from vibratory compaction (using a road roller) considers the following parameters;

- Number of vibrating drums;
- Drum Width;
- Horizontal distance (source to receiver) between 2 m and 110 m; and,
- Maximum amplitude of drum vibration (mm).

Three different vibratory rollers have been adopted for candidate plant to represent three different types of rollers that may be used; a large single drum roller, a smaller double drum ride on roller, and a small walk behind roller. The parameters used for each are detailed in Table 5.14.

In terms of horizontal distance (distance between roller and receptor), this will vary depending on the construction phase, however, for the purpose of this assessment two distances have been considered. The first distance has been selected to predict levels for the worst case scenario i.e. the likely minimum distance between closest receptors and plant. The second distance has been selected to consider a more likely scenario using the typical distance between roller and receptor for activity locations occurring close to properties.

Table 5.14: Roller Specifications Used in Vibration Calculations

Plant	Drums		Max Amplitude	Horizontal Distance		Comment
	No. of	Width (m)	mm	Minimum (m)	Typical (m)	
CASE SV213E	1	2.13	1.96	8	20	Large roller – typical unit used for road construction and in quarries etc.
Case DV45D	2	1.38	0.55	8	20	Smaller roller – also often used for road construction
Bomag BW 80 AD-5	2	0.80	0.50	8	10	Small roller that may be used when working in restricted spaces

Table 5.14 and 5.16 detail the predicted vibration levels at receptors for the use of all three roller types for both worst case and typical scenarios. It should be noted that the predicted vibration levels represent vibration levels for receptors located directly opposite the assessed activity and the for the majority of time as plant move at more distant locations, vibration levels will be lower.

Table 5.15: Predicted Vibration Levels, PPV (95% Confidence Level). Vibratory Compaction

Plant	Vibration Level PPV (mm/s)	
	Minimum distance	Typical distance
CASE SV213E	23.49	7.27
Case DV45D	5.54	1.61
Bomag BW 80 AD-5	5.29	3.89

Table 5.16: Predicted Vibration Levels, PPV (66% Confidence Level). Vibratory Compaction

Plant	Vibration Level PPV (mm/s)	
	Minimum distance	Typical distance
CASE SV213E	12.17	3.77
Case DV45D	2.87	0.83
Bomag BW 80 AD-5	2.74	2.01

With reference to DMRB and the limits presented in Table 5.13, a major magnitude of impact is predicted to occur when the largest of the rollers (Case SV213E) is operating directly opposite receptors at the likely minimum distances (using a 95% confidence calculation). A moderate magnitude of impact will occur at more typical distances for the closest receptors.

Notwithstanding the above, the duration of any compaction activities occurring directly outside a property at the minimum distances will be very short and much less than DMRB exposure periods required for a significant effect.

With reference to BS 7385 and the values detailed in Table 5.10 and Figure 5.1--, and with due regard to the minimum operating frequency of the plant (31 Hz for CASE SV213E), the predicted vibration levels are below the levels required to cause cosmetic damage using both the 95% and 66% confidence level. **Accordingly, no significant effects are anticipated.**

5.7 Further Mitigation and Enhancement

There is the potential for significant effects to occur when operating outside of Weekday Daytime hours (07:00 – 19:00 weekdays and 08:00 – 14:00 on Saturdays). Accordingly, it will be important for the contractor to follow the good practice noise control measures detailed within BS 5228.

There are no specific requirements for mitigation to lessen noise levels during the daytime, as no significant effects are anticipated, however, any noise control measures adopted for evening or weekend periods would also be implemented during the daytime to further reduce noise levels and duration of exposure.

Section 8 of BS 5228-1 recommends a number of simple control measures as summarised below. These will be adopted throughout the construction period. Specifically, the principal contractor will:

- Keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern;
- Ensure site work is within core hours wherever possible and any occasional required work outside of core hours shall be programmed carefully, with consideration to noise and nearby local residents;
- Ensure all vehicles and mechanical plant will be fitted with effective exhaust silencers and be subject to programmed maintenance;
- Select inherently quiet plant where appropriate;
- Ensure all ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Instruct that machines will be shut down between work periods or throttled down to a minimum;
- Undertake regular maintenance of all equipment used on site, including maintenance related to noise emissions; and,
- Ensure all ancillary plant such as generators and pumps will be positioned to cause minimum noise disturbance and, if necessary, temporary acoustic screens or enclosures should be provided.

In addition to the above best practice measures:

- In accordance with a request from Highland Council within the Scoping Response, all mobile plant will be fitted with white noise reversing alarms (as opposed to tonal ‘beeping’ alarms; and,
- Where access and space restrictions allow, temporary noise barriers will be installed. Further detail is provided below.

Use of Noise Barriers

The use barriers can typically reduce noise levels by around 10 dB when installed in optimum locations and noise modelling assuming 2.2m high Herras fencing fitted with temporary sound barrier mats indicates that noise levels at the houses at North Laggan could be reduced in the region of 5 – 8dB, whilst noise levels at the houses closest to the road at Glengarry Lodges could be reduced by up to 12 dB.

Given the restrictions with space limitation and access however, for example, ensuring that driveways are not blocked, the actual amount of barrier attenuation achieved in these situations might be less and careful consideration will need to be given to the placement of any barriers to ensure they are used effectively. Nonetheless, even with reduced levels of attenuation, this could still be a useful means of noise control and should be sufficient to reduce noise levels to below the BS 5228 threshold levels in most situations.

The use of barriers could include the erection of temporary boarding in the vicinity of housing at North Laggan, however, it will most likely be preferable to use ‘acoustic blanket panels’ to hang from heras fencing or similar so that barriers can be easily moved for both safety and access

reasons as well as to optimise the level of attenuation achieved depening on the location of construction activities. This type of barrier should also be used at other locations along the road where access allows if particularly noisy activities are occurring for a prolonged period in close proximity to a dwelling, for example, where rock breaking is required.

Barriers should be installed as close to the activities as is practicable and fitted to interrupt any direct line of site between the construction plant and the closest residential receptors. Examples of appropriate products include Echo Noise Defender and Soundex DeciBloc.

The location of where barriers will be deployed will be detailed within the CEMP.

5.8 Residual Effects

Although a range of good practice measures will be employed during construction to minimise noise impacts, as detailed in 5.7 above, at some locations elements of construction noise will be audible at the closest NSRs for certain periods during the construction phases. Nonetheless, no significant residual effects are anticipated.

5.9 Monitoring

In the absence of any likely significant adverse effects, no noise monitoring is considered to be required.

If rock breaking in the immediate vicinity of residential properties may last for 10 or more days in any 15 consecutive days or exceeding 40 days in any 6 consecutive months, then a vibration monitoring survey will be undertaken. The duration of exposure triggering the survey may occur from rock breaking being undertaken at a single location or the cumulative amount of exposure from rock breaking at multiple locations. The monitoring procedures and study area cannot currently be determined (as the methods by which rock breaking will occur will be defined later by the contractor) but will be detailed within the CEMP as more detail becomes available and before work commences on site.

5.10 Cumulative Effects

Although other construction activities related to the wider Coire Glas project will be taking place during the same construction period as the Kilfinnan Road upgrades, the separation distances between road construction and the wider construction are such that no cumulative construction noise effects would occur.

5.11 Summary

Prediction of construction noise has been undertaken based on a candidate plant list and indicative construction timetable. The predicted noise levels have been compared to noise thresholds detailed in BS 5228, which, if exceeded indicate the potential for significant effects.

The predicted levels have also been compared to noise limits detailed in LA111 of DMRB, which indicates a Magnitude of Impact and allows the significance of effect to be established.

With due regard to the predicted noise levels and the guideline noise limits no significant effects are anticipated during normal daytime construction hours. The assessment, does indicate, however, that significant effects are likely to occur if regular construction activities are undertaken during the evenings and weekends. Accordingly, construction activities during evening and weekend hours will be restricted.

Where temporary barriers can be installed to lessen the noise levels at receptors, this will be employed to allow evening or weekend working if required. Otherwise, construction activities during these time periods will not be undertaken unless the contractor can demonstrate that the BS 5228 threshold levels will not be exceeded, for example, through the use of noise modelling prior to activities being scheduled.

Vibration predictions of compaction activities have been undertaken for two distances, the minimum distance likely to occur between activity and receptor and a more typical distance

representing activities occurring directly opposite a dwelling. The assessment of vibration considers the effects of vibration on both buildings and humans.

Predictions cannot be undertaken for rock breaking activities and so it is proposed to carry out a vibration monitoring survey(s) should rock breaking be required in the immediate vicinity of dwellings for periods of 10 or more days in any 15 consecutive days or exceeding 40 days in any 6 consecutive months.

The predicted levels have been compared to vibration guideline levels in BS7385 and to limits detailed in LA111 of DMRB, which indicates a Magnitude of Impact and allows the significance of effect to be established.

Predicted vibration levels are below the levels that may cause cosmetic damage to buildings.

Predicted vibration levels indicate a major magnitude of impact when the largest of road roller vehicles are operating directly opposite a dwelling (at 8 m distance) but at greater distances vibration levels will be less and due to the short duration of exposure that is anticipated no significant effects are anticipated.

To summarise;

- No significant effects are expected to occur as a result of construction noise during the daytime (07:00-19:00 weekdays, 08:00 – 14:00 Saturdays);
- Significant effects are anticipated in relation to construction noise if working occurs for extended periods during evenings and weekends unless appropriate mitigation measures are put in place in the form of temporary noise barriers; and,
- No significant effects are expected to occur as a result of construction vibration.

5.12 References

Planning Advice Note (PAN) 1/2011 Planning and Noise (Scottish Government 2011)

Technical Advice Note (TAN) 1/2011 Assessment of Noise (Scottish Government 2011)

BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Part 1 Noise (BSI, 2014)

BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Part 2 Vibration (BSI, 2014)

Design Manual for Roads and Bridges (DMRB) LA111 Noise and Vibration (The Crown, 2020)

BS 7385 2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration (BSI, 1993)

BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings (BSI, 2008)