Chapter 15 Noise and Vibration

15.1 Introduction

This chapter of the EIS assesses the impacts of noise and vibration associated with the proposed upgrade of the M7 Naas to Newbridge By-Pass Upgrade Scheme and upgraded Newhall Interchange. The upgrade involves the addition of a third lane to both the northbound and southbound lanes of the M7 motorway between Johnstown and Greatconnell and a new reconfigured interchange at Newhall.

15.2 Methodology

In order to assess the noise impact of any proposed road scheme, the following methodology is normally adopted.

The first stage is to assess and quantify the existing noise environment in the vicinity of sensitive receptors that may be affected by the proposed development. In the case of a road scheme, the selected noise-sensitive locations are likely to be those in closest proximity to the proposed road.

The noise levels resulting from both the construction and operational phases are then calculated using established prediction techniques. The noise levels associated with the operational phase of the proposed development are predicted in accordance with guidance set out in Calculation of Road Traffic Noise (CRTN), giving results in the form of $L_{A10(18hour)}$ values. These are then converted to L_{den} values in accordance with the procedures detailed in the NRA guidance. The derived values for L_{den} should be rounded to the nearest whole number, with 0.5 being rounded up.

Indicative noise levels associated with the construction phase have been calculated in accordance with the methodology set out in BS 5228: Part 1. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations.

The results of the predicted assessment are compared against the most appropriate criteria for both construction and operational phases. Where predicted noise levels are in excess of the adopted criteria, mitigation measures are proposed.

Further details of each phase of the assessment are set out in the individual sections of the chapter.

Assessment Criteria

Operational Phase

There are no statutory guidelines or standards for noise mitigation in Ireland applicable for Road Schemes. For new roads in Ireland, it is standard practice to adopt the traffic noise design goal contained within the NRA document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes 2004*. This document specifies that it is considered appropriate to set the design goal for Ireland as day-evening-night 60dB L_{den} (free field residential façade criterion). This criterion applies to new national roads only and has been selected to account for the introduction of a new scheme into green field environments with existing low noise levels.

In this instance it should be acknowledged that the works under consideration here do not constitute a new road scheme rather an upgrade to an existing element of infrastructure. The guideline notes:

"in devising design goals for national roads, the Authority has balanced environmental and economic considerations. With this in mind, the Authority acknowledges that it may be appropriate to adopt different design goals for diverse situations, e.g. design goals for existing situations may be different from new situations."

Given that the M7 Motorway is currently in operation, the range of noise levels resulting from the exiting motorway are, for a large portion of locations, above the NRA design goal of 60dB $L_{den.}$ It is therefore acknowledged that the 60dB L_{den} design goal for *new* road schemes is not directly applicable to this development and in accordance with the NRA's guidance document a more appropriate assessment is required.

The guidance states that in such circumstances, nevertheless, a structured approach should be taken in order to ameliorate as far as practicable road traffic noise through the consideration of measures such as alignment changes, barrier type (e.g. earth mounds) or low noise road surfaces.

As part of this assessment, therefore, reference has also been made to the **Kildare Local Authorities *Noise Action Plan,* 2013** document which is considered to focus the aims of the NRA guidelines of noise management and reduction from road schemes.

The objectives set out in the Noise Action Plan (NAP) are:

"to avoid, prevent and reduce, where necessary, on a prioritised basis the harmful effects, including annoyance, due to long term exposure to environmental noise. This will be achieved by taking a strategic approach to managing environmental noise and following a balanced approach in the context of sustainable development".

The Noise Action Plan primarily considers the long term environmental noise impact from road traffic noise sources, and sets out an approach to review noise impact levels near to the major sources assessed during the strategic noise mapping in 2011. Assessment threshold values have been set out in the NAP which are:

"a starting point in the process which seeks to identify locations exposed to existing levels of environmental noise for which it may be considered appropriate to address the exposure through mitigation measures."

The noise action plan proposes noise levels for the onset of this assessment of:

- 70dB L_{den}, and;
- 57 dB L_{night}.

The plan notes that the noise levels used do not constitute any form of design guideline for noise management, nor do they necessarily indicate that at or above such levels the environmental noise should be considered undesirable.

In the absence of alternative suitable threshold values, therefore, the determination for mitigation has been governed by both documents with a view to reducing traffic noise levels, as far as is practicable though available methods.

In the case of this upgraded scheme a commencement year of 2015 and a future design year of 2030 have been assessed.

Construction Phase

The NRA guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in **Table 15.1**.

Table 15.1 Maximum Permissible Noise Levels at the Façade of Nearby Dwellings during Construction

Days & Times	$L_{Aeq\ (1hr)}$ dB	L_{Amax} dB(A)
Monday to Friday 07:00 to 19:00hrs	70	80*
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturday 08:00 to 16:30hrs	65	75
Sundays and Bank Holidays 08:00 to 16:30hrs	60*	65*

Note*: Construction activity at these times, other than that required in respect of emergency works, will normally require the explicit permission of the relevant local authority

It should be noted that the noise criteria quoted in the table above are specific to construction activities only (i.e. these levels are not cumulative with the existing noise environment from road traffic and other surrounding sources).

15.3 Description of Existing Conditions

A series of environmental noise surveys were conducted at locations along the length of the proposed upgrade works. These locations have been chosen in order to quantify the existing noise environment in the vicinity of the noise-sensitive locations that may be affected by the proposed works.

Measurement Locations

The measurement location coordinates and location descriptions are presented in **Table 15.2** overleaf and illustrated in **Figures 15.1 - 15.9, EIS Volume 3.**

Table 15.2 Baseline Noise Monitoring Locations

Survey Location	Survey Area	Coordinates	
		Easting	Northing
S01-a	Greatconnell	282,514	213,642
S01-b		282,234	213,549
S01-c		282,561	213,555
S01-d	Clownings	283,507	214,258
S01-e		283,827	214,052
S02-a	Clownings/Lewistown	284,446	215,132
S02-b		284,591	215,372
S02-c		285,020	215,828
S02-d		284,658	216,164

Survey Location	Survey Area	Coordinates	
		Easting	Northing
S02-e	Clownings/Lewistown	285,266	216,980
S02-f		285,367	217,098
S03-a	Monread North /Osberstown	288,985	221,943
S03-b		289,342	221,839
S03-c		288,638	221,835
S03-d	Ploopluck	287,017	219,780
S03-e	Newhall/Ladystown	286,573	218,673
S03-f		286,386	218,856
S04-a	Monread road	290,613	221,447
S04-b	Johnstown	291,760	221,405
S04-c	Johnstown	291,732	221,541
S04-e	Johnstown	292,109	221,670
S04-d	Roseborough	292,117	221,830
S04-f	Johnstown	292,321	222,003

Survey Periods

Unattended noise surveys were conducted at four locations over the course of the following survey periods:

- Location 1A 16:00hrs on 14 March to 16:00hrs 15 March 2012;
- Location 2A 17:00hrs on 14 March to 17:00hrs 15 March 2012;
- Location 3A 18:00hrs on 26 March to 18:00hrs 27 March 2012, and;
- Location 4A 18:00hrs on 26 March to 18:00hrs 27 March 2012.

Location 1A was located within the rear garden of a residential property along Great Connell Road, adjacent to the M7. The monitoring height was at 2m above ground line with the ground floor window.

Location 2A was located within the rear garden of a residential property along the Royal Canal. The monitoring height was at 4m above ground. The monitoring height was at 2m above ground in line with the ground floor window.

Location 3A was located within the side/rear garden of a residential property at Osberstown Cottages. The monitoring height was at 2m above ground in line with the ground floor window.

Location 4A was located within the rear garden of a residential property along the Monread Road. The monitoring height was at 2m above ground in line with the ground floor window.

Attended monitoring was conducted at the 23 locations over the course of the dates above between 10:00 and 17:00 hours. All attended surveys were conducted at a height of *ca*. 1.5m from ground.

Instrumentation

The shortened measurements were performed using Brüel & Kjær Type 2260 Sound Level Meters. The continuous measurements were performed using Brüel & Kjær

Type 3592 Environmental Kits with Brüel & Kjær Type 2238 and 2250 Sound Level Meters in addition to a Larson Davis 820 sound level meter with environmental kit. Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

Procedure

Unattended Noise Measurements

Unattended continuous measurements were performed over a 24-hour period at four locations. Sample periods were 1-hour long and the results were saved to the instrument memory for later analysis. L_{den} values are derived directly from the measured data.

Attended Noise Measurements (Derived Value)

Shortened measurements were conducted at 6 survey locations surrounding each unattended 24 hour location with the exception of S01 where 5 locations were surveyed in the vicinity of this location. Surveys were conducted on a cyclical basis with sample periods of 15 minutes. The results were noted onto a Survey Record Sheet immediately following each sample, and were also saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up. The survey work was conducted in accordance with the shortened measurement procedure as laid down in the NRA guidance document.

When surveying traffic noise, the acoustical parameters of interest are $L_{A10\ (1hour)}$ and $L_{A10\ (18hour)}$, expressed in terms of decibels (dB) relative to 2×10^{-5}Pa. The value of $L_{A10\ (1hour)}$ is the noise level exceeded for just 10% of the time over the period of one hour. $L_{A10\ (18hour)}$ is the arithmetic average of the values of $L_{A10\ (1hour)}$ for each of the one hour periods between 06:00 and 24:00hrs.

The shortened measurement procedure involves a method whereby $L_{A10\ (18hour)}$ values are obtained through a combination of measurement and calculation as follows:

- noise level measurements are undertaken at the chosen location over three consecutive hours between 10:00 and 17:00hrs;
- the duration of the sample period during each hour is selected to encompass sufficient traffic flows to ensure reliable results;
- the $L_{A10\ (18hour)}$ for the location is derived by subtracting 1dB from the arithmetic average of the three hourly sample values,

  i.e. $L_{A10(18hour)} = ((\Sigma L_{A10(1hour)}) / 3) - 1$ dB.
- The L_{den} for the location is then derived from the calculated $L_{A10(18hour)}$ value,

i.e. $L_{den} = 0.86\ L_{A10(18hour)} + 9.86$ dB.

Weather

Weather conditions during all survey periods were dry and calm. Wind speeds were below 1m/s during all monitoring rounds. Temperatures were in the range 19 to 21˚C.

Results of Noise Surveys

Table 15.3 presents the results of the attended measured noise levels for each of the survey locations. Tables A1 to A4 in Appendix 15.1 present the results of the unattended survey results at the 24 hour locations.

The results of the survey have indicated that baseline noise levels at all locations assessed are dominated by the M7 Motorway. At properties located towards Naas and Johnstown, local road traffic along the Monread Road in addition to urban noise sources from retail and commercial premises was also noted to be a source of noise.

Measured noise levels were above 60dB L_{den} at all monitoring locations with the exception of a small number of locations (S01a, S03 and S03b) which were set back further from the M7 Mainline.

Table 15.3 Baseline Noise Monitoring Results

Survey Location	Survey Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			dB L_{den}		Notes
		L_{Aeq}	L_{A10}	L_{A90}	Derived (Short term)	Measured (long term)	
S01-a	10:12 - 10:27	62	64	59	64	69	M7 Dominates
	11:18 - 11:33	62	64	59			
	12:23 - 12:38	62	64	59			
S01-b	10:40 - 10:55	67	70	64	69	n/a	M7 Dominates
	11:36 - 11:51	67	69	63			
	12:32 - 12:47	67	69	63			
S01-c	10:59 - 11:14	65	67	62	66	n/a	M7 Dominates
	11:55 - 12:10	65	67	62			
	12:51 - 13:06	64	66	61			
S01-d	13:15 - 13:30	71	73	67	72	n/a	M7 & M9 Slip road dominates
	14:19 - 14:34	72	74	68			
	14:35 - 14:50	72	74	68			
S01-e	13:55 - 14:10	53	54	50	57	n/a	M7 & M9 Slip road dominates
	14:56 - 15:11	54	56	51			
	16:01 - 16:16	56	58	51			
S02-a	10:35 - 10:50	66	68	62	68	71	M7 Dominates
	11:38 - 11:53	67	69	63			
	12:49 - 13:04	67	69	63			
S02-b	10:57 - 11:12	65	67	62	66	n/a	M7 Dominates
	11:55 - 12:10	65	67	62			
	13:12 - 13:27	65	67	61			

Survey Location	Survey Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			dB L_{den}		Notes
		L_{Aeq}	L_{A10}	L_{A90}	Derived (Short term)	Measured (long term)	
S02-c	11:20 - 11:35	63	65	61	64	n/a	M7 Dominates
	12:29 - 12:44	63	65	61			
	13:30 - 13:45	61	63	59			
S02-d	14:38 - 14:53	64	65	62	66	n/a	M7 Dominates
	15:38 - 15:53	65	66	63			
	16:34 - 16:49	66	67	63			
S02-e	14:18 - 14:33	63	64	60	65	n/a	M7 Dominates
	15:16 - 15:31	64	66	62			
	16:16 - 16:31	65	67	63			
S02-f	13:58 - 14:13	61	63	59	66	n/a	M7 Dominates
	14:57 - 15:12	65	67	63			
	15:58 - 16:13	66	68	64			
S03-a	10:15 - 10:30	57	58	52	59	63	M7 traffic dominates
	12:23 - 12:38	53	55	50			
	13:37 - 13:52	60	60	55			
S03-b	11:40 - 11:55	55	56	51	56	n/a	M7 traffic dominates
	12:43 - 12:58	54	56	50			
	14:01 - 14:16	53	53	49			
S03-c	12:04 - 12:19	57	56	51	60	n/a	M7 traffic dominates
	13:15 - 13:30	60	61	56			
	14:21 - 14:36	60	61	56			
S03-d	14:48 - 15:03	56	59	50	60	n/a	M7 traffic in addition to traffic along overbridge
	16:05 - 16:20	57	60	50			
	17:11 - 17:25	57	61	52			

Survey Location	Survey Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			dB L_{den}		Notes
		L_{Aeq}	L_{A10}	L_{A90}	Derived (Short term)	Measured (long term)	
S03-e	15:18 - 15:33	64	66	56	66	n/a	M7 traffic dominates
	16:29 - 16:44	63	66	57			
	17:32 - 17:47	63	66	57			
S03-f	15:44 - 15:59	57	59	53	60	n/a	M7 and local passing traffic
	16:48 - 17:03	56	59	52			
	17:50 - 18:01	59	60	54			
S04-a	11:18 - 11:33	59	60	56	62	65	M7 & Monread Road Traffic
	12:17 - 12:32	58	60	55			
	13:36 - 13:51	62	64	59			
S04-b	11:37 - 11:52	66	69	60	68	n/a	M7 & Local road traffic
	12:37 - 12:52	66	70	59			
	13:56 - 14:11	64	68	57			
S04-c	11:56 - 12:11	69	71	66	68	n/a	M7 & Local road traffic
	12:55 - 13:10	66	68	63			
	14:12 - 14:27	66	68	63			
S04-d	14:32 - 14:47	68	69	65	68	n/a	M7 & Local road traffic
	15:27 - 15:42	68	69	65			
	16:18 - 16:33	67	69	65			
S04-e	14:48 - 15:03	69	71	65	70	n/a	M7 & Local road traffic
	15:43 - 15:58	69	70	65			
	16:35 - 16:50	69	71	65			
S04-f	15:09 - 15:24	69	73	62	74	n/a	M7 & Local road traffic
	16:00 - 16:15	72	76	64			
	16:53 - 17:08	71	76	61			

15.4 Assessment of Operational Noise

Noise Model

A computer-based prediction model has been prepared in order to quantify the traffic noise level associated with the operational phase of the proposed road scheme. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

Brüel & Kjær Type 7810 Predictor

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates traffic noise levels in accordance with CRTN and NRA guidance.

Brüel & Kjær Type 7810 *Predictor* is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. *Predictor* predicts noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of sound power or traffic flow and average velocity;
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces; and
- the hardness of the ground between the source and receiver.

Prediction of Traffic Noise

Noise emissions during the operational phase of the project have been modelled using *Predictor* in accordance with CRTN and with the application of the relevant conversion factors as detailed in the NRA Guidance. The CRTN method of predicting noise from a road scheme consists of the following five elements:

- divide the road scheme into segments so that the variation of noise within this segment is small;
- calculate the basic noise level at a reference distance of 10 metres from the nearside carriageway edge for each segment;
- assess for each segment the noise level at the reception point taking into account distance attenuation and screening of the source line;
- correct the noise level at the reception point to take account of site layout features including reflections from buildings and facades, and the size of source segment; and
- combine the contributions from all segments to give the predicted noise level at the receiver location for the whole road scheme.

Input to the Noise Model

The noise model was prepared using the following data:

- Ordnance Survey mapping, and 3D topographical data and supplied by Roughan O'Donovan Consulting Engineers;
- traffic flows speed and lane distribution data for the opening and design years of 2015 and 2030 for the M7 Motorway and surrounding road network, as supplied by AECOM traffic consultants;

- Hourly noise predictions were conducted based on these traffic figures in accordance with Method A of the NRA guidelines. The hourly predictions were carried out using the diurnal traffic profiles provided in Appendix 1 of the NRA guidelines. Traffic flows were based on the Medium traffic growth figures for the scheme;
- The existing section of the M7 motorway between Naas and Newhall was resurfaced in 2007/2008 and incorporated a hot bituminous surface with thin surface layer. This surface type has noise reduction properties compared to hot rolled asphalt. A correction factor of -2dB has therefore been applied to this section of road as part of the Do Nothing models, and;
- Traffic noise barriers currently installed along the M7 have been included in the base model (i.e. Do Nothing Models) and incorporated into the Do Something models also.

Output of the Noise Model

Predictor calculates noise levels for a set of receiver locations specified by the user. The results include an overall level in dB L_{den} and the L_{night} parameter.

Calibration

The purpose of noise model validation is to ensure that the software is correctly interpreting the input data and providing results that are valid for the scenario under consideration. I t should be noted that the purpose of the model validation is not to validate the prediction methodology in use as the CRTN prediction methodology has itself been previously validated.

Given the nature of the scale of the scheme in question, it was decided that the most appropriate mechanism for calibration would be to compare the output of a *Predictor* model scenario, using the AADT traffic flows for the existing road network in 2012, with the measured L_{den} value at the 24 hour survey locations S01-a, S02-a and S03-a and S04-a all of which were dominated by road traffic. The L_{den} values measured at these locations are directly taken from the full 24 hour profiles.

Where the comparison between the predicted noise level and the measured noise level is no greater than ±3dB(A) at the assessment locations the model is deemed to be validated. The results of the calibration are presented in **Table 15.4.**

Table 15.4 Noise Model Calibration

Location Reference	Measured L_{den} (dB)	Predicted L_{den} (dB)	Variation (dB)
S01-a	69	68	-1
S02-a	71	68	-3
S03-a	63	63	0
S04-a	65	62	-3

The results of the calibration exercise have indicated that predicted noise levels at the four monitored locations are +/- 1 to 3dB. The model can be considered therefore to be interpreting the various input data correctly. It should be noted that calculated noise levels are based on the source of road traffic alone, whilst during baseline surveys, other surrounding factors contribute to the overall measured noise levels. It should also be noted that on the survey date, the volume and speed of traffic is likely to vary compared to that used in the traffic noise predictions. Taking

into account the above factors, the results of the calibration exercise confirms that the model is valid.

Choice of Receiver Locations

Free-field traffic noise levels have been predicted at 59 residential dwellings in the vicinity of proposed and existing roads. The coordinates of all locations are provided in **Table 15.5.** These receiver locations (Noise Assessment Locations) are detailed in **Figures 15.1 – 15.9, EIS Volume 3.** For single storey properties the receiver height is at ground floor level, for two storey properties the receiver height is at first floor level.

Table 15.5 Noise Assessment Locations

Reference	Location	Co-ordinates		Reference	Location	Co-ordinates	
		Easting	Northing			Easting	Northing
R1	Greatconnell	282,242	213,559	R31	Newhall	286,401	218,831
R2	Greatconnell	282,135	213,614	R32	Halverstown	286,713	219,891
R3	Greatconnell	282,380	213,674	R33	Ploopluck	287,058	219,799
R4	Greatconnell	282,514	213,641	R34	Halverstown	286,598	219,814
R5	Greatconnell	282,557	213,535	R35	Ploopluck	287,077	219,891
R6	Greatconnell	282,612	213,566	R36	Ploopluck	287,070	219,996
R7	Greatconnell	282,673	213,534	R37	Halverstown	287,017	220,668
R8	Greatconnell	283,401	214,190	R38	Halverstown	287,072	220,785
R9	Greatconnell	283,515	214,270	R39	Osberstown	287,563	221,138
R10	Herbertstown	283,855	214,059	R40	Osberstown	288,060	221,712
R11	Clowings	284,355	215,014	R41	Osberstown	288,568	221,828
R12	Clowings	284,433	215,166	R42	Osberstown	288,732	221,933
R13	Clowings	284,511	215,289	R43	Osberstown Cottages	288,998	221,944
R14	Clowings	284,572	215,365	R44	Osberstown Cottages	289,027	221,947
R15	Clowings	284,602	215,408	R45	Osberstown Cottages	289,049	221,944
R16	Clowings	285,038	215,843	R46	Osberstown Cottages	289,066	221,979
R17	Lewistown	284,639	216,184	R47	Monread Road	289,205	221,874
R18	Ladytown	285,195	216,714	R48	Monread Road	289,260	221,864
R19	Ladytown	285,285	216,837	R49	Monread Road	289,323	221,839
R20	Ladytown	285,332	216,924	R50	Monread North	289,188	222,057
R21	Ladytown	285,388	217,113	R51	Monread North	289,336	222,081
R22	Ladytown	285,210	217,328	R52	Monread Road	290,548	221,467
R23	Jigginstown	286,130	217,960	R53	Monread Road	290,618	221,437

Reference	Location	Co-ordinates		Reference	Location	Co-ordinates	
		Easting	Northing			Easting	Northing
R24	Ladytown Crossroads	285,464	218,300	R54	Roseborough	291,660	221,535
R25	Jigginstown	286,338	218,467	R55	Johnstown	291,773	221,403
R26	Jigginstown	286,385	218,509	R56	Johnstown	291,996	221,563
R27	Jigginstown	286,510	218,590	R57	Johnstown	292,019	221,613
R28	Jigginstown	286,534	218,679	R58	Johnstown	292,089	221,667
R29	Jigginstown	286,544	218,624	R59	Johnstown	292,126	221,839
R30	Jigginstown	286,573	218,645				

Traffic Noise Predictions

Traffic noise predictions have been conducted for the operational phase of the scheme for two years, 2015 the proposed year of opening and the design year of 2030. A total of four scenarios have been considered as follows:

- Year 2015 – Do Nothing (i.e. proposed upgrade does not take place);
- Year 2015 – Do Something (i.e. scheme is widened to 3 lanes);
- Year 2030 – Do Nothing;
- Year 2030 – Do Something.

As noted in the previous section, the Do Nothing models incorporate a Low Noise Road Surface (LNRS) between the existing Newhall Junction and Naas providing a noise reduction of -2dB(A) compared to hot rolled asphalt.

Under the Do Something scenarios, a third lane has been modelled within the land take of the existing M7 Motorway, towards the central median. The use of a LNRS, providing a similar noise reduction of -2dB(A) has been assumed along the full length of the widened scheme as part of this scenario.

The results of the traffic noise predictions are presented in **Tables 15.6 and 15.7** overleaf and are compared with the assessment threshold values set out in the Kildare Local Authorities Noise Action Plan to determine those areas which may be considered appropriate to address the noise exposure through mitigation measures.

Review of the predicted noise levels indicate a number of locations which exceed the threshold values of 70dB and L_{den} 57dB L_{night} set out in the NAP. These levels are predicted during both the Do Nothing and Do Something scenarios under existing and future year traffic growth conditions.

Table 15.6 Comparison of Predicted Lden and Lnight Noise Levels Against Noise Action Plan Mitigation Onset Levels for Year 2015

Receiver Location Reference	Opening Year 2015				Noise Action Plan Level Exceeded?	
	Do Nothing		Do Something			
	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
R1	65	56	63	54	No	No
R2	61	53	60	51	No	No
R3	64	55	62	53	No	No
R4	70	61	68	59	No	**Yes**
R5	62	53	60	51	No	No
R6	66	57	64	55	No	No
R7	62	54	60	52	No	No
R8	71	63	69	60	No	**Yes**
R9	73	64	71	62	**Yes**	**Yes**
R10	64	55	62	53	No	No
R11	68	59	66	58	No	**Yes**
R12	70	61	68	59	No	**Yes**
R13	71	63	70	61	No	**Yes**
R14	70	61	68	60	No	**Yes**
R15	69	60	67	58	No	**Yes**
R16	65	56	63	54	No	No
R17	61	52	59	50	No	No
R18	65	57	64	55	No	No
R19	65	56	63	54	No	No
R20	64	55	62	53	No	No
R21	65	56	63	54	No	No
R22	57	49	56	47	No	No
R23	59	50	57	49	No	No
R24	61	52	61	52	No	No
R25	68	59	67	58	No	**Yes**
R26	67	58	66	57	No	No
R27	64	55	64	55	No	No
R28	68	59	69	60	No	**Yes**
R29	64	55	64	55	No	No
R30	64	55	64	55	No	No
R31	66	57	65	56	No	No
R32	60	51	60	51	No	No
R33	62	53	62	53	No	No
R34	61	52	61	52	No	No
R35	63	54	64	55	No	No
R36	66	57	66	58	No	**Yes**
R37	60	51	60	51	No	No
R38	58	49	58	49	No	No

Receiver Location Reference	Opening Year 2015				Noise Action Plan Level Exceeded?	
	Do Nothing		Do Something			
	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
R39	63	54	63	54	No	No
R40	59	51	60	51	No	No
R41	63	54	63	54	No	No
R42	64	55	64	55	No	No
R43	65	56	65	56	No	No
R44	65	56	66	57	No	No
R45	67	58	68	59	No	**Yes**
R46	66	57	67	58	No	**Yes**
R47	66	57	66	57	No	**Yes**
R48	64	55	64	55	No	No
R49	61	52	62	53	No	No
R50	67	58	67	58	No	**Yes**
R51	67	59	68	59	No	**Yes**
R52	60	51	60	51	No	No
R53	62	53	62	54	No	No
R54	66	57	66	57	No	No
R55	69	60	69	60	No	**Yes**
R56	65	56	64	55	No	No
R57	69	60	68	60	No	**Yes**
R58	69	60	68	59	No	**Yes**
R59	70	62	71	62	**Yes**	**Yes**

Table 15.7 Comparison of Predicted Lden and Lnight Noise Levels Against Noise Action Plan Mitigation Onset Levels for Year 2030

Receiver Location Reference	Design Year 2030				Noise Action Plan Level Exceeded?	
	Do Nothing		Do Something			
	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
R1	65	56	64	55	No	No
R2	62	53	60	51	No	No
R3	64	55	63	54	No	No
R4	70	62	69	60	No	**Yes**
R5	62	53	61	52	No	No
R6	66	57	65	56	No	No
R7	63	54	61	52	No	No
R8	72	63	70	61	No	**Yes**
R9	73	65	71	62	**Yes**	**Yes**
R10	65	56	62	54	No	No
R11	69	60	67	58	No	**Yes**
R12	70	62	69	60	No	**Yes**
R13	72	63	70	61	No	**Yes**

Receiver Location Reference	Design Year 2030				Noise Action Plan Level Exceeded?	
	Do Nothing		Do Something			
	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
R14	71	62	69	60	No	**Yes**
R15	70	61	68	59	No	**Yes**
R16	66	57	64	55	No	No
R17	62	53	60	51	No	No
R18	66	57	64	56	No	No
R19	65	56	63	55	No	No
R20	64	55	63	54	No	No
R21	65	56	64	55	No	No
R22	58	49	56	47	No	No
R23	59	50	58	49	No	No
R24	62	53	61	52	No	No
R25	69	60	67	59	No	**Yes**
R26	67	58	66	57	No	No
R27	64	55	64	56	No	No
R28	69	60	69	60	No	**Yes**
R29	64	55	64	56	No	No
R30	64	55	64	55	No	No
R31	66	57	66	57	No	No
R32	60	52	61	52	No	No
R33	62	53	63	54	No	No
R34	61	53	62	53	No	No
R35	64	55	64	55	No	No
R36	67	58	67	58	No	**Yes**
R37	61	52	61	52	No	No
R38	59	50	59	50	No	No
R39	64	55	64	55	No	No
R40	60	51	60	51	No	No
R41	64	55	64	55	No	No
R42	64	55	64	56	No	No
R43	66	57	66	57	No	No
R44	65	57	67	58	No	**Yes**
R45	67	59	69	60	No	**Yes**
R46	66	58	67	58	No	**Yes**
R47	67	58	67	58	No	**Yes**
R48	64	56	65	56	No	No
R49	62	53	62	53	No	No
R50	67	59	68	59	No	**Yes**
R51	68	59	68	59	No	**Yes**
R52	60	52	61	52	No	No
R53	63	54	63	54	No	No

Receiver Location Reference	Design Year 2030				Noise Action Plan Level Exceeded?	
	Do Nothing		Do Something			
	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
R54	66	57	66	57	No	No
R55	69	60	69	60	No	**Yes**
R56	65	56	64	55	No	No
R57	70	61	69	60	No	**Yes**
R58	69	61	68	59	No	**Yes**
R59	71	62	71	62	**Yes**	**Yes**

On review of the results set out in Tables 15.6 and 15.7, noise levels predicted between the Do Nothing and Do Something scenarios are nominally unchanged. This is due to the small variation in traffic flows between both scenarios. The application of a LNRS along the full length of the scheme has reduced traffic noise levels at properties south of Newhall.

Notwithstanding that there is a neutral or slightly positive noise impact associated with the widened scheme, there are a number of locations which are predicted to experience noise levels in excess of the NAP assessment thresholds for both the L_{den} and L_{night} parameters. It should be noted, however, these values are predicted to be experienced both with and without the proposed scheme upgrade works taking place and are as a result of future traffic flows as opposed to the introduction of additional lanes.

It is considered a reasonable approach as part of this EIS assessment, therefore, to identify those areas which are exposed to noise levels above these threshold values which would benefit from the introduction of noise mitigation measures to protect against future noise levels.

15.5 Mitigation Measures – Operational Phase

The scheme will incorporate noise mitigation in the form of a low noise road surface as part of its standard construction. This will be applied along the length of the widened M7 road in addition to the slip roads of the new Newhall Interchange.

Additional mitigation measures which can be considered, therefore, include the use of road side barriers and or bunds or a combination of both. Consideration has therefore been given to noise barriers at locations where the assessment thresholds set out in Kildare Local Authorities NAP are predicted to be exceeded.

Table 15.8 presents the likely required extent of noise barriers assuming a low noise road surface is used along the full length of the widened section of the M7.

Table 15.8 Extent of Noise Mitigation Required

Receiver No.	Barrier Chainage	Side of Road	Barrier Height (m)	Location
R4	~ Ch 620 – Ch 730	North	2m	Top of Cutting
R8 & R9	~ Ch 1,600 - Ch 1,900	North	2.5m	Top of cutting above M9 slip road
	~ Ch 1,600 - Ch 1,900	North	2.5m	Top of embankment of M7 Northbound Lane
R11 – R15	~ Ch 2,770 - Ch 3,680	South	2.5m	Top of embankment/side of road
R25 & R28	~ Ch 7,000 - Ch 7,400	South	2m	Top of cutting
	M7 Southbound Off-Slip (Newhall Interchange)	South	2m	Edge of Road
R36	~ Ch 8,450 - Ch 8,830	South	2m	Edge of road/top of cutting
R44 – R46	~ Ch 11,450 - Ch 11,680	North	2m	Top of cutting
R50 – R51	~ Ch 11,700 - Ch 12,000	North	2.5m	Top of cutting

15.6 Residual Impacts – Operational Phase

The residual noise levels during the operational phase have been calculated, taking into account the proposed mitigation measures outlined in Section 7.3.5. The results of the calculated residual noise levels with mitigation are presented in **Table 15.9** for those locations where mitigation has been provided.

Table 15.9 Residual Noise Levels with Mitigation Measures in Place

Receiver Location Reference	2015 Opening Year		2030 Design Year		Noise Action Plan Level Exceeded?	
	Do Something with Mitigation					
	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
R4	64	55	64	55	No	No
R8	65	56	66	57	No	No
R9	66	58	67	58	No	Yes
R11	63	54	64	55	No	No
R12	64	55	64	55	No	No
R13	64	55	65	56	No	No
R14	64	55	65	56	No	No
R15	63	54	63	54	No	No
R25	65	56	65	56	No	No
R28	64	55	65	56	No	No
R36	64	55	64	55	No	No
R44	64	55	64	56	No	No
R45	65	56	65	57	No	No
R46	65	56	65	56	No	No
R47	66	57	67	58	No	No

Receiver Location Reference	2015 Opening Year		2030 Design Year		Noise Action Plan Level Exceeded?	
	Do Something with Mitigation					
	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
R50	64	55	65	56	No	No
R51	64	55	65	56	No	No
R54	66	57	66	57	No	Yes
R55	69	60	69	60	No	Yes
R57	68	60	69	60	No	Yes
R58	68	59	68	59	No	Yes
R59	71	62	71	62	Yes	Yes

With the proposed mitigation in place, residual noise levels at the majority of residential properties are reduced below 70dB L_{den} and 57dB $L_{night.}$

Noise levels at receiver location R9 are predicted to be 1dB above the night-time 57dB L_{night} mitigation onset level. Residual noise levels at this location are dominated by traffic flows along the M9 slip road. This section of road will remain unchanged during the upgrade works.

At locations R54, R57, R58 and R59 within Johnstown, night-time noise levels are predicted to remain just above the night-time mitigation onset level with the use of a low noise road surface and the existing noise barrier but are nominally reduced to below the L_{den} threshold level. Noise levels are essentially unchanged at these locations between the Do Nothing and Do Something scenarios.

Overall, with the implementation of the proposed mitigation measures along the length of the scheme, noise levels are predicted to reduce by the order of 2 to 8dB(A) when compared to the Do Nothing scenario for the same future years.

15.7 Assessment of Construction Noise

As per NRA guidance noise levels associated with construction may be calculated in accordance with the methodology set out in BS 5228: Part 1. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations. However, it is often not possible to conduct detailed prediction calculations for the construction phase of a project in support of the EIS. This is due to the fact that the programme for construction works has not been established in detail. Under such circumstances, best practice involves the consideration of appropriate mitigation measures. The NRA guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in **Table 15.1**.

A variety of items of plant will be in use during the construction upgrade works. These will include breakers, excavators, dump trucks, and generators in addition to general road surfacing and levelling equipment. They key phases of works will involve ground breaking, drainage works, construction of attenuation ponds and resurfacing works. Due to the nature of the activities undertaken on a road construction site, there is potential for generation of high levels of noise at nearby noise sensitive properties.

Due to the fact that the construction programme is not progressed to a detail level at this stage of the programme, it is not possible to calculate specific noise emissions to

the local environment from different phases of works. However, the following tables present calculations of indicative noise levels for typical noise sources associated with road construction.

BS 5228:2009 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise* sets out typical noise levels for items of construction plant. **Tables 15.10 to 15.12** set out assumed plant items during the key phases of construction with the associated source reference from BS 5228 Part 1 *Noise*. The closest properties to the existing road edge are at distances of approximately 50m. Construction noise calculations have been conducted at distances of 50 to 150m from the works for different work phases, representing the nearest properties to the works.

The calculations assume that plant items are operating for 66% of the time and that all plant items associated with the individual phases are operating simultaneously and at the same distance for any one scenario. A screening correction of 5dB has been included in the calculations, to take account of screening provided by cuttings along the road alignment.

Table 15.10 Indicative construction noise calculations during site preparation, and excavation works.

Site Clearance & Preparation	Calculated $L_{Aeq,\,T}$ at distance from road (m)			
	50m	80m	100m	150m
Pneumatic breaker (C.5.6)	74	70	68	65
Wheeled loader (C2.26)	58	54	52	49
Tracked excavator (loading dump truck) (C1.10)	64	60	58	55
Dozer (C.2.10)	59	55	53	50
Dump Truck (C2.30)	58	54	52	49
Combined L_{Aeq} from all works	75	71	69	65

Table 15.11 Indicative construction noise calculations during excavation and fill works

Excavation and Fill Works	Calculated $L_{Aeq,\,T}$ at distance from road (m)			
	50m	80m	100m	150m
Tracked excavator (loading dump truck) C1-10	64	60	58	55
Articulated dump truck (dumping rubble) C1-11	59	55	53	50
Wheeled loader C2-26	58	54	52	49
Dozer C.2.10	59	55	53	50
Dump Truck Tipping fill (C2.30)	58	54	52	49
Combined L_{Aeq} from all works	68	63	61	58

Table 15.12 Indicative construction noise calculations during road works

Road Works	Calculated $L_{Aeq, T}$ at distance from road (m)			
	50m	80m	100m	150m
Tracked excavator (C2.21)	50	46	44	41
Dump Truck (C2.30)	58	54	52	49
vibration rollers (C5.20)	54	50	48	45
Asphalt Paver & Tipping Lorry (C.5.31)	56	52	50	47
Diesel Generator (C4.76)	40	36	34	31
Road Rollers (C5.19)	64	55	53	50
Combined L_{Aeq} from all works	66	60	58	54

The results of the assessment has indicated that at distances of beyond 50m from the works, the construction daytime noise limit of 70dB L_{Aeq} can typically be complied with for the scenarios assessed.

In order to permit the M7 to remain open to traffic during the upgrade works, certain elements of work will be required outside of 'normal working hours' i.e. Monday to Friday between 07:00 and 19:00hrs. Weekend, evening and on occasion night-time works will be required. The works will be scheduled to ensure that activities with potential for high noise levels, e.g. ground breaking and other percussive works will not take place during periods with higher sensitivity to noise (e.g. night-time periods).

It should be noted that the calculations set out in the above tables are indicative only and are used for the purposes of comparison only with the adopted criteria. Where exceedance of the recommended criteria are expected, the use of noise mitigation measures will be used as part of the construction works.

Construction Noise Mitigation Measures

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of BS 5228-1 2009. These measures will typically include:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.

- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 15.1 using methods outlined in BS 5228:2009 Part 1 through a monitoring programme.
- Plant items such are breakers working in close proximity to residential properties (i.e. within 80m of residential properties) will incorporate additional noise screening measures.

Emergency Work

The emergency work referred to above may include the replacement of warning lights, signs and other safety items on public roads, the repair of damaged fences, repair of water supplies and other services which have been interrupted, repair to any damaged temporary works and all repairs associated with working on public roads.

Construction Phase Residual Noise Impact

The assessment has indicated that construction activities can operate within the adopted noise limits for daytime periods at the nearest properties to the works. Given the linear nature of the works, noise emissions related to construction works will be of short term impact at any one area as the works progress along the length of the scheme. The application of the proposed noise limits and restricted hours of operation, along with implementation of appropriate noise control measures, will ensure that noise impact is kept to within acceptable standards.

15.8 Vibration

Description of Existing Environment

A survey of vibration along the proposed route corridor was not undertaken, as levels associated with existing roads would not be expected to be of a magnitude sufficient to cause disturbance to people or structural damage to property. Furthermore, vibration was not perceptible at any of the noise survey locations.

Potential Impacts – Operational Phase

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle.

It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. Problems attributable to road traffic vibration can therefore be largely avoided by maintenance of the road surface. Given that the existing road scheme does not generate any significant vibration levels at present, vibration levels associated with the upgrade works are not expected to generate any perciptable vibration levels.

Potential Impacts – Construction Phase

The potential for vibration at neighbouring sensitive locations during construction is typically limited to excavation works, breaking operations and lorry movements on uneven road surfaces. The more significant of these is the vibration from excavation and breaking operations; the method of which will be selected and controlled to

ensure there is no likelihood of structural or even cosmetic damage to existing neighbouring dwellings.

Mitigation Measures and Residual Impacts

The NRA Guidelines recommend that in order to ensure that there is no potential for vibration damage during construction, vibration from construction activities should not exceed the values set out in **Table 15.13.**

Table 15.13 Maximum Allowable Vibration Levels During Construction Phase

Allowable vibration velocity (Peak Particle Velocity) at the closest part of any sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	**10 to 50Hz**	**50 to 100Hz (and above)**
8 mm/s	12.5 mm/s	20 mm/s

Ground vibration from the operation of an additional traffic lane will be orders of magnitude less than that required to cause cosmetic or structural damage to buildings or lead to disturbance of occupiers, hence mitigation measures are not required in respect of the operational phase.

It may be concluded that the proposed road scheme is not expected to give rise to vibration that is either significantly intrusive or capable of giving rise to structural or even cosmetic damage.

APPENDIX 15.1
Results of Unattended Baseline Noise Monitoring

Table A1 Results of unattended noise monitoring at Location S01a

Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)		
		L_{Aeq}	L_{AF10}	L_{AF90}
14 March 2012	16:00	68	69	65
	17:00	68	70	65
	18:00	67	69	63
	19:00	65	68	60
	20:00	64	67	58
	21:00	63	66	56
	22:00	62	65	51
	23:00	60	64	46
15 March 2012	00:00	58	63	40
	01:00	57	61	36
	02:00	57	61	35
	03:00	57	61	39
	04:00	59	63	43
	05:00	62	66	52
	06:00	66	68	62
	07:00	67	70	64
	08:00	68	70	64
	09:00	66	69	62
	10:00	66	68	61
	11:00	66	68	62
	12:00	66	68	62
	13:00	66	69	62
	14:00	67	69	63
	15:00	67	69	64
L_{den}	69			

Table A2 Results of unattended noise monitoring at Location S02a

Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)		
		L_{Aeq}	L_{AF10}	L_{AF90}
14 March 2012	17:07	71	71	70
	18:07	70	71	69
	19:07	68	70	67
	20:07	67	68	65
	21:07	66	67	65
	22:07	65	66	64
	23:07	64	65	62
15 March 2012	00:07	61	63	60
	01:07	59	60	58
	02:07	58	59	56
	03:07	59	60	59
	04:07	61	62	60
	05:07	64	65	62
	06:07	67	68	65
	07:07	69	70	68
	08:07	70	71	69
	09:07	69	70	68
	10:07	68	69	67
	11:07	69	69	68
	12:07	69	69	68
	13:07	68	69	66
	14:07	69	70	69
	15:07	69	70	69
	16:07	71	71	70
L_{den}	71			

Table A3 Results of unattended noise monitoring at Location S03a

Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)		
		L_{Aeq}	L_{AF10}	L_{AF90}
26 March 2012	18:00	61	62	58
	19:00	61	62	54
	20:00	57	59	54
	21:00	58	61	55
	22:00	57	60	54
	23:00	56	58	52
27 March 2012	00:00	54	57	49
	01:00	52	55	45
	02:00	51	55	43
	03:00	51	55	44
	04:00	54	57	47
	05:00	56	59	50
	06:00	62	64	57
	07:00	63	65	62
	08:00	63	65	61
	09:00	60	61	58
	10:00	56	58	53
	11:00	55	57	52
	12:00	54	56	51
	13:00	59	60	55
	14:00	58	60	55
	15:00	59	60	56
	16:00	59	61	57
	17:00	59	60	57
L_{den}	63			

Table A4 Results of unattended noise monitoring at Location S04a

Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)		
		L_{Aeq}	L_{AF10}	L_{AF90}
26 March 2012	18:00	58	67	55
	19:00	61	76	58
	20:00	59	69	57
	21:00	60	67	57
	22:00	59	66	56
	23:00	57	67	53
27 March 2012	00:00	56	66	50
	01:00	54	72	47
	02:00	53	66	44
	03:00	53	66	46
	04:00	57	67	52
	05:00	59	70	55
	06:00	63	75	61
	07:00	65	91	63
	08:00	63	72	60
	09:00	60	77	58
	10:00	58	68	55
	11:00	58	71	56
	12:00	59	77	56
	13:00	61	73	59
	14:00	61	70	58
	15:00	60	73	56
	16:00	58	71	55
	17:00	59	75	56
L_{den}	65			