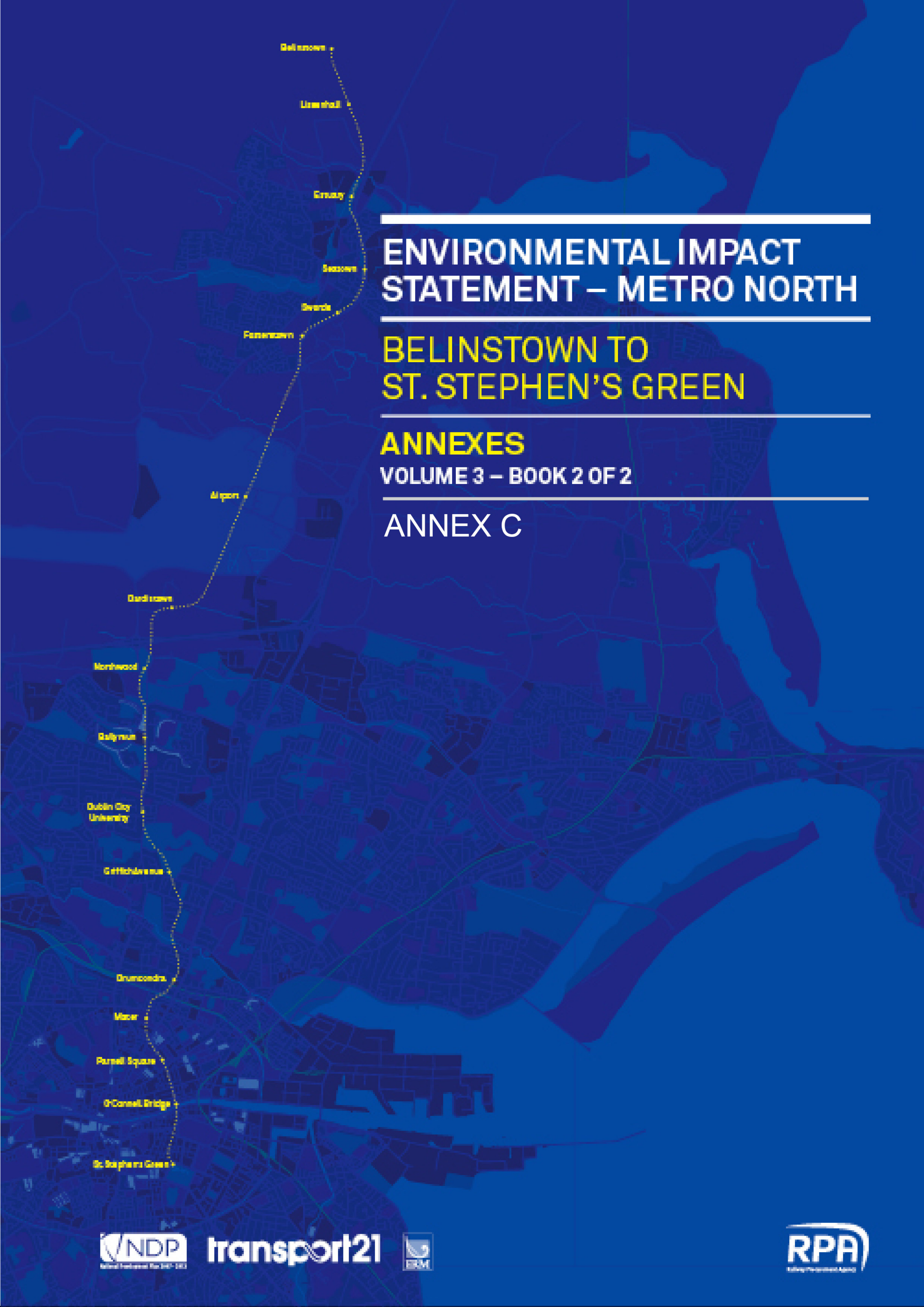
ENVIRONMENTAL IMPACT STATEMENT – METRO NORTH

BELINSTOWN TO ST. STEPHEN'S GREEN

ANNEXES

VOLUME 3 – BOOK 2 OF 2

ANNEX C



Annex C

Metro North EIS

Information supporting the noise impact assessment chapters

- Noise assessment details report

1 Introduction

1.1 Purpose of noise modelling

Noise levels from the operation of light metro vehicles (LMVs) on the proposed scheme and from the construction of the scheme have been predicted, assessed and reported in the EIS. This annex describes the methods used to carry out the modelling, and provides some detailed assumptions that have been made during the modelling. It also gives detailed noise modelling results upon which the assessment is based.

2 Methodology for the modelling of noise from the operation of metro vehicles

2.1 Basic prediction methodology

Noise modelling was based upon the Calculation of Railway Noise (CRN) (UK Department of Transport (DoT), 1995) prediction procedure. CRN is the standard prediction methodology for railway noise in the UK and there is no comparable Irish methodology. The methodology takes into account the type of vehicle, speed, number of carriages and track type. It also includes the basic factors that affect the propagation of noise such as distance from the track, the type of ground between source and receptor and screening from intervening structures. CRN assumes neutral meteorological conditions.

Predicted noise levels are made at 1m from the façade of the receptors and corrected (-2.5dB) to give free field predicted levels.

The noise predictions were carried out for a likely worst case allowing for growth in demand for the service. The effect of the scheme on opening is likely to be lower than is predicted from using this methodology. Initially single carriage LMVs will be used in off-peak services, and these will reduce noise levels generated.

2.2 Modelling software

Noise from the operation of the railway has been modelled using a 3-dimensional computer based noise model, Soundplan® V 6.4. The noise model implements the prediction methodology in CRN (DoT, 1995). Soundplan combines basic model geometry files (called Geofiles) in Scenarios which can be used to run models for particular areas or to simulate particular development Scenarios.

The CRN method requires the track to be segmented to take account of variations in source term and propagation factors. This process is carried out automatically within the modelling software.

2.3 Input data

The main inputs to the model included the following:

- Speed profile data assuming that optional Lissenhall and Estuary Stops are not implemented resulting in faster speeds through these sections. The modelling in

Soundplan has been carried out assuming a standard speed of 70 km/h and the results have then been adjusted at each receptor to reflect the highest of the south and northbound speed profiles values opposite each receptor.

- Base mapping has been provided electronically which has been used to input buildings and walls.
- Topographical survey data have been used to establish ground heights.
- The alignment location and heights and location of crossovers have been provided and imported into the model.
- The Railway Order Drawings have been used to establish structural details such as the width of viaducts and locations viaduct edge features that may provide screening.

The level of service has been agreed with the RPA based on predicted likely operating patterns discussed below.

2.4 Source term assumption

2.4.1 Type of vehicle

The starting point of the modelling is the derivation of a noise source term for the LMVs. At this stage the exact type of vehicle has not been selected, and it is necessary to review source data for various vehicles that have similar operational parameters to those that are likely to be use on the scheme.

The potential providers of the metro vehicle are as follows:

- Alstom Transport SA;
- Ansaldobreda S.P.A;
- Bombardier Transportation (Holdings) UK Limited;
- Construcciones y Auxiliar de Ferrorcarriles S.A; and
- Siemens Ltd.

The metro vehicle will be essentially an underground version that will be similar to the vehicles operated on Luas. The review of information from various systems included the existing Luas lines, Croydon Tramlink, Manchester Metrolink, Midland Metro in Birmingham, and Nottingham Express Transit. The worst likely case has been assumed to provide a robust source term based on typical in service levels rather than testing under controlled conditions on new smooth track. Following the review a source term similar to the rail vehicles operating on the Manchester Metrolink system in the UK was selected.

2.4.2 Service level

The expected numbers of trains running at various times of the day and night are discussed in the main EIS assessment.

2.4.3 Speed

Speed has been based on the speed profile information developed by Jacobs the scheme engineers. The fastest that trains will run on the route is 70km/h. In general speeds are lower mainly when the LMVs are near to stops.

2.4.4 Track type

The track type has been corrected as stated in the advice in CRN compared to ballasted track (+2.5dB for sections with points or crossings, + 1dB for elevated sections). At grade track is largely on slab track or grassed track and a correction of +2dB has been added compared to ballasted track which is from ERM's previous data relating to various light rail. Ballasted track is only specified in a few locations in the tender documentation, and these have been taken account of in the predictions.

As stated above it has been assumed that noise from LMVs on elevated sections of track will be +1dB compared to standard at grade track due to the additional effect of structure radiated noise. Since the design of the elevated sections can affect the wayside noise levels if structure radiated noise is high, mitigation measures have been taken into account in the scheme to ensure that this assumption is valid. These are discussed in detail in Section 3.

2.4.5 Derived source term

A source term is calculated at 25m from the track based on the above approach. The parameter used to define the source term is SEL, which is equal to the L_{Aeq} measured during a single train pass-by plus the time constant +10*log(T). In this case T is the measurement time in seconds. In this way events of different durations can be combined to calculate the L_{Aeq} over the 8 hour night-time period, the 16 hour daytime and the peak hour periods. The source term for a 90 m metro vehicle travelling on standard (non-ballasted) at-grade sections is 90.7dB at 70km/h.

2.5 Propagation

2.5.1 Propagation corrections

The standard corrections for propagation have been assumed from CRN for distance, soft ground absorption (where applicable) and barrier screening.

3 Methodology for the modelling of noise from construction

An inventory of construction plant items has been developed through discussions with the engineers, and associated noise levels have been drawn from the guidance in BS5228 and from previous experience on similar schemes. The key noise generating construction plant inventory for each phase of the scheme are listed in Table 7.6 to Table 7.23.

Predictions of noise levels from construction have been calculated according to the guidance in BS5228, and assume no intervening screening between plant and receptors, and no ground absorption. Plant is assumed to be located at the nearest reasonable location to noise sensitive receptors in order to provide a conservative estimate of likely highest noise levels. Most works will be carried out during daytime hours. Where night-time works have been identified, these have been included.

4 Assumed mitigation of elevated structures

4.1 Description of key issues

4.1.1 Noise generation mechanisms

Railways on elevated structures can give rise to noise levels substantially in excess of those for the same railway at grade. The principal reason for the potential increase in noise is excitation of the structure into vibration, and radiation of the vibration to the wayside as airborne noise. This effect is known as structure-radiated noise. A further potential effect is that in order to reduce excitation of the structure the rail support may be resilient, allowing the rails to vibrate more freely and cause more radiation of wheel/rail noise from the webs of the rails.

There are four mutually-interacting mechanisms that determine the level of wayside noise from an elevated structure:

- force transmission into the structure at the rail support positions;
- the driving-point mobility of the structure at the rail support points;
- the modal response of the structure; and
- the radiation efficiency of the structure.

To achieve low wayside structure-radiated noise, the characteristics discussed in the following sections are required.

4.1.2 Choice of rail support

Low rail support dynamic stiffness is required, subject to ensuring that the natural frequency for the effective bogie unsprung mass and the rail support is adequately separated from modes in the support structure mobility spectrum. This may necessitate rail support dynamic stiffness being higher than the minimum achievable, or the use of added mass between the resilient element and the rail, e.g. by the use of booted blocks.

4.1.3 Driving point mobility

The driving point mobility depends on (a) the mass of the structure, but more particularly (b) on the location of the rail support points relative to the shape and support conditions of the deck plate. Ideally the rails should be supported from or close to nodes in the modal shape of the plate response, and support at or close to antinodes should be carefully avoided.

4.1.4 The modal response of the structure

The modal response of the structure is dependent on the size and shape of plates in the structure, their support conditions, their bending stiffness (primarily a function of thickness) and mass. Plates with clamped (and free) edges have much higher modal frequencies than plates with simple support. Concrete decks supported by steel I-beams are supported in a manner more akin to simple support than is the case for plates supported by concrete webs, which are more akin to clamped edge conditions.

4.1.5 The radiation efficiency of the structure

The radiation efficiency of the structure depends, at each frequency, on the relationship between the wavelength of bending waves in plates in the structure, and the wavelength of the sound in air at that frequency. When the wavelength of the bending waves in the structure is shorter than the wavelength of sound in air, radiation efficiency is low. When the bending wavelengths and airborne wavelengths are the same, radiation in the same plane as the plate is high, and when bending wavelengths are longer than airborne wavelengths, radiation efficiency is high, depending on the shape of the structure.

When an elevated structure such as a viaduct has noise barriers attached, they are potentially efficient radiators of structure-radiated noise, unless they themselves are provided with vibration isolation, as discussed below.

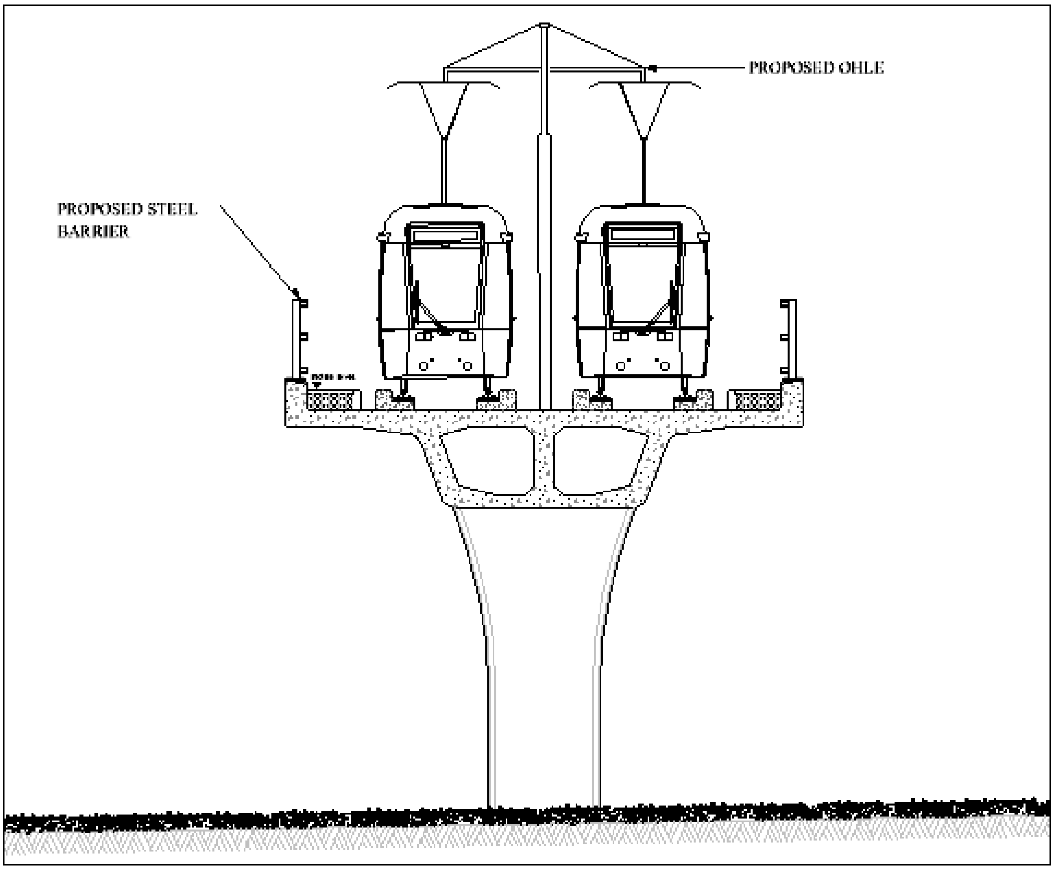
4.1.6 Rail vibration

The potential of resiliently supported rails to vibrate more than those in conventional track depends on the standard of maintenance of the rail. When rail roughness increases, not only does rail vibration increase, and thereby rail-radiated noise increases, but also the resilience of the rail support means that the increased rail vibration persists over a much longer length of track making the effective source length much greater than the length of the vehicle, decreasing the distance loss due to geometric spreading. To minimise this effect, a rail maintenance regime is required to ensure that rail roughness does not grow to levels which result in increased radiation of rail noise. The same considerations also apply to wheel roughness.

4.2 Design issues

Because all the above properties interact with each other, numerical modelling is required to determine the behaviour of the complete system of bogie/rail/rail support/driving point mobility/modal response/radiation efficiency. However, a preliminary analysis is possible based on the main properties of the structure, which in the case of the Pinnock Hill Viaduct is illustrated in Figure 4.1.

Figure 4.1 Cross Section of the Pinnock Hill Viaduct.



Rail support stiffness is not yet determined, and when selected will need to be set so as to avoid deck modes. The lowest transverse mode for bending waves between the central and outer webs of the viaduct box, assuming clamped edge conditions, is likely to be above 250Hz, i.e. of the order of ten times the likely natural frequency of a resilient rail support system. However, the cantilevered outer sections of the deck, if clamped-free edge conditions are assumed, will have a lowest mode of about 25Hz and a second mode at about the same frequency as 1st mode of the central section. This could result in large amplitude vibration at the natural frequency of the rail support system, which also may be in the region of 25Hz. The consequence could be a ground vibration problem together with increased structure-radiated noise around 250Hz. The wavelength of sound in air at 250Hz is 1.4m, less than the wavelength of bending waves at 250Hz in the structure, indicating efficient radiation.

If this is confirmed by numerical modelling, solutions will involve adjusting the dimensions and thicknesses of the plates in the structure to avoid coincidence between the 2nd mode of the cantilever and the first mode of the central plates, and to raise the first mode to a frequency at least twice the natural frequency of the rail support. The natural frequency of the rail support is in itself complex, given the likelihood that the vehicles will have resilient wheels, with both the mass-spring effect of the rims and their resilient fastenings, and the mass-spring effect of the bogie unsprung mass on the primary suspension being coupled to give a set of coupled natural frequencies. This again is solvable by numerical modelling.

To offset the potential for re-radiated noise by noise barriers attached to the viaduct as a result of excitation by bridge deck vibration, the panels of the barrier will need to be attached using vibration isolators. This can be achieved using resilient pads in the clamps used to support the panels or the barrier, and sealing the gap between the panel and its supporting frame and the slab with a flexible seal of extruded neoprene. The plate modes of the barrier panels should be calculated, and their thickness, mass and dimensions selected to ensure that the barrier panel modes do not coincide with viaduct deck modes.

If these measures are taken, the wayside noise from the structure can be controlled to align with the assumption made in 'Calculation of Railway Noise' that concrete bridges and viaducts attract a correction factor of +1dB(A).

5 Unmitigated noise impacts from the operation of LMVs

The results of noise predictions from the operation of LMVs on the proposed scheme without mitigation, and their assessment compared to the daytime and night-time noise criteria are provided below in Table 7.1 to Table 7.4 at the end of this annex, rather than in the main EIS chapters.

In these tables, the predicted peak $L_{Aeq,\ 1\ hour}$ noise levels from the LMVs, the measured ambient level, the resulting total level with the LMVs and the change in ambient during the night are reported. The predicted level for each receptor represents the noise level at the most exposed part of the building, generally the upper floor.

The predicted noise levels from the LMVs are predicted for a full day (16 hours) and night (8 hours) as appropriate. The results are without any noise mitigation applied. The longer periods are used so that the noise levels from the LMVs can be compared with the thresholds for noise impact as identified previously (i.e. the free-field equivalent to the noise thresholds described in the methodology section of the EIS: 55dB $L_{Aeq\ 16\ hour}$ during the day and 45 dB $L_{Aeq\ 8\ hour}$ at night). When averaged over a full 8 hour night, the $L_{Aeq\ 8\ hour}$ level is approximately 4 dB lower than the highest $L_{Aeq\ 1\ hour}$ levels because of the absence of service between 0300 and 0500 and the varying levels of service across the night period. In the daytime, the $L_{Aeq\ 16\ hour}$ level is approximately 2 dB lower than the $L_{Aeq\ 1\ hour}$ due to the reduced level of off-peak services.

The changes in noise levels during the day or night are identified and an overall assessment is made based on the period of most significant impact at each location. L_{den} (day, evening, night) noise levels are also provided as discussed in the EIS.

6 Unmitigated construction noise impacts

Plant teams of key noise generating equipment for the different activities during the construction process are provided below in Table 7.6 to Table 7.23

The results of modelling noise from the construction of the scheme without mitigation, and their assessment compared to the relevant noise criteria are provided below in Table 7.24 to Table 7.30, rather than in the main EIS chapters.

In these tables, the construction activity, distance to receptor, predicted noise level, exceedence of the relevant criteria and impact rating are presented for each receptor being considered. Noise levels ($L_{Aeq,T}$) are presented for the relevant period when works are in progress, usually be the daytime period (0700 to 1900), although some night-time and evening works are also expected.

7 Summary

This annex summarises the methods used to carry out the noise modelling of the LMVs, and the assumptions that have been made during the modelling. A robust source terms has been established by reviewing similar systems, and the predictions have been carried out using standard prediction techniques implemented using a computer model to take into account the geometry and operational characteristics of the scheme. The detailed results of noise modelling prior to mitigation are provided.

The potential for structure radiated noise from elevated sections has been considered in detail. Design considerations have been identified as mitigation measures to be taken forwards, in order to ensure that the predicted noise levels are not exceeded.

Noise impacts arising from the construction process are presented in this report. Noise levels have been modelled by considering representative plant teams. Impacts that have been predicted here have been included in the EIS where mitigation measures are considered and any residual impacts that may remain are then reported.

Table 7.1 Unmitigated Noise Impacts at Night N101 (Free-field dB)

Receptor	Reference	Distance to Alignment	Speed (km/h)	Track Type	Impact		Baseline $L_{Aeq\ 1\ hr}$	Resultant Total Level $L_{Aeq\ 1\ hr}$	Increase $L_{Aeq\ 1\ hr}$	Exceedance of 8 hr Criterion	Overall Impact	Impact Magnitude	L_{DEN}
					$L_{Aeq,\ 8\ hr}$	$L_{Aeq,1\ hr}$							
NML 3 nearby	MN101-1	190	40	Ground level	47.2	51.8	46	52.8	6.8	2.2	2.2	Slight	55.3
NML 4	MN101-2	270	65	Ground level	47.5	52.1	46	53.0	7.0	2.5	2.5	Slight	55.6
NML 5	MN101-3	27	70	Ground level	62.1	66.7	48	66.8	18.8	17.1	17.1	Severe	70.2
NML 6	MN101-4	120	70	Ground level	54.1	58.7	48	59.1	11.1	9.1	9.1	Substantial	62.2
Emmaus retreat Centre	MN101-5	120	70	Ground level	53.1	57.7	48	58.1	10.1	8.1	8.1	Substantial	61.2
NML 9	MN101-6	23	70	Ground level	54.1	58.7	53	59.8	6.7	9.1	6.7	Substantial	62.2
Newcort North	MN101-8	90	50	Elevated	52.2	56.8	57	59.9	2.9	7.2	2.9	Slight	60.3
Newcourt	MN101-9	33	50	Elevated	54.2	58.8	57	61.0	4.0	9.2	4.0	Moderate	62.3
Seatown West	MN101-10	35	50	Elevated	55.2	59.8	57	61.6	4.6	10.2	4.6	Moderate	63.3
The Crescent	MN101-11	42	50	Elevated	54.2	58.8	57	61.0	4.0	9.2	4.0	Moderate	62.3
The Crescent South	MN101-12	65	50	Elevated	51.2	55.8	57	59.4	2.4	6.2	2.4	Slight	59.3
Nethercross Court	MN101-13	68	50	Elevated	52.2	56.8	57	59.9	2.9	7.2	2.9	Slight	60.3
Estuary Court	MN101-14	42	50	Elevated	54.2	58.8	57	61.0	4.0	9.2	4.0	Moderate	62.3
Mantau park (~30m)	MN101-15	29	50	Elevated	56.2	60.8	57	62.3	5.3	11.2	5.3	Substantial	64.3

Receptor	Reference	Distance to Alignment	Speed (km/h)	Track Type	Impact $L_{Aeq, 8 hr}$	Impact $L_{Aeq,1 hr}$	Baseline $L_{Aeq 1 hr}$	Resultant Total Level $L_{Aeq 1 hr}$	Increase $L_{Aeq 1 hr}$	Exceedance of 8 hr Criterion	Overall Impact	Impact Magnitude	L_{DEN}
Mantau park west (~55m)	MN101-16	55	50	Elevated	50.2	54.8	55	57.9	2.9	5.2	2.9	Slight	58.3
Mantau park West (~104m)	MN101-17	104	50	Elevated	49.2	53.8	55	57.4	2.4	4.2	2.4	Slight	57.3
Seatown terrace North	MN101-18	112	50	Elevated	50.2	54.8	55	57.9	2.9	5.2	2.9	Slight	58.3
Seatown Terrace	MN101-19	85	50	Elevated	51.2	55.8	55	58.4	3.4	6.2	3.4	Moderate	59.3
Seatown Walk	MN101-21	45	50	Ground level	57.2	61.8	57	63.0	6.0	12.2	6.0	Substantial	65.3
Seatown Walk South	MN101-22	95	50	Ground level	45.2	49.8	54	55.4	1.4	0.2	0.2	No impact	53.3
Castle park	MN101-23	40	50	Ground level	53.2	57.8	57	60.4	3.4	8.2	3.4	Moderate	61.3
Castle Grove	MN101-24	130	50	Ground Level	32.2	36.8	45	45.6	0.6	-	0	No impact	40.3
Ashley Avenue	MN101-25	45	50	Elevated	34.2	38.8	57	57.1	0.1	-	0	No impact	42.3

Table 7.2 Unmitigated Daytime Impacts MN101 (Free-field dB)

Receptor	Reference	Distance to Alignment	Speed km/h	Track Type	Impact $L_{Aeq, 16 hr}$	Impact $L_{Aeq, 1 hr}$	Baseline $L_{Aeq, 1 hr}$	Resultant Total $L_{Aeq, 1 hr}$	Increase $L_{Aeq, 1 hr}$	Exceedance of 16 hr Criterion	Overall Impact	Impact Magnitude	L_{DEN}
Estuary Road	MN101-7	164	70	Ground level	50.2	51.9	61	61.5	0.3	-	0	No impact	52.3
Seatown School	MN101-20	90	30	Ground level	44.7	46.4	58.0	58.3	0.3	-	0	No impact	46.8

Table 7.3 Unmitigated Noise Impacts at Night MN102 (Free-field dB)

Receptor	Reference	Distance to Alignment	Speed (km/h)	Track Type	Impact $L_{Aeq, 8 hr}$	Impact $L_{Aeq,1 hr}$	Baseline $L_{Aeq 1 hr}$	Resultant Total $L_{Aeq 1 hr}$	Increase $L_{Aeq 1 hr}$	Exceedance of 8 hr Criterion	Overall Impact	Impact Magnitude	L_{DEN}
Carlton Court NML 12	MN102-1	50	30	Elevated	49.7	54.3	57.0	58.9	1.9	4.7	1.9	Slight	57.8
Pinnock Hill Roundabout	MN102-2	40	30	Elevated	50.7	55.3	57.0	59.3	2.3	5.7	2.3	Slight	58.8
Dublin Road	MN102-3	104	30	Elevated	43.7	48.3	57.0	57.6	0.6	-	0	No impact	51.8
First Receiver south of Pinnock Hill	MN102-4	8	30	Ground level	53.7	58.3	57.0	60.7	3.7	8.7	3.7	Moderate	61.8
Willows	MN102-5	26	60	Ground level	57.8	62.4	57.0	63.5	6.5	12.8	6.5	Substantial	65.9
Elms	MN102-6	52	70	Ground level	40.1	44.7	57.0	57.2	0.2	-	0	No impact	48.2

Receptor	Reference	Distance to Alignment	Speed (km/h)	Track Type	Impact		Baseline $L_{Aeq\ 1\ hr}$	Resultant Total $L_{Aeq\ 1\ hr}$	Increase $L_{Aeq\ 1\ hr}$	Exceedance of 8 hr Criterion	Overall Impact	Impact Magnitude	L_{DEN}
					$L_{Aeq,\ 8\ hr}$	$L_{Aeq,1\ hr}$							
Quarry Entrance house	MN102-7	70	70	Ground level	36.1	40.7	57.0	57.1	0.1	-	0	No impact	44.2
Receptor near portal to Airport	MN102-8	150	70	Ground level	37.1	41.7	57.0	57.1	0.1	-	0	No impact	45.2

Table 7.4 Unmitigated Noise Impacts at Night MN103 (Free-field dB)

Receptor	Reference	Distance to Alignment	Speed (km/h)	Track Type	Impact		Baseline $L_{Aeq,1\ hr}$	Resultant Total $L_{Aeq,1\ hr}$	Increase $L_{Aeq,1\ hr}$	Exceedance of 8 hr Criterion	Overall Impact	Impact Magnitude	L_{DEN}
					$L_{Aeq,\ 8\ hr}$	$L_{Aeq,1\ hr}$							
Halting Site Airport	MN101-3	200	70	Elevated	19.6	24.2				-	0	No impact	

Table 7.5 Unmitigated Noise Impacts at Night and MN104 (Free-field dB)

Receptor	Reference	Distance to Alignment	Speed (km/h)	Track Type	Impact		Baseline $L_{Aeq,1\ hr}$	Resultant Total $L_{Aeq,1\ hr}$	Increase $L_{Aeq,1\ hr}$	Exceedance of 8 hr Criterion	Overall Impact	Impact Magnitude	L_{DEN}
					$L_{Aeq,\ 8\ hr}$	$L_{Aeq,1\ hr}$							
Santry Lodge East	MN104-1	82	70	Elevated	54.1	58.7	57.0	60.9	3.9	9.1	3.9	Moderate	62.2
Santry Lodge West	MN104-2	68	70	Elevated	55.1	59.7	57.0	61.6	4.6	10.1	4.6	Moderate	63.2

					Impact							Impact Magni-tude	L_{DEN}
Santry Lodge South	MN104-3	25	30	ground level	53.7	58.3	57.0	60.7	3.7	8.7	3.7	Moderate	61.8

Table 7.6 Construction Plant Inventory – Depot (Top Soil Strip)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Dozer D6	114	1	50	111
25 t 360 Excavators	110	1	50	107
Dump Trucks	109	2	80	111
Wheel Wash	100	1	50	97
Total				**115**

Table 7.7 Construction Plant Inventory – Depot (Substructures)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
100t mobile crane	109	1	50	106
Concrete pumps	107	1	25	101
Compressors	110	2	50	110
Generators	98	2	50	98
Poker Vibrators	106	2	25	103
MEWPS	98	2	30	96
Forklift	104	2	40	103
Steel Saw	98	2	25	95
Total				**113**

Table 7.8 Construction Plant Inventory – Alignment Works

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Dump Trucks	109	1	50	106
Grader D14	111	1	50	108
360 Excavators	110	1	50	107
Piling Plant	112	1	25	106
Concrete Trucks	100	2	25	97
Poker Vibrators	106	4	25	106
Service Crane	109	1	25	103
Total				**114**

Table 7.9 Construction Plant Inventory – Stops (Surface)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
360 Excavator	110	1	100	110
Dump Trucks	109	1	50	106
Total				**111**

Table 7.10 Construction Plant Inventory – Structures

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Crawler Cranes (Piling, Service)	109	1	50	106
Hydraulic Hammer	100	1	20	93
25t 360 Excavators	110	2	100	113
Dump Truck (on & offsite)	109	2	100	112

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Crane (Service)	109	1	80	108
Generator	98	2	100	101
Concrete Mixer Truck	107	2	100	110
Concrete Pump Truck	100	1	50	97
Bar Bender & Cutter	110	1	50	107
Poker Vibrators	106	4	25	106
150 t mobile Crane	109	1	80	108
Total				**119**

Table 7.11 Construction Plant Inventory – Structures (Earthworks at Chapel Lane)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
25t 360 Excavators	110	1	100	110
Total				**110**

Table 7.12 Construction Plant Inventory – Structures (Malahide Underpass)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Piling Plant	112	1	70	110
Concrete Trucks	100	1	50	97
Poker Vibrators	106	2	25	103
Service Crane	109	1	40	105
Total				**112**

Table 7.13 Construction Plant Inventory – Stops (Cut and Cover)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Crawler Cranes (Piling, Service)	109	2	100	112
Hydraulic Hammer	100	2	25	97
Cranes (Excavation)	109	2	100	112
Backhoe	110	4	25	110
Dump Truck (on & offsite)	109	2	100	112
Crane (Service)	109	1	100	109
Generator	98	2	100	101
Concrete Mixer Truck	107	2	100	110
Concrete Pump Truck	100	1	50	97
Bar Bender & Cutter	110	1	50	107
Poker Vibrators	106	4	10	102
Total				**119**

Table 7.14 Construction Plant Inventory – Compounds (Fosterstown)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Forklift	104	1	20	97
360 Excavator	110	2	20	106
Generator	100	2	100	103
Compressor	100	2	100	103
Concrete batching	109	1	100	109
Front end loading shovel	110	1	100	110
Mobile crane	109	1	50	106
Total				**115**

Table 7.15 Construction Plant Inventory – Compounds (Normal Light)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Forklift	104	1	20	97
360 Excavator	110	2	20	106
Generator	100	2	100	103
Compressor	100	2	100	103
Total				**109**

Table 7.16 Construction Plant Inventory – Compounds (Bentonite Batching)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Bentonite batching plant	107	1	100	107
Total				**107**

Table 7.17 Construction Plant Inventory – Tunnelling Support for Albert College Park (Compound)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Tunnel grout plant	107	1	100	107
Gantry crane (30t)	109	1	50	106
wheel wash	100	1	50	97
Lorries	98	5	100	105
Front end loading shovel	110	1	100	110
Total				**114**

Table 7.18 Construction Plant Inventory – Concrete Pour

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Crane (Service)	109	1	50	106
Generator	98	1	100	98
Concrete Mixer Truck	107	1	50	104
Concrete Pump Truck	100	1	100	100
Bar Bender & Cutter	110	1	10	100
Poker Vibrators	106	4	10	102
Total				**110**

Table 7.19 Construction Plant Inventory – Night Demolition

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
100t mobile crane	109	1	100	109
Generators	98	1	100	98
25t 360 Excavators c/w breakers	116	1	50	113
Total				**115**

Table 7.20 Construction Plant Inventory – Structures (Fosterstown Underpass)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Dump Trucks	109	2	50	109
Compacting Roller	108	1	50	105
Grader D14	111	1	50	108
360 Excavators	110	2	50	110
Total				**114**

Table 7.21 Construction Plant Inventory – Cut and Cover (Fosterstown Accommodation bridge, M50 Viaduct and Northwood Overbridge)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Dump Trucks	109	2	50	109
Compacting Roller	108	1	50	105
Grader D14	111	1	50	108
360 Excavators	110	2	50	110
Total				**114**

Table 7.22 Construction Plant Inventory – Structures (The North Portal (Airport Tunnel) and St. Patrick's Head Shaft)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
100t mobile crane	109	1	100	109
Concrete pumps	107	1	100	107
Compressors	110	2	100	113
Generators	98	2	100	101
Poker Vibrators	106	4	25	106
MEWPS	98	2	10	91
Forklift	104	1	50	101
Total				**116**

Table 7.23 Construction Plant Inventory – Cut and Cover (Portal to DCU to Ballymun to Northwood)

Plant Item	Sound Power Level (dBA)	Number of Plant Items	% on-time	Effective Sound Power Level (dBA)
Crawler Cranes (Piling, Service)	109	1	100	109
Backhoe	110	1	25	104
Dump Truck (on & offsite)	109	1	100	109
Generator	98	1	100	98
Concrete Mixer Truck	107	1	50	104
Concrete Pump Truck	100	1	50	97
Bar Bender & Cutter	110	1	50	107
Poker Vibratory Hammer	106	1	10	96
Total				**114**

The following tables present the unmitigated impacts from the construction of the proposed scheme.

Receptors close to compounds other than those for which impacts are predicted here are not expected to be significantly affected by noise as activities from these other compounds which will be limited to offices, storage, welfare or contractor parking only, and these activities are not expected to result in significant noise levels. In other cases, noise will be dominated by permanent works which are covered elsewhere.

Where the distance to a receptor is small (less than 10m), it has been assumed that the noisiest piece of plant operating within this distance will dominate.

Table 7.24 Unmitigated Construction Noise Impacts MN101

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
Spittal Hill (north)	MN101-C3	Alignment	256	61	None	Very Low
Individual Residential Property (no named road)	MN101-C4	Alignment	20	83	13	Very High
Farm Buildings (no named road)	MN101-C5	Alignment	117	68	None	Very Low
Residential Property (Spittal Hill)	MN101-C7	Alignment	21	83	8	High
Castle Park	MN101-C25	Alignment	33	79	4	Medium
Ashley Grove	MN101-C26	Alignment	39	77	2	Low
Individual Residential Property on minor road off Balheary Road	MN101-C2	Stops	175	61	None	Very Low
Spittal Hill (north)	MN101-C3	Stops	252	58	None	Very Low
Individual Residential Property (no named road)	MN101-C4	Stops	97	66	None	Very Low
Spittal Road	MN101-C8	Stops	159	62	None	Very Low
Seatown School	MN101-C22	Stops	78	68	3	Medium
Seatown Walk	MN101-C23	Stops	39	74	None	Very Low
Emmaus Retreat Centre	MN101-C6	Compounds	44	71	None	Very Low
Residential Property (Spittal Hill)	MN101-C7	Compounds	13	82	7	High
Castlegrange Avenue	MN101-C9	Compounds	97	64	None	Very Low
Seatown School	MN101-C22	Compounds	59	69	4	Medium
Seatown Walk	MN101-C23	Compounds	14	81	6	High
Seatown Walk (South)	MN101-C24	Compounds	13	81	6	High
Ashley Grove	MN101-C26	Compounds	5	87	12	Very High
Ashley Avenue	MN101-C28	Compounds	11	83	8	High
Foxwood	MN101-C29	Compounds	8	83	8	High
Seatown Walk (South)	MN101-C24	Night Demolition	20	84	39	Very High
Ashley Grove	MN101-C26	Night Demolition	56	75	30	Very High
House east of Tesco	MN101-C30	Night Demolition	100	70	25	Very High
Foxwood	MN101-C29	Night Demolition	100	70	25	Very High
Individual Residential Property on minor road off Balheary Road	MN101-C2	Depot	150	64 to 66	None	Very Low
Newcourt Mews	MN101-C10	Structures	80	76	1	Very Low
Newcourt	MN101-C11	Structures	26	86	11	Very High
Seatown West	MN101-C12	Structures	24	86	11	Very High
The Crescent	MN101-C13	Structures	32	84	9	High
The Crescent (south)	MN101-C14	Structures	56	79	4	Medium
Seatown Villas	MN101-C15	Structures	55	79	4	Medium
Estuary Court	MN101-C16	Structures	31	84	9	High
Mantua Park	MN101-C17	Structures	17	89	14	Very High
Mantua Park	MN101-C18	Structures	43	81	6	High
Mantua Park (west)	MN101-C19	Structures	92	75	None	Very Low

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
Seatown Terrace (North)	MN101-C20	Structures	101	74	None	Very Low
Seatown Terrace	MN101-C21	Structures	75	76	1	Low
Seatown Walk (South)	MN101-C24	Structures	16	81	6	High
Ashley Grove	MN101-C26	Structures	5	91	16	Very High
Castle Grove	MN101-C27	Structures	49	77	2	Low
Ashley Avenue	MN101-C28	Structures	34	76	1	Low
Foxwood	MN101-C29	Structures	5	91	16	Very High
Foxwood	MN101-C29	Structures	63	69	None	Very Low
House east of Tesco	MN101-C30	Structures	101	67	None	Very Low
House east of Tesco	MN101-C30	Structures	79	67	None	Very Low

Table 7.25 Unmitigated Construction Noise Impacts MN102

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Ex-ceedance (dB)	Impact Rating
Carlton Close	MN201-C3	Alignment	44	76	1	Low
Dublin Road / Willows Road junction	MN201-C7	Alignment	21	83	8	High
Dublin Road	MN201-C8	Alignment	46	76	1	Very Low
Carlton Close	MN201-C1	Stops	62	70	None	Very Low
Office Building on Lakeshore Drive	MN201-C2	Stops	84	68	None	Very Low
Dublin Road	MN201-C6	Stops	5	92	17	Very High
Dublin Road Roundabout / Motel	MN201-C5	Compounds	29	75	None	Very Low
Dublin Road	MN201-C6	Compounds	5	90	15	Very High
Dublin Road	MN201-C10	Compounds	47	77	2	Low
Residential Property on Dublin Road	MN201-C11	Compounds	5	96	21	Very High
Carlton Close	MN201-C4	Structures	29	85	10	High
Dublin Road Roundabout / Motel	MN201-C5	Structures	18	89	14	Very High
Dublin Road / Willows Road junction	MN201-C7	Structures	16	85	10	High
Dublin Road	MN201-C8	Structures	41	77	2	Low
Nevinstown Lane / Dublin Road Junction	MN201-C9	Structures	6	93	18	Very High
Dublin Road	MN201-C10	Structures	62	73	None	Very Low

Table 7.26 Unmitigated Construction Noise Impacts MN103

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
Residential / Haltings Site on Naul Road	MN301-C1	Structures	5	91	16	Very High

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
Residential Property of Naul Road	MN301-C2	Structures	71	74	None	Very Low

Table 7.27 Unmitigated Construction Noise Impacts MN104

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
Rural residential property on Ballymun Road (not dual carriageway)	MN401-C4	Alignment	13	87	12	Very High
Rural residential property on Ballymun Road (not dual carriageway)	MN401-C5	Alignment	21	83	8	High
Residential Property on Ballymun Duel Carriageway	MN401-C6	Cut and Cover	25	81	6	High
Rural residential property on Ballymun Road (not dual carriageway)	MN401-C4	Stops	70	69	None	Very Low
Rural residential property on Ballymun Road (not dual carriageway)	MN401-C5	Stops	46	73	None	Very Low
Football Club	MN401-C1	Compounds	64	68	None	Very Low
Santry Lodge (East)	MN401-C2	Compounds	66	68	None	Very Low
Santry Lodge (West)	MN401-C3	Compounds	17	79	4	Medium
Rural residential property on Ballymun Road (not dual carriageway)	MN401-C4	Compounds	46	69	None	Very Low
Rural residential property on Ballymun Road (not dual carriageway)	MN401-C5	Compounds	16	78	3	Medium
Santry Lodge (West)	MN401-C3	Structures	12	95	20	Very High
Santry Lodge (West)	MN 401-C3	Structures	73	72	None	Very Low
Rural residential property on Ballymun Road (not dual carriageway)	MN 401-C4	Structures	36	78	3	Low

Table 7.28 Unmitigated Construction Noise Impacts MN105

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
Flats on Ballymun Road	MN501-C1	Cut and Cover	33	79	4	Medium
Clarke (Ballymun) Tower Flats (Ballymun Road)	MN501-C2	Cut and Cover	30	79	4	Medium
Ballymun Shopping Centre (Ballymun Road)	MN501-C3	Cut and Cover	43	76	1	Low
James Connolly Tower Flats (Ballymun Road)	MN501-C4	Cut and Cover	27	80	5	High
Ballymun Civic Centre	MN501-C5	Cut and Cover	15	86	11	Very High
Gateway View Flats on Ballymun Road	MN501-C6	Cut and Cover	22	82	7	High

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
School on Ballymun Road	MN501-C7	Cut and Cover	47	76	11	Very High
Ballymun Road / Shanliss Road junction	MN501-C8	Cut and Cover	22	82	7	High
Libray / School / Ballymun Road	MN501-C9	Cut and Cover	29	80	15	Very High
Ballymun Road	MN501-C10	Cut and Cover	15	86	11	Very High
Junction of Ballymun Road and Glasnevin Road	MN501-C11	Cut and Cover	30	79	4	Medium
Church on Ballymun Road	MN501-C12	Cut and Cover	5	89	24	Very High
Ballymun Shopping Centre (Ballymun Road)	MN501-C3	Stops	39	82	7	High
James Connolly Tower Flats (Ballymun Road)	MN501-C4	Stops	33	84	9	High
Ballymun Civic Centre	MN501-C5	Stops	13	92	17	Very High
Church on Ballymun Road	MN501-C12	Stops	5	90	25	Very High
Ballymun Road	MN501-C13	Stops	5	90	15	Very High
Ballymun Road	MN501-C14	Stops	43	81	6	High
Albert College Grove	MN501-C15	Stops	6	88	13	Very High
Ballymun Road / St. Pappins Road	MN501-C16	Stops	43	81	6	High
Albert College Crescent	MN501-C17	Stops	19	89	14	Very High
Flats on Ballymun Road	MN501-C1	Compounds	10	82	7	High
James Connolly Tower Flats (Ballymun Road)	MN501-C4	Night Concrete Pours	33	75	30	Very High
Ballymun Civic Centre	MN501-C5	Night Concrete Pours	13	83	38	Very High
Ballymun Road	MN501-C13	Night Concrete Pours	5	87	42	Very High
Ballymun Road	MN501-C14	Night Concrete Pours	43	72	27	Very High
Albert College Grove	MN501-C15	Night Concrete Pours	6	85	40	Very High
Ballymun Road / St. Pappins Road	MN501-C16	Night Concrete Pours	43	72	27	Very High
Albert College Crescent	MN501-C17	Night Concrete Pours	19	80	35	Very High

Table 7.29 Unmitigated Construction Noise Impacts MN106

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
The Rise	MN601-C5	Stops	64	78	3	Low
Griffith Avenue	MN601-C6	Stops	49	80	5	High
Griffith Avenue	MN601-C7	Stops	80	76	1	Very Low
Walnut Lawn / Walnut Rise	MN601-C8	Stops	164	70	None	Very Low
St. Alphonsus Road (Lower)	MN601-C12	Stops	9	95	30	Very High
St. Joeseph's Avenue	MN601-C13	Stops	13	91	16	Very High
St. Alphonsus Avenue	MN601-C14	Stops	17	89	24	Very High
Mater Misericodiae Hospital	MN601-C15	Stops	19	89	24	Very High
Mater Misericodiae Hospital / Leo Street	MN601-C16	Stops	12	93	28	Very High
Leo Street	MN601-C17	Stops	12	92	17	Very High
Mater Private Hospital	MN601-C18	Stops	38	82	17	Very High
Ballymun Road	MN601-C1	Compounds	81	71	None	Very Low

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
Ballymun Road	MN601-C2	Compounds	87	70	None	Very Low
Hampstead Avenue	MN601-C3	Compounds	73	72	None	Very Low
Hampstead Avenue (east)	MN601-C4	Compounds	51	75	None	Very Low
Ballymun Road	MN601-C1	Compounds	81	71	None	Very Low
Ballymun Road	MN601-C2	Compounds	87	70	None	Very Low
The Rise	MN601-C5	Night Concrete Pours	64	69	24	Very High
Griffith Avenue	MN601-C6	Night Concrete Pours	49	71	26	Very High
Griffith Avenue	MN601-C7	Night Concrete Pours	80	67	22	Very High
Walnut Lawn / Walnut Rise	MN601-C8	Night Concrete Pours	164	61	16	Very High
St. Joeseph's Avenue	MN601-C13	Night Concrete Pours	13	82	37	Very High
St. Alphonsus Avenue	MN601-C14	Night Concrete Pours	17	80	35	Very High
Mater Misericodiae Hospital	MN601-C15	Night Concrete Pours	19	80	35	Very High
Mater Misericodiae Hospital / Leo Street	MN601-C16	Night Concrete Pours	12	84	39	Very High
Leo Street	MN601-C17	Night Concrete Pours	12	83	38	Very High
Mater Private Hospital	MN601-C18	Night Concrete Pours	38	73	28	Very High
St. Patrick's College / Ferguson Road	MN601-C9	Structures	16	87	22	Very High
St. Patrick's College / Millbourne Road	MN601-C10	Structures	12	89	24	Very High
St. Patrick's College	MN601-C11	Structures	5	91	26	Very High

Table 7.30 Unmitigated Construction Noise Impacts MN107

Receptor	Reference	Activity	Distance to Works (m)	Predicted Noise Level LAeq,T	Exceedance (dB)	Impact Rating
Finlater's Church	MN701-C1	Stops	33	84	19	Very High
Parnell Square / Gardiner's Row	MN701-C2	Stops	12	92	17	Very High
Gate Theatre	MN701-C3	Stops	17	89	24	Very High
Parnell Square East	MN701-C4	Stops	13	92	17	Very High
O'Connell St Lower (West)	MN701-C5	Stops	32	84	9	High
O'Connell St Lower (East)	MN701-C6	Stops	38	82	7	High
O'Connell St Lower (East)	MN701-C7	Stops	16	90	15	Very High
O'Connell Bridge House	MN701-C8	Stops	35	83	8	High
Westmorland St (hotel)	MN701-C9	Stops	75	76	1	Low
Westmorland St	MN701-C10	Stops	80	76	1	Very Low
Fitzwilliam Hotel	MN701-C11	Stops	54	79	4	Medium
Royal College of Surgeons	MN701-C12	Stops	95	74	9	High
St. Stephen's Green North	MN701-C13	Stops	52	80	5	Medium
St. Stephen's Green South	MN701-C14	Stops	190	68	None	Very Low
Westmorland St	MN701-C10	Night Concrete Pours	80	67	22	Very High
Fitzwilliam Hotel	MN701-C11	Night Concrete Pours	54	70	25	Very High