Contents

17 Noise and Vibration

17.1 Introduction

This chapter of the EIAR consists of an appraisal of the proposed N6 Galway City Ring Road, hereafter referred to as the proposed road development, under the heading of noise and vibration.

The chapter sets out the methodology (**Section 17.2**), describes the receiving environment (**Section 17.3**) and summarises the main characteristics of the proposed road development which are of relevance for noise and vibration (**Section 17.4**). The evaluation of impacts of the proposed road development on noise and vibration are described (**Section 17.5**). Measures are proposed to mitigate these impacts (**Section 17.6**) and residual impacts are described (**Section 17.7**). The chapter concludes with a summary (**Section 17.8**) and reference section (**Section 17.9**).

This chapter has utilised the information gathered during the constraints and route selection studies for the proposed road development to inform the noise and vibration impact appraisal. **Sections 4.15**, **6.5.10** and **7.6.10** of the **Route Selection Report** considered the noise and vibration constraints within the scheme study area and compared the potential noise and vibration impacts of the proposed route options respectively. These sections of the Route Selection Report contributed to the design of the proposed road development which this chapter appraises.

The key guidance documents referred to in this chapter are the TII 2004 *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* and the TII 2014 Document *Good Practice Guidelines for the Treatment of Noise during the Planning of National Road Schemes,* referred to as the TII 2004 Noise Guidelines and the TII 2014 Noise Guidelines respectively within this chapter.

17.2 Methodology

17.2.1 Introduction

In order to assess the noise impact of any proposed road development, the following methodology has been 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 road development. Noise sensitive receptors include residential properties, education buildings, hospitals and areas of high amenity value in existing low noise settings. In the case of a road scheme, the selected noise-sensitive locations are those in closest proximity to the proposed road development and along sections of existing roads where changes in traffic volumes are expected.
- The noise levels resulting from both the construction and operational phases for the future years are then calculated using established prediction techniques.

- 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 this chapter.

17.2.2 Relevant Guidelines

The assessment has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration from road traffic which are set out within the relevant sections of this chapter and included in the references section. Specifically, as noted in **Section 17.1**, the key guidance documents relating to this chapter are:

- TII 2004 Guidelines for the Treatment of Noise and Vibration in National Road Schemes
- TII 2014 Document Good Practice Guidelines for the Treatment of Noise during the Planning of National Road Schemes, (TII 2014)

In addition to specific noise guidance documents, the following guidelines were considered and consulted for the purposes of the proposed road development:

- Guidelines on the Information to be contained in Environmental Impact Statements', (EPA, 2002)
- 'EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), (EPA, 2003)
- 'EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015)
- EPA Guidelines on the information to be contained in environmental impact assessment reports (Draft August 2017)

17.2.2.1 Construction Phase

Guidelines relating to construction noise and vibration limits are set out within the TII guidance documents and other relevant national and international documentation for the control of noise and vibration from construction sites. These are discussed in the following sections.

Construction Noise

The TII noise guidance documents specify noise levels that are deemed acceptable in terms of construction noise for new national roads. These limits are set out in **Table 17.1**.

Table 17.1: Maximum Permissible Noise Levels at the Facade of Dwellings during Construction Phase

Days and Times	Noise Levels (dB re. $2x10^{-5}$ Pa)	
	$L_{Aeq,1hr}$	L_{ASmax}
Monday to Friday 07:00 to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturdays 08:00 to 16:30hrs	65	75
Sundays & Bank Holidays 08:00 to 16:30hrs	60*	65*

Note * Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the local authority.

The TII guidelines do not include specific night-time construction noise limit values. In order to determine appropriate limits for any scheduled night-time works, best practice guidelines are taken from the British Standard BS5228 – 1: 2009 +A1 2014: *Code of practice for noise and vibration control on construction and open sites – Noise*. The standard provides guidance on setting appropriate limit values for construction based on exiting ambient noise levels in the absence of construction noise. The guidance levels for night-time periods are summarised in **Table.17.2**.

Table 17.2: Example Threshold of Significant Effect at Dwellings

Days and Times	Threshold Values (dB)		
	Category A [A]	Category B [B]	Category C [C]
Night-time 23:00 to 07:00hrs	45	50	55

- Note A: Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
- Note B: Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
- Note C: Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

Construction Vibration

With regards to construction vibration, the TII guidelines outline the following limits in respect of ensuring that no cosmetic damage occurs to buildings in the vicinity of construction works.

Table 17.3: Allowable vibration during road construction in order to minimise the risk of building damage

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)**
8mm/s	12.5mm/s	20mm/s

Blasting

When assessing the potential impact of blasting, the relevant parameters used are both air overpressure and Peak Particle Velocity (PPV) mm/s. The TII guidelines recommends a PPV limit value of 12mm/s for blasting control. The Irish EPA Guidance *Environmental Management in the extraction industry* (2006) also recommend a PPV limit of 12mm/s in addition to an acceptable limit for air overpressure of 125dB (Lin) Peak Value. In addition, the EPA recommends blasting is only carried out between 09:00 – 18:00 Monday to Friday.

BS 6472 -2 2008: *Guide to Evaluation of Human Exposure to vibration in buildings. Part 2: Blast Induced Vibration* suggests satisfactory vibration magnitudes from blasting relating to human response. The document notes that for up to three blasts per day, a PPV limit value between 6 and 10mm/s is deemed reasonable, however it states these limit values relate to long term blasting operations from surface mineral extraction sites. The standard notes that *for civil engineering projects, such as tunnel and foundation excavations, it should be recognised that the application of human response criteria, rather than conservative damage criteria, could significantly prolong project durations. In turn this could lead to increased complaint levels.*

The standard notes higher levels may be more appropriate for short term projects, where good public relations, property surveys etc. are undertaken.

The frequency of blasting for the proposed road development will be no greater than one blast per day in any one site. Taking the blasting frequency into account, the nature of this engineering project and to expedite works as far as practical in excavation areas to avoid prolonged impacts, the limit values relating to structural damage are considered the most appropriate for this project, i.e. 12mm/s.

Disturbance of Particularly Vibration-Sensitive Equipment and Processes

There are no standard criteria for assessing the potential impact of vibration on sensitive equipment or processes. British Standard BS 5228 *Code of Practice for Noise and Vibration Control on Construction and Open Sites* – Part 2: *Vibration* (2009 +A1 2014) provides a guide of vibration sensitivities of differing types of sensitive equipment from microscopes to microelectronic manufacturing equipment, however these ranges are generic and relate to the sensitivity of the equipment as installed, not the external façade of the building. The most advisable approach for the control of potential vibration impacts at areas of vibration sensitive equipment or processes, is to review each location on its own merit in order to determine the site specific vibration limits taking into account any building or machinery isolation already in place. In this instance, where a receptor has been identified or made known within the study area that is potentially sensitive to vibration through questionnaires and consultations, this area is highlighted as one for consideration and consultation. In these instances, it is not possible to set specific vibration limits at this stage of the EIAR due to complexities in both the level of detail available at this stage and knowledge of the receptor. Further discussion on particularly sensitive equipment/processes are set out in **Section 17.6.1**.

17.2.2.2 Operational Phase

TII Noise Guidance Documents

There are no statutory guidelines relating to noise from road schemes in Ireland. In the absence of statutory guidance, the most commonly applied standard is that issued by the TII within their 2004 and 2014 noise guidance documents. Both documents specify that the following absolute noise design criterion for new national road schemes in Ireland is appropriate:

Day-evening-night value of: **60dB L_{den}**.

This is a free field façade criterion, i.e. does not take account of reflections from building facades.

L_{den} is the 24hour noise rating level determined by the averaging of the L_{day} with the $L_{evening}$ (plus a 5dB penalty) and the L_{night} (plus a 10dB penalty). L_{den} is calculated using the following formula:

$$L_{den} = 10log\left(\frac{1}{24}\right)\left(12 * \left(10^{\frac{Lday}{10}}\right) + 4 * \left(10^{\frac{Levening+5}{10}}\right) + 8 * \left(10^{\frac{Lnight+10}{10}}\right)\right)$$

Where:

- L_{day} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the day periods of a year
- $L_{evening}$ is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year
- L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the night periods of a year

This criterion applies to new national roads. The following three conditions must be satisfied under the TII guidelines in order for noise mitigation to be provided:

a) The combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road development together with other traffic in the vicinity is greater than the design goal of 60dB L_{den}

b) The relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road development in place

c) The contribution to the increase in the relevant noise level from the proposed road development is at least 1dB

The proposed road development under consideration here is a new national road and hence the design goal and assessment methodology set out in the TII guidelines for the assessment of potential noise impacts from national road schemes are deemed directly applicable.

It should be noted that the design goal is applicable to new road schemes only. In addition, the design goal is applied to existing receptors in respect of both the year of opening and the Design Year, typically 15 years after projected year of opening. In the case of this proposed road development a commencement year of 2024 and a future Design Year of 2039 have been assessed.

Galway City and County Council Noise Action Plans 2013 - 2018

The Galway City Council and the County Galway Local Authorities Noise Action Plans (NAP) relates to the management of environmental noise in accordance with the Environmental Noise Directive (END) (202/49/EC). The purpose of the Action Plan is to manage and reduce, where necessary, environmental noise through the adoption of the action plans.

In the case of Galway City Council, noise due to road traffic sources from sections of roads with a traffic flow threshold above 3 million vehicle trips per annum were mapped in accordance with the second round of noise mapping studies within Europe. This applied to certain sections of the R336, R337, R338, R339, R446, R863, R864, R865, R866, R921, N6, N83, N59 and N84, which lie within the city boundaries.

Both NAPs have proposed the onset levels for assessment of noise management measures as follows.

- 70dB, L_{den}
- 57dB, L_{night}

The onset levels for noise management in addition to a decision matrix is used to identify those areas which may require noise intervention or management.

An implementation plan outlines a proposed programme of works for the period 2013 – 2018. The programme is largely dependent on traffic management and construction projects with the aim to reduce vehicle numbers and to re-distribute traffic on the road network of the city.

One of the management procedures referred to within both plans is mitigation through traffic planning. These specifically refers to a ring road for Galway City as a management procedure for reducing traffic volumes along existing routes across the city.

17.2.3 Data Sources and Consultations

Information relating to the proposed road development have been obtained primarily from the design team. Any comments that related to noise and vibration from consultations undertaken by the design team with stakeholders during the design development process were considered during the preparation of this chapter.

The following items of information were supplied by the design team which formed the main basis for the impact assessment:

- Background OS Mapping of the study area
- 3D ground contour mapping
- 3D road alignment drawings for the proposed road development
- Traffic flow forecasts for future opening and design years for study area
- Ongoing consultation feedback relevant to noise and vibration issues from interested and affected parties

- Landscaping proposals
- Construction plan information (compound locations, expected areas of blasting, construction traffic information etc.)

17.2.4 Study area and Baseline Data Collection

The study area for the noise and vibration impact assessment is focused on the areas likely to be affected by the operation of the proposed road development. This includes the closest noise/vibration sensitive locations along the route of the proposed road development in addition to those in proximity to existing roads in the vicinity of the proposed road development. Noise sensitive locations within a study area of approximately 300m from the centreline of the proposed road development was focused on for the baseline noise studies which is considered to capture the baseline noise environment at locations likely to be impacted by the proposed road development.

A comprehensive baseline noise study has been undertaken within the study area in order to provide a context of the typical noise environment and to determine the main contributors to the existing environment.

The surveying was completed in accordance with relevant guidance and standards including:

- Guidelines for the Treatment of Noise and Vibration in National Road Schemes (NRA, 2004)
- Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (NRA, 2014)
- Calculation of Road Traffic Noise Shortened Measurement Procedure (CRTN 1988)
- ISO 1996-2007 Acoustics – Description, Measurement and Assessment of Environmental Noise – Part 2 Determination of environmental noise levels. 1:2016

The survey locations were selected to represent the environments through which the proposed road development will pass which is predominately residential. Survey locations were therefore focused on residential areas set back from existing roads along the route of the proposed road development, residential estates, and residential properties located along local, regional and national roads. Additional surveys were undertaken at recreational facilities, schools and crèches, a church, a hospital, and commercial facilities. These were surveyed to gain information specific to these locations in addition to representing general ambient noise levels in the areas which they are located. Further details are set out in **Section 17.3**.

Unattended 24-hour monitoring stations were selected to represent specific noise environments (including those listed above) and a range of satellite attended measurement locations were monitored in the vicinity of these locations to characterise the noise environment within each area.

Given the extent of the baseline study area, it was not possible to gain access to all locations requested as part of the baseline study. In these instances, attended noise measurements were made at proxy locations to the nearest sensitive properties and unattended noise measurements were conducted, as far as practicable, at adjacent properties, depending on access being granted to private lands.

The surveying programme encompassed attended surveys at 73 locations and unattended surveys at 33 locations. A summary of results is presented and discussed in **Section 17.3**.

A survey of vibration levels along the corridor of the proposed road development 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. Comment on vibration sensitive equipment is set out in **Section 17.6.2.3**.

17.2.4.1 Unattended Measurements

The continuous measurements were conducted using a Brüel & Kjær UA 1404 Environmental Outdoor Kit, with either Brüel & Kjær Type 2238 or 2250 Sound Level Meters.

The measurement apparatus was check calibrated before and after each survey using a Brüel & Kjær Type 4231 Sound Level Calibrator. The results were saved to the instrument memory for later analysis.

Unmanned continuous measurements were conducted over at least 24-hour periods at thirty-three locations. L_{den} values are derived directly from the measured $L_{Aeq,1\ hour}$ measured data using the formula included in **Section 17.2.1**.

17.2.4.2 Attended Measurements

The short-term measurements were performed using Brüel & Kjær Type 2250 or 2260 Sound Level Meters. Short-term measurements were conducted at survey locations on a cyclical basis. Sample periods were 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 short-term measurement procedure as specified in the TII noise guidance documents.

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 2x10-5Pa.

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. $L_{A10(18hour)}$ is the parameter typically used in for the purposes of assessing traffic noise, where relevant.

The shortened measurement procedure involves a method whereby $L_{A10(18hour)}$ and L_{den} 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.

  $L_{A10(18hour)} = ((\sum L_{A10(15\ minutes)}) \div 3) - 1\ dB$

- The derived L_{den} value is calculated from the $L_{A10(18hour)}$ value, i.e.

  $L_{den} = 0.86 \times L_{A10(18hr)} + 9.86\ dB$

The L_{den} is a long-term average indicator and represented the annual daily noise level.

The guidelines note that *where traffic is not the dominant noise source, then the normal correction cannot be applied to convert the 15 minute samples to an 18-hour value. However, it may be possible to derive a site specific correction from a nearby long-term site affected by the same noise sources. If there is not comparator site, a short-term measurement is inappropriate and a 24-hour measurement will be required.*

The baseline survey locations were selected in order to ensure that where traffic was not the dominant source at monitoring positions that an unattended 24-hour survey was conducted in order to directly derive a L_{den} from the measured data and satellite attended measurements were conducted in the vicinity of this location.

17.2.4.3 Monitoring Locations

The location of the surveyed baseline monitoring positions are presented in **Figure 17.1.01** to **17.1.14**. The majority of monitoring locations were positioned within gardens of residential properties or at proxy locations to residential locations in public areas where access to private lands were not possible. Additional surveys were undertaken at the Sporting Campus of NUIG (10b), Dangan House Commercial/Recreational (10c), St. James' Church, Bushypark (9g), Castlegar School (11i/11g), Ballybrit Industrial Estate (13a), Galway Clinic (14b) and Galway Racecourse (13h).

The location of the monitoring positions and the calculated L_{den} for each position is included in **Table 17.8** in **Section 17.3**. Baseline monitoring which are grouped in attended and unattended satellite locations are presented together. Full survey results for all locations are included in **Appendix A.17.1**.

17.2.4.4 Survey Periods

The baseline survey was undertaken over the course of the following dates:

- 10 February 2016
- 11 February 2016
- 23 February 2016
- 24 February 2016
- 25 February 2016
- 14 March 2016
- 15 March 2016
- 16 March 2016
- 22 March 2016
- 19 April 2016
- 20 April 2016
- 22 April 2016
- 31 May 2016
- 01 June 2016
- 02 June 2016
- 10 - 15 August 2017

17.2.4.5 Personnel and Instrumentation

The baseline surveys were undertaken by Enfonic and AWN Consulting Ltd. This involved installing all noise monitoring equipment at the monitoring locations and conducting the attended surveys.

17.2.5 Impact Assessment Methodology

17.2.5.1 Operational Phase Impact Assessment Process

The impact assessment methodology used for this chapter is based on the guidance contained within the 2004 and 2014 TII noise guidance documents and the EPA Draft Guidelines on the information to be contained in environmental impact assessment reports (Draft August 2017). The following methodology has been undertaken in accordance with the relevant guidelines:

- Characterise the existing baseline noise environment through environmental noise surveys
- Develop a 3D noise model of the study area and calculate noise levels for a baseline model to calibrate the model output

- Calculate the traffic noise levels at the nearest noise sensitive locations which are affected by the operation of the proposed road development for the following scenarios:
    - Do-Minimum – Opening Year (i.e. proposed road development is not built)
    - Do-Something – Opening Year (i.e. the proposed road development is built)
    - Do-Minimum – Design Year
    - Do-Something – Design Year
- In the case of this proposed road development, the Opening Year assessed is 2024 and the Design Year is 2039
- Assess the calculated noise levels for each scenario at the assessment locations to determine if the three conditions for noise mitigation have been met (Refer to **Section 17.2.2**). The cumulative impact assessment is incorporated into the modelling scenarios for the various scenarios defined above
- Where the three conditions for noise mitigation have been met, a review of potential noise mitigation measures is conducted for each assessment location to reduce noise levels to within the design goal, where practicable
- Determine the residual noise impacts taking into account the proposed mitigation measures at the sensitive locations along the route of the proposed road development
- Characterise the residual noise impacts of the proposed road development through reference to relevant criteria
- Assess the likely potential construction noise and vibration impacts associated with the short-term construction phase

17.2.5.2 Construction Phase Impact Assessment

Assessment of potential impacts during the construction phase is limited to information available at EIAR stage. Whilst the phasing of works and location of activities and work sites have been progressed to detailed stages as part of the EIAR, the specifics in terms of plant items, plant numbers, their locations and operational duration will be subject to site conditions, work scheduling and contractor proposals. In this instance, it is not possible to perform detailed calculations or detailed impact assessment for any one area given the variations in the items above on a week to week or day to day basis. It is however possbile to determine noise levels from typical construction activities associated with the various phases.

The TII Guidelines spefically note that there is limited information available on specific construction methods, numbers and types of plant before the appointment of a Contractor, which will normally happen after a scheme has been approved. The guidelines note that it is more appropriate to address the way in which potential construction impacts will be assessed and how they will be managed, including forms of mitigation and codes of practices that will be applied.

The guidelines do note, however, that areas of major earthworks or blasting should be noted and locations where particularly noisy activities such as piling (depending on the method used), rock breaking, and or night-works are identified.

The TII guidelines note that in the absence of an Irish or international standard relevant to construction noise, reference can be made to BS 5228 -*:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 1 Noise* and Part 2 *Vibration.* This standard includes recommended methodologies for calculating construction noise levels and includes a range of best practice mitigation and management measures for the control of noise and vibration from construction sites.

In terms of calculation, this standard sets out sound power levels for a wide range of plant items normally encountered on construction sites, which in turn enables the prediction of indicative noise levels at distances from the works. The standard also includes empirical data on vibration levels measured at set distances from specific vibration generating activities in different ground and site conditions.

17.2.5.3 Operational Phase Impact Assessment

Noise Modelling

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 development and associated road traffic changes on the surrounding network. This section discusses the methodology behind the noise modelling process.

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 the UK's Department of Transport, Calculation of Road Traffic Noise (CRTN) 1988 and relevant TRL correction procedures for calculating L_{den}.

Predictor calculates 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 speed
- 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
- The hardness of the ground between the source and receiver

Prediction of Traffic Noise

Noise emissions during the operational phase of the proposed road development have been modelled using Predictor using the CRTN methodology and the TRL 'Method 1' calculation procedure to calculate L_{den} values, using hourly traffic flows. The CRTN method of predicting noise from a road development consists of the following five elements:

- Divide the proposed road development 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
- Combine the contributions from all segments to give the predicted noise level at the receiver location for the whole proposed road development

Note that all calculations are performed to one decimal place. For the purposes of comparison with the design goal of 60dB L_{den}, the relevant noise level is to be rounded to the nearest whole number in accordance with TII guidance.

Model Inputs

The noise model was prepared using the following data:

- 3D road alignment drawings of the proposed road development supplied by the design team
- 3D topographical contour data for the surrounding study area incorporating the noise sensitive assessment locations
- background ordnance survey mapping
- the Annual Average Daily Traffic (AADT), % Heavy Goods Vehicles (HGV's) and traffic speeds

Modelled traffic data for the 'Medium Growth' scenario has been used for the noise impact assessment. Where noise mitigation was identified as a requirement for specific locations, however, the effectiveness of the mitigation was also tested against the 'High Growth' traffic scenarios to ensure a robust analysis.

Traffic flow data was provided for the Do-Nothing and Do-Something scenarios for the Opening Year of 2024 and Design Year of 2039. (Refer to **Chapter 6, Traffic Assessment and Route Cross Section**, for traffic figures used in the modelling exercise).

A standard road surface type, such as hot rolled asphalt (HRA), has been assumed for all roads as part of the base model development.

Model Calibration and Validation

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. It 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 proposed road development 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 2016, with the measured L_{den} values at the unattended survey locations in the vicinity of the existing national road network. The reason for choosing those survey locations along the existing national road network for the purposes of calibration, is to ensure that the noise environment was dominated by road traffic noise during the survey period. Noise levels calculated at 9 unattended locations in proximity to existing roads are presented in **Table 17.4** and compared against those measured during the baseline noise surveys. The variation in calculated noise levels is between 0 and ±1dB L_{den} at the assessment locations and hence is considered a strong correlation. It should be noted that the model results reflect road traffic noise only whereby the baseline noise environment has other contributing sources from other local roads, environmental conditions (leaf rustle, bird song etc.) industrial, commercial and or residential type sources, where relevant.

The results of the calibration are presented in **Table 17.4**.

Table 17.4: Model Calibration

Survey Location	Incident to road	Measured L_{den}, dB	Model Predicted L_{den}, dB	Variation (dB)
R1c	R336 Bearna	65	64	1
R3a	Na Foraí Maola	45	44	1
R9c	N59 Moycullen Road	62	61	1
R11g	School Road	52	52	0
R12e	N83 Tuam Road	72	72	0
R13d	Monivea Road R339 East	62	62	0
R14a	N6 Bóthar na dTreabh	57	56	1
R14b	R446	64	65	-1
R17b	N84 Headford Road	56	56	0

Receiver Locations

Free-field traffic noise levels have been predicted at a number of properties in the vicinity of proposed and existing roads. For single storey properties, noise levels are calculated to a height of 1.5m above ground. For multiple storey properties, the calculated noise level is made at the height of the most exposed window (e.g. first, second or third floor).

A total of 270 noise sensitive buildings have been considered in this assessment. For certain properties, receiver locations have been positioned at two or more locations around the building to assess noise levels associated with different facades facing different noise sources thus resulting in a total of 299 modelled receiver locations. The properties were selected on the basis of proximity to the existing and proposed roads. The modelled locations represent the closest noise sensitive locations to the proposed road development and along sections of the existing road network where traffic volumes are modelled to change as a result of the proposed road development. Receptor locations were positioned at locations representing clusters or rows of properties where a number of noise sensitive buildings are in close proximity to each other.

The locations of all receptors are shown on **Figure 17.1.001** to **17.1.114**.

Model Output

The output of the model is a calculated traffic noise levels in terms of the L_{den} parameter at specific modelled receiver locations.

Four scenarios have been considered as follows:

- Year 2024 – Do-Minimum (i.e. proposed road development is not built)
- Year 2024 – Do-Something (i.e. proposed road development in place)
- Year 2039 – Do-Minimum
- Year 2039 – Do-Something

Criteria for Noise Mitigation

The calculated noise levels at each modelled location are reviewed and compared against the three criteria for noise mitigation set out in the TII noise guidance documents as included in **Section 17.2.2.2**.

Where modelled locations are determined to meet the three criteria, the use of noise mitigation has been recommended to reduce noise levels to within the relevant design criterion.

Evaluation of Potential Noise Impacts

There are no guidelines in Ireland for assigning significance criteria for new road developments. The TII Guidance for noise does not prescribe a methodology for evaluating the magnitude or significance of road traffic noise from a new road development. The use of an absolute criterion is used as a threshold value above which noise mitigation measures are to be provided, assuming the 3 conditions for noise mitigation are met. The 60dB L_{den} design goal takes into consideration the alignment of the majority of new national roads in Ireland across a range of different environments including rural, semi-rural, suburban and urban locations.

In order, therefore, to evaluate the potential significance of the noise levels associated with the operation of the proposed road development, consideration needs to be given to issues such as the absolute level of noise under consideration, the magnitude of change in noise levels at a given location and the receptor

sensitivity. Comment on potential night-time noise exposure should also be considered.

Magnitude of Change

In the absence of any Irish guidelines or standards relating to describing the effects associated with changes in road traffic noise levels, reference has been made to the UK's Design Manual for Roads and Bridges. Volume 11 Section 3 Part 7 (2011). This document provides suggested magnitude rating tables relating to changes in noise levels associated with road traffic noise. The document suggests that during the year of opening, the magnitude of impacts between the Do-Minimum and the Do-Something scenarios are likely to be greater compared to the longer term period when people become more habitualised to the source.

This document suggests that changes in noise levels between the Do-Minimum and Do-Something scenarios for the year of opening are compared and categorised in line with the 'short term' table reproduced in **Table 17.5**. Longer term impacts are assessed by comparing the Do Minimum noise level calculated for the opening year against the Do Something scenario for the design year (typically 15 years after opening) as reproduced in **Table 17.6**.

It should be noted the tables below relates to the $L_{A10,18hr}$[1] parameter as opposed to the L_{den} which is the assessment parameter for road traffic noise in Ireland.

Table 17.5: Classification of Magnitude of Noise Impacts in the Short Term

Noise Change, dB(A)	Magnitude of Impact
0	No Change
0.1-0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

Table 17.6: Classification of Magnitude of Noise Impacts in the Long Term

Noise Change, dB(A)	Magnitude of Impact
0	No Change
0.1 – 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10+	Major

Whilst the DMRB magnitude of change tables are a means of assigning an objective rating against a change in noise levels, it is important to note the following limitations of this approach:

[1] This parameter refers to the $L_{A10,18hr}$ parameter which is typically equivalent to L_{den} when free field conditions are considered. The $L_{A10,18hr}$ includes a façade correction which broadly equivalent to L_{den} (free field) plus 2.5dB.

- The DMRB notes the method used to assess magnitude of change significance is based on surveys conducted at sites where road traffic was the dominant noise source with noise exposure levels in the range of 65 to 78dB $L_{A10,18h}$, with the changes in traffic noise being up to 10dB $L_{A10,18h}$ at dwellings up to 18m from the roadside kerb. The document states that on this basis this method should be used with caution.
- Reliance on calculated 'Do Minimum' noise levels to represent noise levels in the absence of the proposed road development will result in artificially low base levels at some receptors, particularly in rural settings set back from modelled roads.
- Reference to the baseline measured noise levels is required to verify the pre-existing noise environment.
- Whilst a significance rating is applied to a change in noise level based on the above information, the absolute noise level is an important consideration when determining the response to noise levels from the population at large. This is particularly valid for locations where 'major' ratings are applied against comparably low absolute noise levels.

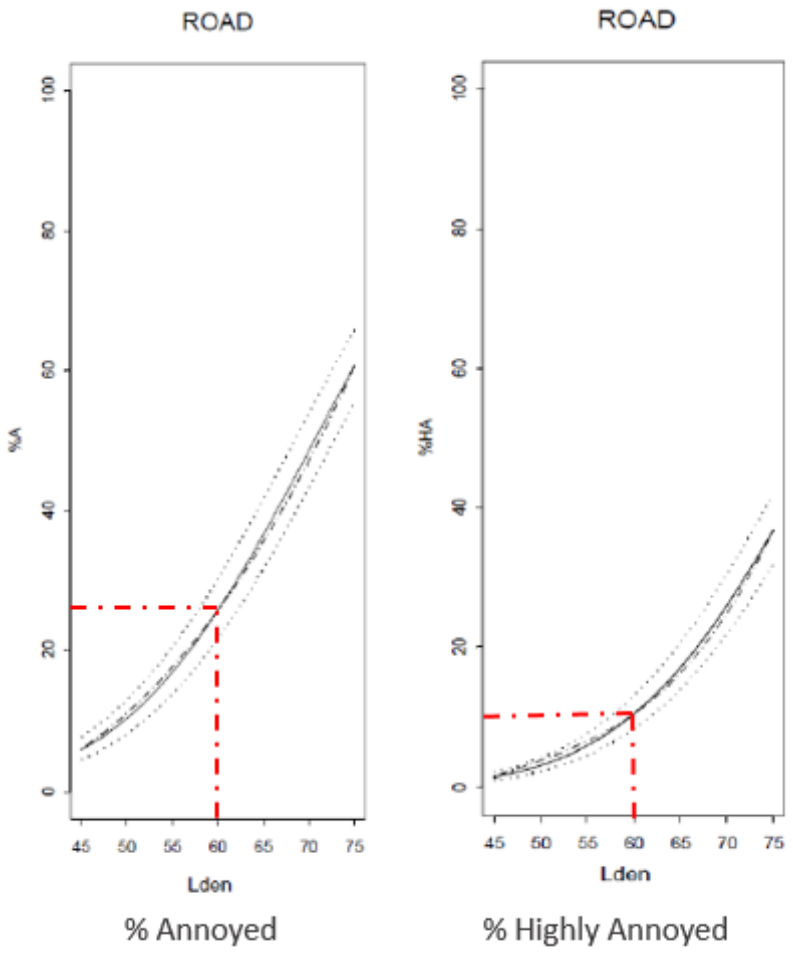
Commentary on Absolute Noise Level

The absolute noise level associated with the proposed road project is another important consideration when evaluating the impacts of the proposed road development. In instances where an increase of noise levels of +5dB(A) are calculated during the year of opening, resulting in a 'major' significance rating, for example, the actual level of traffic noise at the property may still be below a level considered to cause any significant effect.

In order to provide some context on the potential level of annoyance associated with road traffic noise, reference is made to the European Environmental Agency (EEA) publication 'Good Practice Guide on Noise Exposure and Potential Health Effects' (EEA Technical Report 11/2010). This document provides exposure-response relationships relating to different noise source types. Figure 3.1 of the document presents the percentage of the population defined as being 'annoyed' and 'highly annoyed' by road traffic noise based on European wide studies. The parameter referred to in the study is L_{den} which is directly comparable to the parameter assessed as part of this proposed road development.

The annoyance figure is reproduced in **Plate 17.1** with the 60dB L_{den} value illustrated against which the proposed road development has been assessed.

Plate 17.1: Percentage of People Annoyed by Road Traffic Noise



The figure indicates that at a road traffic noise level of 60dB L_{den}, 26% of the population have the potential to be 'annoyed' and 10% 'highly annoyed'. The report notes that for roads with quiet road surfaces, there is a decrease in reported annoyance response compared to those in the response curves.

Night-time Noise Levels

Noise levels relating to the proposed road development are assessed in terms of the L_{den} parameter which includes day, evening and night-time noise levels with the relevant penalties included for evening and night-time periods. The TII noise documents do not specify a separate design goal for night-time periods, however it is important to note that night-time noise levels are encompassed within the overall 60dB L_{den} deign goal.

The following relevant documents provide guidance on night-time noise levels:

- The Galway City and Galway Council Noise Action plans (2013 – 2018) sets night-time onset levels of 57dB L_{night} as a threshold for consideration for noise management.
- The WHO Night Noise Guidelines for Europe (NNG 2009) sets an Interim Target of 55dB L_{night}, outside.

- The DMRB notes that night-time road traffic noise levels below 55dB are not included in a relative change assessment as they fall below the WHO Night Noise Guidelines for Europe (NNG 2009) Interim Target of 55dB L_{night}, outside.
- The DMRB recommends that changes in noise levels are assessed for locations with a road traffic noise level in excess of 55dB L_{night}. At these locations, the magnitude of noise change is determined using the 'Long term' classification tables.

Receptor Sensitivity

Other considerations relating to the evaluation of impacts is the sensitivity of the receptor under consideration. The following sensitivity is proposed for the property types along the route of the proposed road development.

Table 17.7: Classification of Receptor Sensitivity to Noise

Sensitivity of Receptor	Description
High	Residential properties, hospitals, nursing homes, educational buildings (daytime)
Medium	Places of worship, community facilities, amenity areas
Low	Commercial and industrial premises

The noise sensitive receptors assessed along route of the proposed road development are predominately residential properties. There are two schools (St. James' National School, Bushypark and Castlegar School, on School Road) a nursing home on School Road and Galway Clinic along R446 Road, all of which are categorised as High Sensitive receptors.

One church (St. James' Church, Bushypark) is included in the assessment which is defined as a medium sensitive receptor. The community facilities and amenity areas of the NUIG Sporting Campus and Galway Racecourse are also included in the assessment and are considered to be of medium sensitivity. A small number of commercial premises are assessed along the N83 Tuam Road and Parkmore and Ballybrit area and are defined as being of low noise sensitivity. Vibration sensitive locations are addressed separately.

The above information will be used as a basis for evaluating potential noise impacts from the proposed road development.

17.3 Receiving Environment

The receiving environment for the proposed road development is a mixture of semi-rural and suburban lands on the fringes of Galway City. In the case of a road development, the selected noise-sensitive locations are those in closest proximity to the proposed road development and those along existing roads which are being traversed by the proposed road development. Both the construction and operational phases of the proposed road development are reviewed when selecting appropriate measurement locations.

17.3.1 Summary of Survey Results

A summary of the measured and derived L_{den} values for each monitoring location is presented in **Table 17.8** below. The baseline monitoring which are grouped in attended and unattended satellite locations are presented together for each area.

Full survey results for all attended and unattended survey locations, along with the derived L_{den} values, are presented in **Tables A.17.1.1** to **A.17.34** in **Appendix 17.1**.

Table 17.8: Summary of Baseline Survey Results

Location	Survey Type	Location	Calculated L_{den}	Location	Survey Type	Location	Calculated L_{den}
1c	Unattended	Along R336, Bearna	65	4a	Unattended	Troscaigh	43
1a	Attended		60	4b	Attended		47
1d	Attended		67	4c	Attended		48
1e	Attended		66	4d	Attended		43
1f	Unattended	Na Foraí Maola	47	4e	Attended		46
2d	Attended		48	4f	Attended		49
1b	Attended		44	5a	Unattended	Ballard West	50
2c	Attended		43	5b	Attended	Ballard West	49
2b	Attended		44	5c	Attended	Ballard West	46
2a	Unattended		43	5d	Unattended	Cappagh Road	52
2f	Attended		45	5e	Attended	Cappagh Road	48
3c	Attended	Na Foraí Maola	48	5f	Attended	Cappagh Road	52
3e	Attended		46	6a	Unattended	Ballyburke/Ballymoneen Road	43
3a	Unattended		45	6b	Attended	Ballyburke/Ballymoneen Road	45
2e	Attended		52	6c	Attended	Ballymoneen Road	64
3b	Attended		45	6d	Attended	Ballymoneen Road	53
3d	Attended		45	7b	Unattended	Árd na Gaoithe, Ballymoneen	44

Location	Survey Type	Location	Calculated L_{den}	Location	Survey Type	Location	Calculated L_{den}
3f	Attended		42				
7a	Unattended	Rahoon Road	46	9h	Unattended	Knockadoney	56
7c	Attended		57	9i	Attended	St James' Church/N59 Moycullen Road	58
7d	Attended		58	18f	Attended	N59 Moycullen Road	71
7e	Attended		51	18e	Attended	N59 Moycullen Road	68
7f	Attended		64	18b	Attended	N59 Moycullen Road	63
8a	Attended	Rosán Glas/N59 Link Road. Letteragh	45	18c	Attended	N59 Moycullen Road	66
8b	Attended		63	10a	Unattended	Aughnacurra	53
8c	Unattended	Letteragh Road	51	10h	Attended	Aughnacurra	51
8c	Attended		51	10b	Attended	NUIG Sporting Campus	52
8f	Attended		56	10c	Unattended	Dangan House	49
8d	Unattended	An Chloch Scoilte	50	10d	Unattended	Menlo/Coolough	51
8e	Attended		49	10e	Attended	Menlo/Coolough	47
8g	Unattended	Knocknabrona	47	10f	Attended	Menlo/Coolough	54
9a	Unattended	The Heath/Upper Dangan	54	10g	Attended	Coolough Road	63
9b	Unattended		47	11a	Unattended	N84 Headford Road	54
9d	Attended		58	11b	Attended		66
9e	Unattended		53	11c	Attended		78
9f	Attended		71	17b	Unattended		56

Location	Survey Type	Location	Calculated L_{den}	Location	Survey Type	Location	Calculated L_{den}
9c	Unattended	Upper Dangan/N59 Moycullen Rd	62	17a	Attended		77
9g	Attended	N59 Moycullen Road	64	13a	Unattended	Ballybrit, Racecourse Avenue	50
11d	Unattended	Bóthar an Chóiste/Castlegar	47	13b	Attended		57
11f	Attended	Bóthar an Chóiste/Castlegar	50	13c	Unattended	Ballybrit Crescent	57
11e	Attended	Bóthar an Chóiste/Castlegar	54	13d	Unattended	R339 Monivea Road East	62
12b	Attended	School Road-Castlegar	45	13e	Attended	Briarhill N6 Coolagh Junction	61
11g	Unattended	School Road - rear of house	52	13f	Attended		63
11h	Attended	School Road - front of house	56	13g	Attended		66
11i	Attended	School – Castlegar, front of building	63	13h	Unattended	Galway Racecourse, Ballybrit	53 - 63
12c	Attended	School Road South (close to road)	67	14a	Unattended	Coolagh, east of N6 Coolagh Junction	56
12a	Unattended	N83 Tuam Road Junction South	61	14c	Attended		50
12d	Attended		48	14e	Attended		48

Location	Survey Type	Location	Calculated L_{den}	Location	Survey Type	Location	Calculated L_{den}
12e	Unattended	N83 Tuam Road Junction North	72	14b	Unattended	R446 Doughiska - Galway Clinic	64
16a	Attended	N83 Tuam Road North	77	15a	Attended	N6 South of Ballybrit – The Meadows Estate, on green	54
16b	Attended	N83 Tuam Road North	65	15b	Attended	Along Monivea Road	72
16c	Attended	N83 Tuam Road North	68	15c	Attended	South of existing N6 on green	61

17.3.2 Discussion of Baseline Environment

The results of the baseline surveys indicate the range of noise levels measured across the extent of the study area.

17.3.2.1 R336 Coast Road to Cappagh Road (Ch. 0+000 – 4+450)

At the western end of the proposed road development at properties along the R336 Coast Road, noise levels are dominated by traffic flows along this road. Noise levels were measured in the range of 60 to 67dB $L_{den,}$ the main difference in the measured levels being the proximity to and line of sight from the road of the monitoring position.

Within Na Foraí Maola, residential properties are set back from heavily trafficked roads such as the R336 Bearna Road at distances of approximately 200m to 1km and are influenced predominately by local passing traffic, local activities within the residential areas and environmental sources including bird song, leaf rustle etc. Noise levels were measured in the range of 42 to 52dB L_{den} at the surveyed locations. The higher noise levels measured in this area were typically associated with intermittent local sources during the surveys, e.g. local deliveries to properties (post-delivery, oil deliveries, garden activities etc.).

Surveyed locations in the vicinity of Troscaigh and Ballard West were measured in the range of 43 to 50dB $L_{den..}$ Noise levels at the surveyed locations were noted to be influenced by passing traffic along the local roads in proximity to the monitoring positions in addition to local activities within gardens and bird song.

17.3.2.2 Cappagh Road to Rahoon Road (Ch. 4+450 – 6+650)

Noise monitoring locations within the gardens of properties in the vicinity of Cappagh Road, Ballymoneen Road and Árd Na Gaoithe in Ballymoneen set back from passing traffic were measured in the range of 43 to 45dB $L_{den.}$ Noise levels at property facades located along the Cappagh and Ballymoneen Roads, were of the order of 52 and 53dB L_{den}. The highest noise level measured in this area was at monitoring location 6c which was measured at the front gate of a property along the footpath which was dominated by passing traffic, an L_{den} noise level of 64dB was measured at this location.

Surveyed properties along the Rahoon Road were measured in the range of 46 to 64dB $L_{den.}$ At survey locations set back from the existing road and screened from passing road traffic by the property buildings, noise levels were measured in the range of 46 to 51dB L_{den}. At locations located in closer proximity to the existing road, noise levels were in the range of 57 to 64dB $L_{den,}$ the higher noise level being recorded at location 7f which was noted to be influenced by passing road traffic.

17.3.2.3 Rahoon Road to N59 Moycullen Road (Ch. 6+650 – 8+550)

Noise levels at two areas in the vicinity of Rosán Glas within Letteragh were surveyed. At survey location 8a an L_{den} value of 45dB(A) was derived. Noise levels at this location were influenced mainly by intermittent passing vehicles entering the estate along Bóthar Diarmuida and bird song. At location 8b passing traffic was noted to be significantly more frequent and the monitoring location closer to the road side. In addition, a greater level of local estate activities was noted resulting in noise levels of 63dB L_{den} being measured at this location.

Noise levels measured in the vicinity of Letteragh Road and Knocknabrona were measured 47 to 56dB L_{den} (survey locations 8c to 8g). Similar to the above areas, at survey locations set back from passing road traffic, lower noise levels were measured, typically in the range of 47 to 51dB L_{den} which were noted to be influenced by distant and intermittent passing traffic and bird song. The highest noise level of 56dB L_{den} was measured at location 8f due to the proximity and line of sight to passing road traffic.

In the vicinity of the proposed N59 Letteragh Junction and proposed River Corrib Bridge, noise levels varied at the surveyed locations depending on their distance to existing road traffic. At monitoring locations within The Heath and Knockadoney within Upper Dangan (9a, 9b & 9e), noise levels were measured in the range of 47 to 58dB L_{den}. At all locations road traffic from the N59 Moycullen Road and birdsong was noted to be the main noise sources noted. Higher noise levels were recorded at properties located closer to the N59 Moycullen Road (i.e. location 9d & 9c) measuring noise levels in the range of 58 to 62dB L_{den}.

Properties directly accessing the N59 Moycullen Road (9g, 9f, 18b, 18c, 18e and 18f) measured highest noise levels in this area, ranging between 63 to 71dB L_{den} depending on the proximity of the measurement position to the existing road.

17.3.2.4 N59 Moycullen Road to Menlough (Ch. 8+550 – 11+000)

In the vicinity of NUIG Sporting Campus and Aughnacurra (10a, 10b, 10c and 10h), measured noise levels were recorded in the range of 49 to 53dB L_{den} which were noted to be influenced predominately by distant road traffic, grounds works, birdsong and plant noise from an adjacent business campus. Similar noise levels were recorded in the vicinity of Menlough and Coolough (locations 10d, 10d and 10f) in were the range of 47 to 54dB L_{den} which were noted to be influenced by intermittent traffic, bird song, dog barking and leaf rustle. Higher noise levels were recorded at Location 10g (63dB L_{den}) due to the proximity of the monitoring location to the road.

17.3.2.5 Menlough to N83 Tuam Road (Ch. 11+000 – 14+450)

To the east of Coolough the proposed development passes through a more built up environment crossing a number of main routes into Galway City, namely the N84 Headford Road, N83 Tuam Road and existing N6.

In the vicinity of the N84 Headford Road and proposed new junction, noise levels were measured in the range of 54 to 77dB L_{den}. Noise levels of 54 and 56dB L_{den} were recorded at the unattended monitoring positions located to the rear and side of properties set back from the N84 Headford Road (locations 11a and 17b). Higher noise levels were measured to the front of properties facing directly into the existing road with survey locations 17a and 11c recording highest levels due to their close proximity to the existing road.

Within the area of Castlegar, noise levels were measured in the range of 45 to 54dB L_{den} which were noted to be influenced by road traffic from School Road, the N84 Headford Road and from passing local traffic. Properties located off School Road measured noise levels in the vicinity of 63 to 67dB L_{den} when measured at the property boundaries in close proximity to the existing road. At monitoring locations set back from the road edge, noise levels measured 56dB L_{den} (11g) and were lower again at the rear of properties along this road shielded by road traffic noise (11g), measuring 52dB L_{den}.

Noise surveys undertaken at properties in the vicinity of the proposed N83 Tuam Road Junction were predominately influenced by traffic along the N83 Tuam Road. Monitoring locations fronting properties along this existing road were in the range of 61 to 77dB L_{den} (locations 12a, 12e, 16a, 16b and 16c). Lowest noise levels in this area were recorded at location 12d (48dB L_{den}) which is set back from the N83 Tuam Road and was shielded from the road traffic by local topography.

17.3.2.6 N83 Tuam Road to Coolagh Junction (Ch. 14+450 - 17+500)

Noise surveys conducted in the area of Ballybrit and Briarhill ranged between 50 and 57dB L_{den} (locations 13a, 13b, and 13c). Higher noise levels were recorded at locations 13b and 13c due to their proximity to road traffic from Ballybrit Crescent and local passing traffic.

At surveyed locations along the R339 Monivea Road and the existing N6 in the vicinity of the Ballybrit and Doughiska (locations 13d, 13e, 13f, 13g, 14b), noise levels were measured in the range of 61 to 66dB L_{den} which were all influenced by passing road traffic.

Within Galway Racecourse, noise levels presented represent those when no race activity was taking place. This represents lowest noise levels in this area when the facility is typically not in use. Noise levels were measured in the range of 53 to 63dB L_{den} over a 5 day monitoring period.

To the east of the proposed Coolagh Junction within Coolagh (locations 14a, 14c and 14e), noise levels were measured in the range of 48 to 56dB $L_{den.}$ The dominant sources at these locations were noted to be road traffic and birdsong.

At survey locations along the R339 Monivea Road to the south of the existing N6 (locations 15a, 15b and 15c) noise levels were measured in the range of 54 to 72dB $L_{den.}$ Lowest noise levels were measured at location 15a which was positioned within a green area fronting houses within The Meadows Estate which was shielded from road traffic. Highest noise levels were recorded at locations 15b due high volumes of traffic passing along the R339 Monivea Road in addition to the existing N6.

17.3.3 Summary of Noise Survey Results

The results of the baseline noise survey indicate that the noise environment varies across the proposed road development depending on the surrounding noise sources. In general, properties facing directly onto existing roads are dominated by road traffic and experience noise levels in excess of 60dB L_{den}. Properties in more rural settings set back from road traffic experience noise levels typically in the range of 42 to 50dB L_{den} depending on local sources in the vicinity.

The range of noise levels measured during the baseline surveys are an accurate representation of the baseline noise environment at properties likely to be affected by the proposed road development.

17.4 Characteristics of the Proposed Road Development

17.4.1 Construction Phase

The construction phase of the proposed road development will involve predominately ground breaking, earthworks and earthworks haulage, drainage works, construction of drainage ponds and surfacing works, construction of tunnels, bridges and overpasses, as well as the movement of machinery and materials within and to and from the construction compounds and along local roads.

A variety of items of plant will be in use during these construction works all of which have the potential to generate high levels of noise and potential levels of perceptible vibration. These will include breakers, rock drills, excavators, dump trucks, and generators in addition to general road surfacing and levelling equipment.

Blasting of bedrock will also be required on certain sections of the proposed road development depending on the ground conditions and the required depth of excavations. **Chapter 7, Construction Activities** provides a full description of the proposed construction phasing and works for the proposed road development.

It is envisaged that an east to west build will be adopted and construction may be completed in two concurrent phases or a single overall contract:

- Phase 1 – N6 Coolagh to N59 Letteragh Junction – 9.9km (Including the N59 Link Road North and South.)
- Phase 2 – N59 Letteragh Junction to R336 Coast Road west of Bearna -7.5km

In general, road building works by their nature are transient in nature as the works progress along the length of the route of the proposed road development. This includes excavation and fill works, structures, and road completion works. Site compounds in phases 1 and 2 will be set up typically at the commencement of the works and remain in place until all construction in the area is completed.

Within each phase, it is likely that the main construction work for the proposed road development will be split up into different sections along the route of the proposed road development. For the purposes of the EIAR, 15 individual construction sections are set out. Sections may be completed simultaneously and combined in certain areas. **Table 7.1** in **Chapter 7, Construction Activities** includes a summary of each section with the estimated time for the completion of works in these areas.

Typical working hours during the construction phase will be:

- 0700 1900 Monday – Friday
- 0700 1600 Saturday

It will be necessary to work overtime (including weekends) and night shifts at certain critical stages during the project. There may be some periods where 24hr work and supervision is required. Over the expected 36 month construction phase there will be up to 10 weeks of night time working along different sections of the proposed road development primarily to facilitate bridge works over existing roads.

The potential noise and vibration impacts associated with this phase are set out within **Section 17.5.3**.

17.4.2 Operational Phase

The operational phase will involve a new road alignment, junctions, overpasses, tunnels and bridges as part of the proposed road development. The proposed road development will introduce traffic noise to areas which are not currently exposed to any significant level of road traffic, particularly at properties set back from existing local roads in rural settings. The character of the noise environment will be altered at properties where intermittent traffic forms part of the noise environment to a more continual source of noise as a result of the operational phase. In addition to the above, the proposed road development will divert traffic flows from sections of existing roads across the city and hence, will result in a reduction in traffic noise along sections of these roads once operational.

The operational phase will be of long term duration and will alter the existing noise environment at properties in proximity to the proposed road development and along existing roads to different extents.

The potential impacts associated with this phase are set out within **Section 17.5.4**.

17.5 Evaluation of Impacts

17.5.1 Introduction

The potential impacts of noise and vibration as a result of the proposed road development will vary depending on the proximity of sensitive locations to the proposed road development, the pre-existing noise levels in the area and the duration of the impacts considered. It is estimated that the overall construction period will last for approximately 36 months. During the construction phase, potential noise and vibration impacts will be more significant compared to the operational phase but the duration will be short-term in nature. The operational phase will result in long-term effects but the significance of which will vary depending on the sensitivity of the existing environment and the magnitude of change against the Do-Minimum scenario, and the absolute noise levels under consideration.

17.5.2 Do-Nothing Impact

The Do-Nothing impact of the proposed road development assumes the proposed road development is not built and traffic management plans within the Galway city area are not in place. In line with traffic growth factors, traffic volumes will continue to increase along the existing routes accessing Galway City as part of the Do-Nothing Scenario. From a noise point of view, this will result in increased noise levels over and above the current scenario at properties located along the main national and regional roads. At properties set back from trafficked roads, noise levels measured as part of the baseline survey are expected to remain broadly similar. Noise levels at properties identified as 'hot spots' and areas for noise management within the Galway City Noise Action Plan (2013 – 2018) will remain above the threshold noise levels for noise management and are likely to be further increased as a result of increased traffic volumes.

17.5.3 Potential Construction Impacts

17.5.3.1 Noise

As per TII guidance, indicative ranges of noise levels associated with construction may be calculated in accordance with the methodology set out in *BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise*. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels. However, it is not possible to conduct detailed accurate prediction calculations for the construction phase of a project in support of the EIAR due to the limitations previously discussed in **Section 17.2.5**. The following section discusses typical noise levels associated with road construction activities and comments on potential noise impacts across the proposed road development.

Intrusive Works and High Noise Activities

Reference to BS 5288:2009+A1 2014: Part 1 indicates that highest noise levels are associated with activities associated with rock breaking, rock drilling, rock crushing and some impact piling works. Noise levels from these activity types are typically in the range of 85 to 95dB L_{Aeq} at 10m. All of the above activities will be required as part of the construction of the proposed road development.

For construction activities associated with rock extraction and processing a total construction noise level of 93dB L_{Aeq}, at 10m has been used for the purposes of indicative calculations. This would involve for example, 1 item of plant at 90dB L_{Aeq} and 3 items of plant at 85dB L_{Aeq} operating simultaneously within one work area which is considered a worst-case scenario.

Utilities, Bulk Excavation, Bridge Works & Road Works

For construction works associated with activities such as site clearance, excavation and fill, bridge works etc. including excavators, loaders, dozers, cranes, generators, concreting works etc. noise levels are typically in the range of 70 to 80dB L_{Aeq} at 10m.

For ongoing construction activity associated with the above activities, a total construction noise level of 85dB L_{Aeq} at 10m has been used for the purposes of indicative calculations. This would include, for example two items of plant at 80dB L_{Aeq} and three items of plant at 75dB L_{Aeq} operating simultaneously within one work area.

Compounds and Lower Noise Activities

For construction work areas with lower noise levels such as site compounds (for storage, offices and material handling, generators etc.), smaller items of mobile plant (excavators, cranes, dozers), landscaping and concreting works with lower noise emissions, a total construction noise level of 78dB L_{Aeq} at 10m has been used for the purposes of indicative calculations. This would include, for example one item of plant at 75dB L_{Aeq} and three items of plant at 70dB L_{Aeq} operating simultaneously within a work area.

Given the variations of on-site activities and noise levels over any one day and considering that all activities will not operate simultaneously, the values noted above are considered robust for the purposes of assessing potential construction impacts.

The closest properties to the proposed road development which are not being acquired or demolished are at distances of approximately 20m. Remaining properties are located at distances of 50 to >300m from different work phases.

Table 17.9 presents the calculated noise levels at distances between 20 and 250m representing the closest noise sensitive properties to the construction works. The calculations assume that plant items are operating for 66%[2] of the time and do not

[2] This estimate that assumes that the plant will operate a full 8-hour shift over the proposed 12 hour working period which equates to a 66% on time over a daytime period or 40 minutes over a 1-hour period. The dynamic nature of construction sites is such that this is deemed to be a conservative estimate, particularly for breaking and drilling work.

include any attenuation from screening of site hoarding, road cuttings, buildings or structures, hence relate only to distance attenuation over hard ground.

Table 17.9: Indicative construction noise calculations at varying distances

Construction Activities	Combined LAeq at 10m	Calculated Noise Level at Increasing Distances					
		20m	50m	80m	100m	150m	250m
Rock Breaking / Drilling / Rock Crushing / Impact Piling	93	85	77	73	71	68	63
Site Clearance Utilities Excavation & fill Structures Road Works	85	77	69	65	63	60	55
General site work	77	69	62	57	55	52	48

The reference values outlined in **Table 17.9** indicate that for construction activities with highest noise levels (L_{Aeq} up to 93dB at 10m), the daytime construction noise limit value of 70dB L_{Aeq} Monday through Friday (07:00 to 19:00hrs) is likely to be exceeded at distances of up to 100m from the works boundary in the absence of any noise mitigation. Evening and weekend construction noise limits would be exceeded at distances up to 250m in the absence of noise mitigation. Noise mitigation will therefore be required to reduce construction noise levels from this type of activity during all periods at the closest properties.

During normal road construction works including site clearance, bulk excavation, structures etc. with site works up to 85dB L_{Aeq} at 10m, the daytime construction noise limit value of 70dB L_{Aeq} Monday through Friday (07:00 to 19:00hrs) is likely to be exceeded at distances of up to 50m from the works boundary in the absence of any noise mitigation. Evening and weekend construction noise limits would be exceeded at distances up to 150m in the absence of any mitigation. Noise mitigation will therefore be required to reduce construction noise levels from this type of activity, particularly during any scheduled evening and weekend works.

During general site work with lower noise emissions (L_{Aeq} up to 77dB at 10m) the daytime construction noise limit value of 70dB L_{Aeq} Monday through Friday (07:00 to 19:00hrs) can be complied with at distances of 20m and beyond. Evening and weekend construction noise limits would be exceeded at distances up to 80m in the absence of any mitigation. Noise mitigation will therefore be required to reduce construction noise levels from this type of activity, specifically during any scheduled evening and weekend works.

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

measures will be used as part of the construction works. Further details are set out in **Section 17.6.1**.

In line with the TII Guidelines on assessment of construction noise impacts, areas of major earthworks, blasting and piling (depending on the method to be used) should be identified. In addition, given two tunnel sections form part of the proposed road development, discussion of these areas should be included also. These are discussed in turn below.

Major Earthworks

Areas of major earthworks are associated with large cuttings and embankment constructions involving activities including excavation works, drill and blast techniques, rock crushing and fill works.

Moving west to east, construction of the mainline of the proposed road development below the Aille Road L5384 (Construction Section S2) will require a substantial amount of material excavation most likely using drill and blast techniques. Given the extent of the work in this area, it is likely that excavated material will be segregated, graded and crushed using mobile plant items within the excavated area. The closest properties to these works are some 120m from the earthworks boundary. During the early stages of construction in this area, there is potential for construction noise levels to exceed the noise criteria in the absence of any noise mitigation assuming rock drilling, crushing and a number of mobile plant items are operating at existing ground level. As the excavation works progress, the lowered ground level and screening from the cutting will significantly reduce noise levels at the closest properties.

Construction of the Letteragh Junction and approach roads (Construction Section S3 and S4) will require a substantial volume of engineering fill and an element of cutting for slip roads. Closest noise sensitive locations are between 50m and 60m from these junction works. In the absence of specific noise mitigation measures, there is potential for evening and weekend construction noise criteria to be marginally exceeded, should works occur during these time periods.

Construction of the N59 Link Road North (Construction Section S5) involves deep excavation towards the N59 Moycullen Road tie in, therefore a substantial volume of soil and rock excavation will be required which will likely require drill and blasting excavation. Closest noise sensitive locations are approximately 50 from the excavation works. In the absence of specific noise mitigation measures, it is likely that construction noise limits during, day, evening and weekend periods will be exceeded, specifically during the intermittent use of high noise activities (rock drilling, crushing and breaking, if required). The use of specific noise mitigation measures will be applied in this area therefore including scheduling of works, choice of plant, screening etc. Further discussion on mitigation measures are discussed in **Section 17.6.1**.

Construction of the N59 Letteragh Junction (Construction Section S6) involves an extensive area of cuttings which will likely require drill and blast excavation. Closest noise sensitive locations are approximately 25m from the excavation works. Whilst excavation works will take place within the cutting area, it is likely that crushing and regrading works will take place within a specific site compound

located along the N59 link Road North, set back from noise sensitive properties. Notwithstanding the above, given the close distances of excavation works to noise sensitive properties, the use of controlled noise mitigation measures will be required in this area to reduce construction noise levels at the nearest noise sensitive locations.

Construction Section S10 involves construction of a large embankment connecting to the Menlough Viaduct. Moving east, construction of the dual carriageway will involve a deep cutting as it approaches the Lackagh Tunnel. The closest noise sensitive properties in this area are approximately 40m from the embankment works but are over 300m from the excavation works for the cutting. In the absence of specific noise mitigation measures, there is potential for evening and weekend construction noise criteria to be marginally exceeded, should works occur during these time periods.

Construction of the Lackagh Tunnel (Construction Section S11) will be undertaken in an east to west direction using drill and blast techniques. The tunnel portal and main works area will be within the Lackagh Quarry site compound. The closest noise sensitive properties to the tunnel are over 500m and hence are well set back from the main excavation works in this area. Further comment on Lackagh Quarry site compound is discussed separately in the following Section.

Construction of the N84 Headford Road Junction and the cutting on the eastern side of Lackagh Quarry (Construction Section S12) will involve substantial earthworks for both cutting and embankment construction. There will be a large cutting into the eastern face of Lackagh Quarry within the eastern end of this Section which is located some 300m from the nearest noise sensitive locations. Construction of the N84 Headford Road Junction will involve extensive engineered fill works to cross the existing N84 Headford Road with an element of cutting required for slip roads. The closest noise sensitive locations are within 40 to 50m from these works and hence there is potential for construction noise levels to exceed daytime, evening and weekend construction noise criteria in the absence of noise mitigation measures.

Construction Section S13 between School Road to Galway Racecourse Tunnel will involve a large number of major earthworks including a large cutting east of School Road and a grade separated junction at the N83 Tuam Road involving engineered embankments to cross the existing N83 Tuam Road. Moving east, the mainline will cut into a hill as far as the portal of the proposed Galway Racecourse Tunnel, thus requiring extensive excavation in this area. Drill and blast will be required for the main excavated sections in these areas. The closest noise sensitive locations to the excavation works west of School Road are between 30 and 50m thus the construction noise criteria for day, evening and weekend periods are likely to be exceeded in the absence of mitigation measures during specific excavation works. Further discussion on mitigation measures are discussed in **Section 17.6.1**.

Construction Section S14 involves the construction of the Galway Racecourse Tunnel using cut and cover techniques. Excavation will likely involve drill and blast to remove the shallow rock head in this area. The works will be scheduled in consultation with Galway Racecourse to minimise the disruption to the commercial practice of the business throughout the year. The construction works will be phased

and will cease for the racing period. The closest noise sensitive locations to the tunnel works are typically 90 to 100m at commercial premises to the north and residential properties to the southeast. During short term periods of high noise activities (drill and blast, rock crushing etc.) there is potential for the construction noise criteria to be exceeded in the absence of mitigation. During the main construction of the tunnel structure and ancillary elements, construction noise levels will be further reduced.

The construction Section S15 between Galway Racecourse Tunnel and Coolagh Junction will involve excavation works to the east of the tunnel portal and the connection with the existing N6/M6 at Coolagh. Drill and blast excavation is possible at these locations due to the presence of shallow rock. There is a large amount of engineering fill required in this section due to the proposed overbridges and raised junction at Coolagh which will require a large amount of earthworks mobile plant and machinery. The closest noise sensitive locations to large excavation works are at distances of approximately 90m. There is potential for exceedance of the construction noise criteria during day, evening or weekend periods in the absence of noise mitigation at these properties. The closest noise sensitive locations to the Coolagh Junction are between 80 and 100m. It is possible to work within the construction noise criteria at these distances from the main engineering fill works, depending on the activities involved.

Structures

Construction of various bridge structures over and under existing roads, the Menlo Viaduct, River Corrib Bridge Crossing, Lackagh and Galway Racecourse Tunnel Structures will involve standard construction techniques which will likely involve piling (type and method dependent on ground conditions), engineered fill structures, lifting equipment etc. Daytime construction noise limits can typically be complied with at distances of 50m and beyond from these works.

Temporary night-time closure of existing roads will be required where overbridges are to be constructed at locations such as the Rahoon Road, Letteragh Road, N59 Moycullen Road, Menlo Castle Bóthrín, Bóthar Nua, An Seanbóthar, N84 Headford Road, N83 Tuam Road, Briarhill Business Park Road and R339 Monivea Road. This is required to avoid road closure during day time periods to facilitate lifting beams into place and other key works. Heavy or noisy construction activities will be avoided outside normal hours and the amount of work outside normal hours will be strictly controlled.

Noise levels associated with night-time works will tyically involve lifting equipment for beam construction. There is potential for the use of generators to power temporary lighting and other small items of mobile plant. Noise levels will be strictly controlled during these phases to ensure noisy items of plant are sited away from noise sensitive properties (e.g. generators), are enclosed or screened. Specific noise limits for night-time works will be set taking into account the pre-existing noise environment as per **Table 17.2**. These limits are site specific, hence will be fully reviewed prior to commencement of any night works and specific noise control measures put in palce. Best practice control meaures that will form part of the noise mitigation are included in **Section 17.6.1**.

Site Compounds

There are twelve sites identified as potential site compounds across the proposed road development. The siting of compounds has been chosen based on proximity to major works, proximity to residential properties and other environmental constraints. The site compounds are listed in **Table 17.10** with approximate distance to nearest noise sensitive locations and general comments on potential noise impacts included.

Table 17.10: Site Compound Potential Noise Impacts

Site No.	Location	Main Construction Activities	Closest Noise Sensitive Locations (m)	Potential Impacts
SC 00/01	R336 Baile Nua	Western tie-in for proposed road development	10	Potential exceedance of construction noise criteria to east of compound. Boundary screening, working hours, site layout planning to be undertaken prior to commencement of works
SC 04/01	Aille	Aille Cutting, Rock Crushing Plant	320	No significant impacts expected due to distances to NSL's. Assessment of rock crushing noise impacts required prior to commencement
SC 05/01	Ballymoneen	Aille Cutting, Letteragh and Rahoon Road Overbridge	50 – 100	Potential exceedance of construction noise criteria to southeast of compound, depending on siting of on-site activities. Boundary screening to south/ south east and site layout planning will be undertaken
SC 07/01	Letteragh	Major cut at Letteragh for GSJ and River Corrib Bridge (western section) Rock Crushing & Regrading Plant	400	Impacts can be well controlled through siting high noise activities away from noise sensitive boundaries
SC 08/01	Dangan (Aughnacurra)	River Corrib Bridge (western section). Used for storage only.	10 – 20	Storage only. No significant activities on site. No significant impacts expected
SC 09/01	Menlough (East of River Corrib)	River Corrib Bridge (eastern section) & Menlough Viaduct	400	No significant impacts expected due to distances to noise sensitive locations
SC 11/01	Lackagh Quarry	Lackagh Tunnel and potential for concrete batching plant, crushing and regrading of material.	100 – 200	Impacts can be well controlled through siting high noise activities away from noise sensitive boundaries, site orientation and use of quarry face for noise screening

Site No.	Location	Main Construction Activities	Closest Noise Sensitive Locations (m)	Potential Impacts
SC 14/01	Twomileditch (N83 Tuam Road Junction)	N83 Tuam Road Junction and Parkmore Link Road - Rock Crushing Plant	40 – 50	Potential exceedance of construction noise criteria at closet boundaries. Boundary screening to west and site layout planning will be undertaken
SC 14/02	Twomileditch (N83 Tuam Road Junction)	N83 Tuam Road Junction and Parkmore Link Road	200	No significant impacts. Boundary screening and site layout where necessary following assessment prior to commencement
SC 14/03	Twomileditch (N83 Tuam Road Junction)	N83 Tuam Road Junction and Parkmore Link Road	250	No significant impacts. Boundary screening and site layout where necessary following assessment prior to commencement
SC 14/04	Galway Racecourse Tunnel Western Portal	Galway Racecourse Tunnel (western section)	240	No significant impacts. Boundary screening and site layout where necessary following assessment prior to commencement
SC 15/01	Coolagh/Briarhill	Galway Racecourse Tunnel (eastern section)	30	Potential exceedance of construction noise criteria at closet boundaries. Boundary screening to north and east and siting of noisy activities away from noise sensitive boundaries will be undertaken
SC 16/01	Coolagh	Coolagh Junction	90	Potential exceedance of construction noise criteria at closet boundaries Boundary screening to north and east and site layout where necessary following assessment prior to commencement

The site compounds across the site are largely set back from noise sensitive properties and the noise emissions from these areas can be largely controlled through the use of boundary screening and site layout planning, as required. The largest site compound will be located at Lackagh Quarry which will be in use for the full extent of the construction of the proposed road development. This compound will be the main portal for the Lackagh Tunnel and will likely include a concrete batching plant, mobile rock crushing and rock grading equipment. All of the above have the potential to generate high levels of noise, however, given the large extent of the compound (9ha approximately), there is ample opportunity to sufficiently locate activities with high noise levels away from noise sensitive boundaries. In addition, the existing quarry profile will provide substantial screening to noise sensitive properties beyond.

Other site compounds where rock crushing activities are likely are well set back from noise sensitive locations and noise levels from this activity is not expected to generate noise levels in exceedance of the construction noise criteria. There is potential for rock crushing plant to be positioned within Site Compound SC 14/01

at the N83 Tuam Road Junction where noise sensitive properties are at distances of approximately 40m across the N83 Tuam Road. The location of rock processing equipment can be sited at distances further into the compound to reduce noise emission from this activity.

Overall, the potential impacts during the construction phase will be moderate to very significant and short term in the absence of noise mitigation. A range of control measures will be required at specific working areas to suitably reduce noise impacts at noise sensitive locations.

Emergency Work

Emergency work 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.

17.5.3.2 Construction Traffic

In addition to direct impacts from the construction works including site compounds, there is also the potential for noise impacts from construction traffic along public roads.

A detailed analysis of construction traffic volumes has been conducted to determine the expected lorry movements required to transport the materials extracted and delivered to site. A total of 16 public roads has been identified as required haul routes where construction traffic will be permitted to travel along. Whilst the overall construction period is forecast as three years, construction traffic movements are split over a 12 month period along haul roads accessing specific work zones and a two-year period for national and regional roads serving multiple work zones to allow for a robust assessment to be made.

Traffic volumes for the base scenario are based on the 2024 Do Minimum flows projected along the local road network. These are AADT flows with percentage HGV's. The additional HGV and LGV flows per day associated with construction traffic along each road including construction staff vehicles, deliveries and earthworks material haulage are added to the base traffic volumes. The estimated construction traffic volumes incorporate a series of worst case assumptions including concentrated construction periods at working areas and assumes that no delivery of materials will occur along the corridor of the proposed road development which is highly worst case. In reality the proposed road development will be constructed in phases and the corridor of the proposed road development will be used for a large bulk of construction delivery vehicles along its route.

In order to determine the potential noise impacts associated with additional construction traffic on the identified haul routes, a comparison between traffic noise levels during for the base (Do Minimum) scenario and the Do Something (base plus construction) scenario were determined.

Noise levels associated with passing event such as road traffic may be expressed in terms of its Sound Exposure Level (L_{AX}). The Sound Exposure Level can be used

to calculate the contribution of an event or series of events to the overall noise level in a given period using the following formulae:

$L_{Aeq,T} = L_{AX} + 10\log10(N) – 10\log10(T)$ dB

where:
$L_{Aeq,T}$ is the equivalent continuous sound level over the time period T (in seconds)
L_{AX} is the "A-weighted" Sound Exposure Level of the event considered (dB)
N is the number of events over the course of time period T

The mean value of Sound Exposure Level for truck moving at low to moderate speeds is in the order of 82dB L_{AX} at a distance of 10 metres from the vehicle. The mean value of Sound Exposure Level for car or light good vehicle passing at low to moderate speeds is in the order of 68dB L_{AX} at a distance of 10 metres from the vehicle.

Noise levels associated with additional construction traffic volumes are calculated over a 12hr period, relating to the typical construction working day (i.e. 07:00 to 19:00hrs). The combined value represents the total noise level over a daily (24hr) period.

Table 17.11 presents a summary of the construction traffic noise assessment. Traffic noise levels at a distance of 10m from the haul roads is calculated for the base (Do-Minimum) scenario and the Do-Something (base plus construction) scenario. The increase in noise levels between both scenarios is also presented.

Reference to **Table 17.11** overleaf confirms the increase in noise level along the majority of the haul routes is negligible (<1dB) due to the existing volume of traffic along these roads and the relatively low additional HGV and LGV traffic per day forecast. The greatest increase in noise levels is calculated along the Bearna to Moycullen Road (L1321) in Zone 1, the Cappagh Road in Zone 2 and along Bóthar Nua in Zone 4.

Along the Bearna to Moycullen Road (L1321), existing traffic volumes are moderate with an associated low number of HGV's. Noise levels are calculated to increase by the order of 3dB over a concentrated worst case 12-month period assuming an additional 20 HGV and 374 LGV movements per day along this road. Reference to **Table 17.5** (classifications of Magnitude of Noise Impacts in the Short Term) defines an increase of this magnitude to be 'moderate'. Whilst a perceptible change in noise level is calculated, the overall noise level along this road is of low to moderate level, calculated at 56dB $L_{Aeq, T}$ at 10m from the road edge. Considering the above, the overall impact is deemed to be moderate, short-term.

Along the Cappagh Road, existing traffic volumes are low with an associated low number of HGV's. Noise levels are calculated to increase by the order of 8dB over a concentrated worst case 12-month period assuming an additional 29 HGV and 370 LGV movements per day along this road. Reference to **Table 17.5** (classifications of Magnitude of Noise Impacts in the Short Term) defines an increase of this magnitude to be 'major'. Whilst a perceptible change in noise level is calculated, the overall noise level along this road will remain low to moderate, at

55dB $L_{Aeq, T}$ at 10m from the road edge. Considering the above, the overall impact is deemed to be moderate, short-term.

Along Bóthar Nua, existing traffic volumes are moderate and baseline noise levels are calculated as 55dB $L_{Aeq, T}$ at 10m from the existing road edge. Noise levels are calculated to increase by the order of 7dB over a concentrated worst case 12-month period assuming an additional 154 HGV and 177 LGV movements per day along this road. Reference to **Table 17.5** defines an increase of this magnitude to be 'major'. Whilst a perceptible change in noise level is calculated, the overall noise level along this road are calculated as 62dB $L_{Aeq,T}$ at 10m from the existing road edge. Considering the above, the overall impact is deemed to be major, short-term.

Table 17.11: Construction Traffic Noise Assessment

Section	Road Link	Do Minimum		Do Something (Construction)		Calculated Change in Noise Levels, dB
		Total Vehicles (AADT)	Do Minimum Noise Level at 10m, dB	Additional Construction (AADT)	Cumulative Noise Level at 10m, dB	
Zone 1	R336	14,550	63	394	64	+0.4
Zone 1	Bearna to Moycullen Road - L1321Road	1,841	52	394	56	+3.4
Zone 2	Cappagh Road	494	47	399	55	+8.4
Zone 2	Seamus Quirke Road	13,789	64	396	65	+0.4
Zone 2	Kingston Road. Kingston	11,278	63	396	63	+0.5
Zone 3	N59 at Hazel Park	6,343	59	119	60	+0.8
Zone 3	N59 at Chestnut Lane	16,596	64	119	64	+0.3
Summary of West	Quincentenary Bridge	33,491	69	486	69	+0.2
Zone 4	Bóthar Nua	3,344	55	330	62	+6.8
Zone 5	N84 Headford Road at Ballinfoyle	12,819	64	174	65	+0.4
Zone 5	N83 Tuam Road at City North Business Park	17,250	66	174	66	+0.3

Section	Road Link	Do Minimum		Do Something (Construction)		Calculated Change in Noise Levels, dB
		Total Vehicles (AADT)	Do Minimum Noise Level at 10m, dB	Additional Construction (AADT)	Cumulative Noise Level at 10m, dB	
Zone 5	N6 Bóthar na dTreabh between N83 Tuam Road Junction and Morris Junction	25,721	68	825	68	+0.8
Zone 5	N6 Bóthar na dTreabh between N84 Headford Road Junction and N83 Tuam Road Junction	20,019	66	810	67	+1.0
Zone 6	Parkmore Link Road at Business Park Junction 2	3,567	60	264	62	+2.0
Zone 6	N6 Bóthar na dTreabh between Morris Junction and Lynch Junction	24,446	68	957	69	+0.8
Zone 7	N6 Bóthar na dTreabh at Ardaun	19,223	68	1,025	69	+0.9

17.5.3.3 Vibration

The potential for elevated levels of vibration at sensitive locations during construction is typically associated with excavation works, rock-breaking and blasting operations. Depending on the method and equipment used, there is potential for some vibration relating to piling operations, demolition works and lorry movements on uneven road surfaces. The more significant of these relates to vibration from excavation and rock-breaking operations.

In terms of piling, low vibration methods involving bored or augured piles will be selected over and above percussive type piling, where ground conditions permit. This piling method significantly minimises the levels of both noise and vibration generated as it is a non-percussive piling technique.

For the purposes of this assessment, however, vibration levels associated with driven piles are assessed in order to determine potential worst case impacts. British Standard BS 5228 *2 :2009+A1:2014: Vibration*, includes measured magnitude of vibration associated with different piling types. **Table 17.12** reproduces those associated with steel sheet piling.

Table 17.12: Vibration Magnitudes associated with Sheet Steel Piling

Soil Conditions	Pile Dimensions	Distance, m	PPV, mm/s
Very soft to soft (0 – 10m), soft to medium clay (10 – 20m)	U-shaped LX 16 sheet piles	4.8 – 24	4.3 – 0.5
(not provided)	U-shaped piles	7.1	0.3 – 0.7
Made ground 0 – 3m, loose and very dense sand and silt 3 – 17m, firm to stiff clay 17 – 25m	244mm diameter driven tubular steel piles	5 – 20	13.9 – 4.3
Made ground 0 – 3m, loose and very dense sand and silt 3 – 17m, firm to stiff clay 17 – 25m	275mm driven square piles	5 – 20	11.4 – 4.3

The vibration magnitudes outlined in **Table 17.12** indicate that at distances beyond 20m, vibration magnitudes are significantly reduced to well below those associated with any form of cosmetic damage to buildings.

During rock breaking, there is also potential for vibration to be generated through the ground. Empirical data for this activity is not provided in the BS 5228-*2:2009+A1:2014* standard, however the likely levels of vibration from this activity is expected to be significantly below the vibration criteria for building damage on experience from other sites. AWN Consulting have previously conducted vibration measurements under controlled conditions, during trial construction works, on a sample site where concrete slab breaking was carried out. The trial construction works consisted of the use of the following plant and equipment when measured at various distances:

- 3 tonne hydraulic breaker on small CAT tracked excavator
- 6 tonne hydraulic breaker on large Liebherr tracked excavator

Vibration measurements were conducted during various staged activities and at various distances.

Peak vibration levels during staged activities using the 3 Tonne Breaker ranged from 0.48 to 0.25 PPV (mm/s) at distances of 10 to 50m respectively from the breaking activities. Using a 6 Tonne Breaker, measured vibration levels ranged between 1.49 to 0.24 PPV (mm/s) at distances of 10 to 50m respectively.

Whilst these measurements relate to a solid concrete slab, the range of values recorded provides some context in relation typical ranges of vibration generated by construction breaking activity.

Demolition of existing structures will involve careful deconstruction using controlled techniques. There may be a requirement for breaking ground as part of specific demolition procedures, depending on the structure. Vibration levels associated with this activity will be of similar or lower magnitude to rock breaking discussed above.

Referring to the vibration magnitudes above, vibration impacts due to ongoing construction works will be not significant and short term.

Notwithstanding the above, any construction activities undertaken on the site will be required to operate below the recommended vibration criteria set out in **Table 17.3**.

17.5.3.4 Blasting

Ground investigations have indicated that blasting will be required at a number of locations along the route of the proposed road development, in proximity to access roads, stream diversions and attenuation ponds, ref **Figures 7.3.1** and **7.3.2**. The extent of blasting will depend on the rock type and depth in the area and the depth of the cutting involved. For the majority of identified locations, a relatively shallow blast depth is required. There are a number of locations along the route of the proposed road development where a cut depth of greater than 10m will be required as part of the construction of the proposed road development.

Whilst drill and blast methods generate intermittent high noise levels when taking place, the time period over which impacts are experienced are significantly shorter compared to other extraction methods. For the proposed road development where a significant portion of hard rock is required to be excavated, the use of drill and blast will enable extraction works to be undertaken at a significantly faster rate compared to traditional rock breaking techniques.

Blasting impacts relate to both ground vibration and air overpressure, the magnitude of which depends on a variety of factors.

Air Overpressure (AOP)

Air overpressure is energy transmitted from the blast site within the atmosphere in the form of pressure waves. As such a wave passes a given position, the pressure of the air at this point rises very rapidly to a value above the ambient pressure, and then falls more slowly to a value below, before returning to the ambient value after

a series of oscillations. The maximum excess pressure in this wave is known as the peak air overpressure. This value is typically measured in terms of dB (L_{in}).

These pressure waves will consist of energy over a wide range of frequencies, some of which are audible and known as sound waves or noise, but most of the energy is inaudible at frequencies of less than 20Hz which is not heard by the human ear but is sensed as pressure.

The main sources of air overpressure from blasting relate to blast design and set up (e.g. detonating cord, stemming release and gas venting) and physical properties of the site (movement of rock and reflection of stress waves). The intensity of air overpressure levels at a receiver location is highly dependent on meteorological conditions which affect ambient air pressure including temperature, cloud cover, humidity, wind speed and direction etc. Due to the large variability in these conditions, it is not possible to reliably calculate AOP. The control of its intensity is therefore undertaken at source through careful blast design.

It is important to note that routine open-pit blasting operations regularly generate air overpressures up to a magnitude of 120dB (Lin), with levels in excess of 125dB (Lin) being relatively rare. Damage levels are rarely approached let alone exceeded. BS 5228-2 notes that there is no known evidence of structural damage to structures from excessive air overpressure levels from quarry blasting in the UK.

Ground Vibration

The level of vibration at a receiver location from a blast depends predominately on the distance from the blast, the maximum instantaneous charge (MIC), sequencing of charges and ground conditions between the blast area and the receiver location. Whilst it is possible to undertake indicative predictive calculations for ground vibrations from a blast site using information on the MIC, distance and ground factors, the most accurate methodology for determining vibration levels is through controlled trial blasts at specific sites and undertaking scaled distance regression analysis to determine maximum charge values in order to comply with set criteria. This is therefore undertaken by experienced contractors as part of the blast design (refer to **Chapter 9, Soils and Geology**).

In the case of the proposed road development, blast events will be clearly perceptible at the nearest sensitive receptors due to ground vibration and air overpressure levels, however the duration of the effects are intermittent. The overall impacts are therefore considered to be significant, momentary and localised. The closest sensitive properties to the identified likely blast sites are at distances of 30 to 50m. It is expected that these potential impacts can be appropriately mitigated through the implementation of best practice blasting control measures which are outlined in **Section 17.6.1**. Specific assessment of potential impacts of blasting on birds and other sensitive species are included in **Chapter 8, Biodiversity**.

17.5.4 Potential Operational Impacts

17.5.4.1 Operational Noise Levels

Traffic noise levels have been calculated at the 299 receiver locations along the length of the proposed road development in accordance with the methodologies outlined in **Section 17.2.5**.

The calculated noise levels in **Table 17.13** are presented for the Opening Year (2024) and Design Year (2039) of the proposed road development and compares the calculated results against the three TII conditions (referenced in **Section 17.2.2.2**) for noise mitigation.

When considering the requirement for noise mitigation under Condition C, traffic noise levels must be attributed to the physical proposed road development under consideration in order for noise mitigation to be provided. In certain instances, traffic flows along the local road network are higher during the Do-Something scenario compared to the Do-Nothing scenario due to traffic volumes along these road links. In these instances, Condition C is not triggered and hence noise mitigation is not included as part of this proposed road development.

The calculated "Do Minimum" noise levels presented in Table 17.13 relate to traffic noise levels associated with modelled roads only. These are presented predominately to assess the requirement for noise mitigation against Condition b, particularly for locations along existing roads where traffic noise levels exceed 60dB L_{den} in the absence of the proposed road development.

The modelled calculated noise level at each assessment location is included within **Table 17.13**.

Table 17.13: Calculated Traffic Noise Levels

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
1	R336 West of Bearna West Roundabout	61	62	Yes	No	No	No	62	63	Yes	No	No	No
2	R336 West of Bearna West Roundabout	58	59	No	No	No	No	59	59	No	No	No	No
3	Na Foraí Maola Thoir	39	46	No	Yes	Yes	No	39	47	No	Yes	Yes	No
4	Na Foraí Maola Thoir	38	49	No	Yes	Yes	No	39	50	No	Yes	Yes	No
5	R336 West of Bearna West Roundabout	62	62	Yes	No	No	No	62	63	Yes	No	No	No
6	R336 West of Bearna West Roundabout	62	63	Yes	No	No	No	63	64	Yes	No	No	No
7	R336 West of Bearna West Roundabout	57	60	No	Yes	Yes	No	58	61	Yes	Yes	Yes	Yes
8	R336 East of Bearna West Roundabout	58	61	Yes	Yes	Yes	Yes	59	62	Yes	Yes	Yes	Yes
9	Na Foraí Maola Thoir	43	56	No	Yes	Yes	No	43	57	No	Yes	Yes	No
10	Na Foraí Maola Thoir	39	57	No	Yes	Yes	No	39	57	No	Yes	Yes	No
11	Na Foraí Maola Thoir	44	55	No	Yes	Yes	No	45	55	No	Yes	Yes	No

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
12	R336 East of Bearna West Roundabout	66	66	Yes	No	No	No	67	67	Yes	No	No	No
13	Na Foraí Maola Thoir	35	62	Yes	Yes	Yes	Yes	36	62	Yes	Yes	Yes	Yes
14	Na Foraí Maola Thoir	44	52	No	Yes	Yes	No	45	53	No	Yes	Yes	No
15	Na Foraí Maola Thoir	40	52	No	Yes	Yes	No	40	53	No	Yes	Yes	No
16	Na Foraí Maola Thiar	36	54	No	Yes	Yes	No	36	55	No	Yes	Yes	No
17	Na Foraí Maola Thoir	52	54	No	Yes	Yes	No	53	55	No	Yes	Yes	No
18	Na Foraí Maola Thoir	37	53	No	Yes	Yes	No	37	54	No	Yes	Yes	No
19	Na Foraí Maola Thoir (to be demolished)	37	63	Yes	Yes	Yes	No	38	64	Yes	Yes	Yes	No
20	Na Foraí Maola Thoir	46	51	No	Yes	Yes	No	46	52	No	Yes	Yes	No
21	Na Foraí Maola Thoir	44	50	No	Yes	Yes	No	44	51	No	Yes	Yes	No
22	Na Foraí Maola Thoir	35	55	No	Yes	Yes	No	36	56	No	Yes	Yes	No
23	Na Foraí Maola Thiar	37	58	No	Yes	Yes	No	37	59	No	Yes	Yes	No
24	Na Foraí Maola Thiar	39	53	No	Yes	Yes	No	39	54	No	Yes	Yes	No
25	Foraí Maola Road	47	47	No	No	No	No	47	47	No	No	No	No
26	Foraí Maola Road	44	55	No	Yes	Yes	No	44	56	No	Yes	Yes	No

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
27	Na Foraí Maola Thiar (to be acquired)	44	63	Yes	Yes	Yes	Yes	44	64	Yes	Yes	Yes	Yes
28	Foraí Maola Road	43	50	No	Yes	Yes	No	43	50	No	Yes	Yes	No
29	Foraí Maola Road	41	56	No	Yes	Yes	No	41	57	No	Yes	Yes	No
30	R336 East of Bearna West Roundabout	65	65	Yes	No	No	No	65	66	Yes	No	No	No
31	Na Foraí Maola Thoir	34	54	No	Yes	Yes	No	34	55	No	Yes	Yes	No
32a	Na Foraí Maola Thoir	48	57	No	Yes	Yes	No	48	58	No	Yes	Yes	No
32b	Na Foraí Maola Thoir	34	59	No	Yes	Yes	No	35	60	No	Yes	Yes	No
33	Na Foraí Maola Thoir	46	58	No	Yes	Yes	No	46	59	No	Yes	Yes	No
34	Na Foraí Maola Thoir	42	54	No	Yes	Yes	No	42	55	No	Yes	Yes	No
35	Troscaigh Road	48	55	No	Yes	Yes	No	48	55	No	Yes	Yes	No
36	Troscaigh Road (to be acquired)	48	58	No	Yes	Yes	No	48	59	No	Yes	Yes	No
37	Troscaigh Road	45	59	No	Yes	Yes	No	45	59	No	Yes	Yes	No
38	Troscaigh Road	38	56	No	Yes	Yes	No	38	57	No	Yes	Yes	No
39	Troscaigh Road	43	58	No	Yes	Yes	No	43	58	No	Yes	Yes	No
40	Troscaigh Road	38	62	Yes	Yes	Yes	Yes	38	62	Yes	Yes	Yes	Yes

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
41	Troscaigh Road	47	52	No	Yes	Yes	No	47	52	No	Yes	Yes	No
42	Troscaigh Thiar	31	53	No	Yes	Yes	No	31	54	No	Yes	Yes	No
43	Troscaigh- Ann Gibbons Road	33	51	No	Yes	Yes	No	33	52	No	Yes	Yes	No
44	Troscaigh- Ann Gibbons Road	31	55	No	Yes	Yes	No	31	56	No	Yes	Yes	No
45	Troscaigh- Ann Gibbons Road	32	48	No	Yes	Yes	No	32	48	No	Yes	Yes	No
46	Troscaigh- Ann Gibbons Road	34	61	Yes	Yes	Yes	Yes	34	61	Yes	Yes	Yes	Yes
47	Troscaigh Thoir	40	52	No	Yes	Yes	No	41	52	No	Yes	Yes	No
48	Troscaigh Thoir - L1321 North	47	58	No	Yes	Yes	No	48	58	No	Yes	Yes	No
49	Troscaigh Thoir - L1321 North	50	58	No	Yes	Yes	No	50	59	No	Yes	Yes	No
50	Troscaigh Thoir - L1321 North	46	56	No	Yes	Yes	No	47	56	No	Yes	Yes	No
51	Troscaigh Thoir - L1321 South	50	57	No	Yes	No	No	51	58	No	Yes	No	No

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
52	An Chloch Scoilte	35	52	No	Yes	Yes	No	35	53	No	Yes	Yes	No
53	An Chloch Scoilte	37	56	No	Yes	Yes	No	37	57	No	Yes	Yes	No
54a	An Chloch Scoilte	37	47	No	Yes	Yes	No	37	48	No	Yes	Yes	No
54b	An Chloch Scoilte	33	51	No	Yes	Yes	No	33	52	No	Yes	Yes	No
55	An Chloch Scoilte	42	52	No	Yes	Yes	No	42	53	No	Yes	Yes	No
56	An Chloch Scoilte (to be acquired)	47	57	No	Yes	Yes	No	47	58	No	Yes	Yes	No
57	An Chloch Scoilte - Aille Road L5384	45	50	No	Yes	Yes	No	45	51	No	Yes	Yes	No
58	An Chloch Scoilte- Aille Road L5384	45	52	No	Yes	Yes	No	45	52	No	Yes	Yes	No
59	An Chloch Scoilte- Aille Road L5384 (to be acquired)	39	52	No	Yes	Yes	No	39	52	No	Yes	Yes	No
60	Ballard East	45	56	No	Yes	Yes	No	45	56	No	Yes	Yes	No
61	An Chloch Scoilte - Aille Road L5384	40	56	No	Yes	Yes	No	40	56	No	Yes	Yes	No
62	Cappagh Road North	46	54	No	Yes	Yes	No	47	54	No	Yes	Yes	No
63a	Cappagh Road North	49	65	Yes	Yes	Yes	Yes	49	66	Yes	Yes	Yes	Yes

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
63b	Cappagh Road North	49	62	Yes	Yes	Yes	Yes	49	63	Yes	Yes	Yes	Yes
64a	Cappagh Road North	46	57	No	Yes	Yes	No	47	58	No	Yes	Yes	No
64b	Cappagh Road North	36	53	No	Yes	Yes	No	36	53	No	Yes	Yes	No
65a	Cappagh Road North	47	60	No	Yes	Yes	No	48	61	Yes	Yes	Yes	Yes
65b	Cappagh Road North	39	60	No	Yes	Yes	No	39	61	Yes	Yes	Yes	Yes
66a	Cappagh Road South	44	63	Yes	Yes	Yes	Yes	45	63	Yes	Yes	Yes	Yes
66b	Cappagh Road South	48	64	Yes	Yes	Yes	Yes	48	64	Yes	Yes	Yes	Yes
67a	Cappagh Road South	45	60	No	Yes	Yes	No	45	60	No	Yes	Yes	No
67b	Cappagh Road South	49	60	No	Yes	Yes	No	49	61	Yes	Yes	Yes	Yes
68	Ballyburke	39	53	No	Yes	Yes	No	39	54	No	Yes	Yes	No
69	Ballyburke	39	55	No	Yes	Yes	No	39	56	No	Yes	Yes	No
70	Ballyburke	39	57	No	Yes	Yes	No	39	58	No	Yes	Yes	No
71	Ballyburke	40	59	No	Yes	Yes	No	40	59	No	Yes	Yes	No
72	Ballymoneen Road South	36	57	No	Yes	Yes	No	36	58	No	Yes	Yes	No
73	Ballymoneen Road South	40	55	No	Yes	Yes	No	40	56	No	Yes	Yes	No
74a	Ballymoneen Road South	50	66	Yes	Yes	Yes	Yes	51	67	Yes	Yes	Yes	Yes
74b	Ballymoneen Road South	35	68	Yes	Yes	Yes	Yes	35	68	Yes	Yes	Yes	Yes

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
75a	Ballymoneen Road South	52	63	Yes	Yes	Yes	Yes	52	64	Yes	Yes	Yes	Yes
75b	Ballymoneen Road South	36	56	No	Yes	Yes	No	36	57	No	Yes	Yes	No
76	Ballymoneen Road North	51	61	Yes	Yes	Yes	Yes	51	62	Yes	Yes	Yes	Yes
77	Ballymoneen Road South	53	60	No	Yes	No	No	53	61	Yes	Yes	No	No
78	Ballymoneen Road South	52	60	No	Yes	No	No	52	61	Yes	Yes	No	No
79	Ballymoneen Road North	53	62	Yes	Yes	Yes	Yes	53	63	Yes	Yes	Yes	Yes
80a	Ballymoneen Road North	53	64	Yes	Yes	Yes	Yes	53	64	Yes	Yes	Yes	Yes
80b	Ballymoneen Road North	47	65	Yes	Yes	Yes	Yes	47	65	Yes	Yes	Yes	Yes
81	Ballymoneen Road South	42	58	No	Yes	Yes	No	42	58	No	Yes	Yes	No
82	Ballymoneen	55	51	No	No	Yes	No	55	52	No	No	Yes	No
83	Ballymoneen Road	54	61	Yes	Yes	No	No	54	62	Yes	Yes	No	No
84	Ballymoneen	55	53	No	No	Yes	No	55	54	No	No	Yes	No
85	Árd na Gaoithe - Ballymoneen	38	59	No	Yes	Yes	No	38	59	No	Yes	Yes	No
86	Árd na Gaoithe - Ballymoneen	39	62	Yes	Yes	Yes	Yes	39	63	Yes	Yes	Yes	Yes
87	Árd na Gaoithe - Ballymoneen	36	50	No	Yes	Yes	No	36	50	No	Yes	Yes	No

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
88	Árd na Gaoithe - Ballymoneen	40	61	Yes	Yes	Yes	Yes	40	61	Yes	Yes	Yes	Yes
89a	Rahoon Road	51	51	No	No	Yes	No	51	52	No	No	Yes	No
89b	Rahoon Road	50	59	No	Yes	Yes	No	50	59	No	Yes	Yes	No
90	Rahoon Road	41	59	No	Yes	Yes	No	41	60	No	Yes	Yes	No
91a	Rahoon Road	51	57	No	Yes	Yes	No	51	58	No	Yes	Yes	No
91b	Rahoon Road	48	58	No	Yes	Yes	No	48	58	No	Yes	Yes	No
92	Árd na Gaoithe - Ballymoneen	39	58	No	Yes	Yes	No	40	59	No	Yes	Yes	No
93	Clybaun Road South	42	58	No	Yes	Yes	No	42	58	No	Yes	Yes	No
94	Clybaun Road South	43	59	No	Yes	Yes	No	44	60	No	Yes	Yes	No
95	Clybaun Road North	42	61	Yes	Yes	Yes	Yes	42	61	Yes	Yes	Yes	Yes
96	Clybaun Road North	45	63	Yes	Yes	Yes	Yes	45	63	Yes	Yes	Yes	Yes
97	Clybaun Road North	37	55	No	Yes	Yes	No	37	55	No	Yes	Yes	No
98	Clybaun Road North	38	56	No	Yes	Yes	No	38	57	No	Yes	Yes	No
99	Rahoon Road	46	56	No	Yes	Yes	No	46	56	No	Yes	Yes	No
100	Rahoon Road	56	59	No	Yes	Yes	No	56	60	No	Yes	Yes	No

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
101	Rahoon Road	47	56	No	Yes	Yes	No	47	56	No	Yes	Yes	No
102	Rahoon Road	52	55	No	Yes	Yes	No	52	55	No	Yes	Yes	No
103	Between Rahoon & Letteragh Road	39	55	No	Yes	Yes	No	39	56	No	Yes	Yes	No
104	Between Rahoon & Letteragh Road	42	51	No	Yes	Yes	No	42	51	No	Yes	Yes	No
105	Rahoon Road	59	59	No	No	No	No	59	60	No	Yes	No	No
106	Between Rahoon & Letteragh Road	36	63	Yes	Yes	Yes	Yes	37	64	Yes	Yes	Yes	Yes
107	Letteragh Road North	43	64	Yes	Yes	Yes	Yes	46	65	Yes	Yes	Yes	Yes
108	Letteragh Road North	41	61	Yes	Yes	Yes	Yes	44	62	Yes	Yes	Yes	Yes
109	Letteragh Road South	42	61	Yes	Yes	Yes	Yes	44	62	Yes	Yes	Yes	Yes
110	Letteragh Road South	42	62	Yes	Yes	Yes	Yes	44	63	Yes	Yes	Yes	Yes
111	N59 Moycullen Road (Parknagapple)	63	63	Yes	No	No	No	63	63	Yes	No	No	No
112	N59 Link Road/ Bushypark	46	54	No	Yes	Yes	No	47	55	No	Yes	Yes	No
113	Letteragh Road South	45	59	No	Yes	Yes	No	47	60	No	Yes	Yes	No
114	Bun A Chonic	40	59	No	Yes	Yes	No	41	59	No	Yes	Yes	No

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
115	Rosán Glas - Letteragh	46	58	No	Yes	Yes	No	46	58	No	Yes	Yes	No
116	Knocknabrona (to be acquired)	36	62	Yes	Yes	Yes	Yes	37	63	Yes	Yes	Yes	Yes
117	Rosán Glas - Letteragh	58	58	No	No	No	No	58	59	No	No	No	No
118	Knocknabrona (to be acquired)	36	60	No	Yes	Yes	No	36	61	Yes	Yes	Yes	Yes
119	Bushypark/ N59 Moycullen Road	55	58	No	Yes	Yes	No	55	59	No	Yes	Yes	No
120a	Letteragh Road South	45	64	Yes	Yes	Yes	Yes	48	65	Yes	Yes	Yes	Yes
120b	Letteragh Road South	44	64	Yes	Yes	Yes	Yes	46	64	Yes	Yes	Yes	Yes
121	Bushypark/ N59 Moycullen Road	64	65	Yes	No	No	No	64	65	Yes	No	No	No
122	Bushypark/N59 Moycullen Road	59	59	No	No	No	No	59	59	No	No	No	No
123	Bushypark/ N59 Moycullen Road	65	65	Yes	No	No	No	66	66	Yes	No	No	No
124	Knocknabrona (Cloghscoltia)	36	58	No	Yes	Yes	No	37	59	No	Yes	Yes	No
125	Knocknabrona (Cloghscoltia)	37	58	No	Yes	Yes	No	38	59	No	Yes	Yes	No

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
126	N59 Link Rd /Radharc an Locha	49	52	No	Yes	Yes	No	49	52	No	Yes	Yes	No
127	St. James' Church N59 Moycullen Road	60	60	No	No	No	No	60	61	Yes	No	Yes	No
128	Letteragh Road South	46	63	Yes	Yes	No	No	49	65	Yes	Yes	No	No
129	Letteragh Road South	46	60	No	Yes	No	No	48	61	Yes	Yes	No	No
130	Letteragh Road South	41	59	No	Yes	No	No	44	60	No	Yes	No	No
131	N59 Moycullen Road	62	62	Yes	No	Yes	No	62	63	Yes	No	Yes	No
132	The Heath Knocknabrona	37	54	No	Yes	Yes	No	37	55	No	Yes	Yes	No
133	Knocknabrona	36	52	No	Yes	Yes	No	37	52	No	Yes	Yes	No
134	Barnacranny	40	61	Yes	Yes	Yes	Yes	40	62	Yes	Yes	Yes	Yes
135	The Heath	40	60	No	Yes	Yes	No	40	60	No	Yes	Yes	No
136	Barnacranny	50	62	Yes	Yes	Yes	Yes	50	63	Yes	Yes	Yes	Yes
137	Circular Road	36	51	No	Yes	Yes	No	37	52	No	Yes	Yes	No
138	The Heath	43	66	Yes	Yes	Yes	Yes	43	67	Yes	Yes	Yes	Yes
139	N59 Moycullen Road/ Ard na Locha	61	63	Yes	Yes	Yes	Yes	61	64	Yes	Yes	Yes	Yes
140	Barnacranny	49	68	Yes	Yes	Yes	Yes	49	69	Yes	Yes	Yes	Yes

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
141	N59 Moycullen Road/Chestnut Lane	63	63	Yes	No	Yes	No	63	63	Yes	No	Yes	No
142	N59 Moycullen Road/ Ard na Locha	50	65	Yes	Yes	Yes	Yes	50	66	Yes	Yes	Yes	Yes
143	The Heath_ Upper Dangan	43	59	No	Yes	Yes	No	44	60	No	Yes	Yes	No
144a	Árd an Locha (to be acquired)	54	66	Yes	Yes	Yes	Yes	54	66	Yes	Yes	Yes	Yes
144b	Árd an Locha (to be acquired)	57	63	Yes	Yes	Yes	Yes	58	64	Yes	Yes	Yes	Yes
145	The Heath	46	63	Yes	Yes	Yes	Yes	46	64	Yes	Yes	Yes	Yes
146a	Árd an Locha	45	66	Yes	Yes	Yes	Yes	46	67	Yes	Yes	Yes	Yes
146b	Árd an Locha	50	69	Yes	Yes	Yes	Yes	50	70	Yes	Yes	Yes	Yes
147a	Árd an Locha	59	66	Yes	Yes	Yes	Yes	60	67	Yes	Yes	Yes	Yes
147b	Árd an Locha/ N59 Moycullen Road	67	67	Yes	No	Yes	No	67	68	Yes	No	Yes	No
148a	N59 Moycullen Road/ Aughnacurra	62	64	Yes	Yes	Yes	Yes	62	65	Yes	Yes	Yes	Yes
148b	N59 Moycullen Road/ Aughnacurra	65	65	Yes	No	Yes	No	66	66	Yes	No	Yes	No
149	Circular Road Upper Dangan	47	61	Yes	Yes	Yes	Yes	48	62	Yes	Yes	Yes	Yes

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		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
150	St. James' National School Upper Dangan	48	63	Yes	Yes	Yes	Yes	48	64	Yes	Yes	Yes	Yes
151a	Upper Dangan /N59 Moycullen Road	60	67	Yes	Yes	Yes	Yes	60	68	Yes	Yes	Yes	Yes
151b	Upper Dangan /N59 Moycullen Road	57	67	Yes	Yes	Yes	Yes	58	68	Yes	Yes	Yes	Yes
152	Aughnacurra	49	60	No	Yes	Yes	No	49	61	Yes	Yes	Yes	Yes
153	Aughnacurra (to be acquired)	56	66	Yes	Yes	Yes	Yes	57	67	Yes	Yes	Yes	Yes
154	Aughnacurra	51	65	Yes	Yes	Yes	Yes	52	66	Yes	Yes	Yes	Yes
155	Upper Dangan/N59 Moycullen Road	61	65	Yes	Yes	Yes	Yes	62	66	Yes	Yes	Yes	Yes
156	Aughnacurra	45	64	Yes	Yes	Yes	Yes	45	65	Yes	Yes	Yes	Yes
157	N59 Moycullen Road	64	64	Yes	No	Yes	No	64	65	Yes	No	Yes	No
158	NUIG	49	67	Yes	Yes	Yes	Yes	50	68	Yes	Yes	Yes	Yes
159	N59 Moycullen Road	68	67	Yes	No	No	No	69	67	Yes	No	No	No
160	NUIG	46	65	Yes	Yes	Yes	Yes	46	66	Yes	Yes	Yes	Yes
161	N59 Moycullen Road	69	68	Yes	No	No	No	69	68	Yes	No	No	No
162	N59 Moycullen Road/NUIG	59	62	Yes	Yes	Yes	Yes	60	62	Yes	Yes	Yes	Yes

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
163	Dangan House	43	61	Yes	Yes	Yes	Yes	44	62	Yes	Yes	Yes	Yes
164	N59 Moycullen Road/Clifton Close	64	63	Yes	No	No	No	65	64	Yes	No	No	No
165	Menlo Castle	45	63	Yes	Yes	Yes	Yes	45	64	Yes	Yes	Yes	Yes
166	The Orchard, Menlo Park, Menlough	40	57	No	Yes	Yes	No	40	58	No	Yes	Yes	No
167	Menlough/ Bóthar Nua	42	60	No	Yes	Yes	No	42	61	Yes	Yes	Yes	Yes
168	Coolough Road	42	62	Yes	Yes	Yes	Yes	42	63	Yes	Yes	Yes	Yes
169	Menlough / Seanbóthar	45	59	No	Yes	Yes	No	45	60	No	Yes	Yes	No
170	Menlough / Seanbóthar	55	65	Yes	Yes	Yes	Yes	55	65	Yes	Yes	Yes	Yes
171	Coolough Rd	45	58	No	Yes	Yes	No	45	59	No	Yes	Yes	No
172	N84 Headford Road/ Ballinfoyle	64	66	Yes	Yes	No	No	65	66	Yes	No	No	No
173	Ballindooley Boithrin / N84 Junction	56	67	Yes	Yes	Yes	Yes	57	68	Yes	Yes	Yes	Yes
174a	N84 Headford Road Junction South	68	70	Yes	Yes	No	No	68	70	Yes	Yes	No	No
174b	N84 Headford Road Junction South	58	63	Yes	Yes	Yes	Yes	59	64	Yes	Yes	Yes	Yes

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
175a	N84 Headford Road Junction South (to be demolished)	68	71	Yes	Yes	Yes	No	69	72	Yes	Yes	Yes	No
175b	N84 Headford Road Junction South (to be demolished)	66	69	Yes	Yes	Yes	No	66	70	Yes	Yes	Yes	No
176	N84 Headford Road Junction South	56	63	Yes	Yes	Yes	Yes	56	64	Yes	Yes	Yes	Yes
177a	N84 Headford Road Junction	62	66	Yes	Yes	Yes	Yes	62	67	Yes	Yes	Yes	Yes
177b	N84 Headford Road Junction	64	67	Yes	Yes	Yes	Yes	64	67	Yes	Yes	Yes	Yes
178	Ballindooley Boithrin / N84 Junction	52	63	Yes	Yes	Yes	Yes	52	63	Yes	Yes	Yes	Yes
179	Ballindooley / N84 Headford Road	65	66	Yes	No	No	No	66	67	Yes	No	No	No
180	Ballindooley/ N84 Headford Road	66	67	Yes	No	No	No	66	67	Yes	No	No	No
181	N84 Headford Road Junction	68	69	Yes	Yes	Yes	Yes	69	70	Yes	Yes	Yes	Yes
182	N84 Headford Road Junction	71	71	Yes	No	Yes	No	71	72	Yes	No	Yes	No
183	N84 Headford Road Junction	62	65	Yes	Yes	Yes	Yes	62	66	Yes	Yes	Yes	Yes
184	N84 Headford Road Junction (to be demolished)	61	66	Yes	Yes	Yes	No	62	66	Yes	Yes	Yes	No

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
185	Ballindooley/ N84 Headford Road	65	66	Yes	No	No	No	66	66	Yes	No	No	No
186	Ballindooley/ N84 Headford Road	68	68	Yes	No	No	No	68	69	Yes	No	No	No
187	Bóthar an Chóiste	51	60	No	Yes	Yes	No	52	61	Yes	Yes	Yes	Yes
188	Bóthar an Chóiste	49	62	Yes	Yes	Yes	Yes	49	63	Yes	Yes	Yes	Yes
189	Bóthar an Chóiste	47	59	No	Yes	Yes	No	48	60	No	Yes	Yes	No
190	Bóthar an Chóiste	49	61	Yes	Yes	Yes	Yes	49	62	Yes	Yes	Yes	Yes
191	Castlegar	47	63	Yes	Yes	Yes	Yes	47	64	Yes	Yes	Yes	Yes
192	Castlegar	48	67	Yes	Yes	Yes	Yes	48	68	Yes	Yes	Yes	Yes
193	Castlegar	48	63	Yes	Yes	Yes	Yes	48	63	Yes	Yes	Yes	Yes
194	School Road North	50	65	Yes	Yes	Yes	Yes	50	66	Yes	Yes	Yes	Yes
195a	School Road (to be acquired)	62	58	No	No	Yes	No	62	59	No	No	No	No
195b	School Road (to be acquired)	59	67	Yes	Yes	Yes	Yes	59	68	Yes	Yes	Yes	Yes
196	School Road North	49	64	Yes	Yes	Yes	Yes	50	65	Yes	Yes	Yes	Yes
197	Castlegar School	58	60	No	Yes	Yes	No	58	61	Yes	Yes	Yes	Yes
198a	Castlegar/ School Road South (to be acquired)	54	64	Yes	Yes	Yes	Yes	54	64	Yes	Yes	Yes	Yes

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
198b	Castlegar/ School Road South (to be acquired)	62	60	No	No	Yes	No	62	61	Yes	No	No	No
199	Castlegar School	50	58	No	Yes	Yes	No	50	59	No	Yes	Yes	No
200	Castlegar / School Road South (to be demolished)	57	64	Yes	Yes	Yes	No	57	64	Yes	Yes	Yes	No
201	Castlegar/ School Road South (to be demolished)	50	59	No	Yes	Yes	No	50	60	No	Yes	Yes	No
202	Castlegar/ School Road South	46	55	No	Yes	Yes	No	46	56	No	Yes	Yes	No
203	Castlegar	49	62	Yes	Yes	Yes	Yes	49	63	Yes	Yes	Yes	Yes
204	Castlegar / N83 Tuam Road	52	63	Yes	Yes	Yes	Yes	52	63	Yes	Yes	Yes	Yes
205	N83 Tuam Road South	70	71	Yes	No	Yes	No	70	71	Yes	No	Yes	No
206	Castlegar / N83 Tuam Road	59	64	Yes	Yes	Yes	Yes	59	65	Yes	Yes	Yes	Yes
207a	Castlegar/ N83 Tuam Road South	69	69	Yes	No	Yes	No	69	69	Yes	No	Yes	No
207b	Castlegar/ N83 Tuam Road South	61	63	Yes	Yes	Yes	Yes	62	64	Yes	Yes	Yes	Yes
208	Castlegar / N83 Tuam Road	56	67	Yes	Yes	Yes	Yes	56	67	Yes	Yes	Yes	Yes
209	City North Park Link Road	58	61	Yes	Yes	Yes	Yes	58	61	Yes	Yes	Yes	Yes

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
210	N6 Bothar na dTreabh	73	70	Yes	No	No	No	73	71	Yes	No	No	No
211	Monivea Road R339 west	55	53	No	No	No	No	55	53	No	No	No	No
212a	N83 Tuam Road North (rear)	53	65	Yes	Yes	Yes	Yes	53	66	Yes	Yes	Yes	Yes
212b	N83 Tuam Road North (front)	56	65	Yes	Yes	Yes	Yes	56	66	Yes	Yes	Yes	Yes
213a	N83 Tuam Road North/Ceapach na Boirne	70	69	Yes	No	Yes	No	70	69	Yes	No	Yes	No
213b	N83 Tuam Road North /Ceapach na Boirne	63	65	Yes	Yes	Yes	Yes	63	66	Yes	Yes	Yes	Yes
214	N83 Tuam Road North /Ceapach na Boirne	70	69	Yes	No	Yes	No	70	69	Yes	No	No	No
215	N83 Tuam Road North /Ceapach na Boirne	67	67	Yes	No	No	No	67	67	Yes	No	No	No
216	N83 Tuam Road North	68	68	Yes	No	No	No	68	68	Yes	No	No	No
217	The Meadows / N6 Bóthar na dtreabh	69	66	Yes	No	No	No	69	67	Yes	No	No	No
218	Galway Racecourse	48	56	No	Yes	Yes	No	49	57	No	Yes	Yes	No
219	N83 Tuam Road South	70	72	Yes	Yes	No	No	70	72	Yes	Yes	No	No
220	N83 Tuam Road North	66	66	Yes	No	No	No	66	66	Yes	No	No	No

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
221	Galway Racecourse	52	54	No	Yes	Yes	No	53	55	No	Yes	Yes	No
222	The Meadows / N6 Bóthar na dTreabh	68	65	Yes	No	No	No	68	66	Yes	No	No	No
223	N83 Tuam Road North	66	66	Yes	No	No	No	66	66	Yes	No	No	No
224	Racecourse Ave, Ballybrit	53	60	No	Yes	Yes	No	53	61	Yes	Yes	Yes	Yes
225	The Paddocks, N6 Bóthar na dTreabh	71	68	Yes	No	No	No	71	69	Yes	No	No	No
226	Galway Racecourse	54	54	No	No	Yes	No	54	55	No	No	Yes	No
227	Galway Racecourse	51	54	No	Yes	Yes	No	52	55	No	Yes	Yes	No
228	Racecourse Business Park (to be demolished)	51	64	Yes	Yes	Yes	No	51	65	Yes	Yes	Yes	No
229	Racecourse Ave, Ballybrit (to be demolished)	54	64	Yes	Yes	Yes	No	54	65	Yes	Yes	Yes	No
230	Racecourse Ave, Ballybrit	52	57	No	Yes	Yes	No	52	58	No	Yes	Yes	No
231	Racecourse Ave, Ballybrit	53	54	No	Yes	Yes	No	53	55	No	Yes	Yes	No
232	Racecourse Ave, Ballybrit	54	57	No	Yes	Yes	No	54	58	No	Yes	Yes	No
233	Ballybrit Crescent	58	60	No	Yes	Yes	No	58	61	Yes	Yes	Yes	Yes
234a	Ballybrit Crescent	63	62	Yes	No	No	No	63	62	Yes	No	No	No

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
234b	Ballybrit Crescent	53	61	Yes	Yes	Yes	Yes	54	61	Yes	Yes	Yes	Yes
235	Ballybrit Crescent	55	67	Yes	Yes	Yes	Yes	55	68	Yes	Yes	Yes	Yes
236	Ballybrit Crescent	53	61	Yes	Yes	Yes	Yes	53	62	Yes	Yes	Yes	Yes
237	An Sean Bhaile	69	69	Yes	No	Yes	No	70	69	Yes	No	No	No
238	Monieva Road R339, Ballybrit Crescent Junction	66	65	Yes	No	Yes	No	66	65	Yes	No	Yes	No
239	Monieva Road R339, Ballybrit Crescent Junction	67	66	Yes	No	Yes	No	66	67	Yes	No	Yes	No
240	An Sean Bhaile	70	66	Yes	No	No	No	71	67	Yes	No	No	No
241	Merlin Woods School	59	55	No	No	No	No	60	56	No	No	No	No
242	Monieva Road R339 East	56	60	No	Yes	Yes	No	56	61	Yes	Yes	Yes	Yes
243	Coolagh Village	55	57	No	Yes	Yes	No	55	58	No	Yes	Yes	No
244	Garran Iseal	69	70	Yes	Yes	No	No	69	71	Yes	Yes	No	No
245	Coolagh Village	55	60	No	Yes	Yes	No	56	60	No	Yes	Yes	No
246	Coolagh Village	56	61	Yes	Yes	Yes	Yes	57	62	Yes	Yes	Yes	Yes
247	Galway Clinic R446 Doughiska	63	66	Yes	Yes	No	No	63	66	Yes	Yes	No	No
248	Coolagh Village	53	57	No	Yes	Yes	No	54	57	No	Yes	Yes	No

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
249	Coolagh Village	54	57	No	Yes	Yes	No	55	57	No	Yes	Yes	No
250	Coolagh Village	53	53	No	No	Yes	No	53	54	No	No	Yes	No
251a	Menlough / Sean Bothar	42	66	Yes	Yes	Yes	Yes	42	67	Yes	Yes	Yes	Yes
251b	Menlough / Sean Bothar	47	66	Yes	Yes	Yes	Yes	47	67	Yes	Yes	Yes	Yes
252	Cappagh Road South	48	59	No	Yes	No	No	49	60	No	Yes	No	No
253	Cappagh Road South	51	58	No	Yes	No	No	51	58	No	Yes	No	No
254	Cappagh Road South	51	56	No	Yes	No	No	51	57	No	Yes	No	No
255a	Letteragh Road South	45	64	Yes	Yes	No	No	49	65	Yes	Yes	No	No
255b	Letteragh Road South	44	57	No	Yes	Yes	No	46	58	No	Yes	Yes	No
256	Cappagh Road South	37	58	No	Yes	Yes	No	37	58	No	Yes	Yes	No
257	Cappagh Road South	45	60	No	Yes	Yes	No	45	61	Yes	Yes	Yes	Yes
258	Parkmore Link Road	49	53	No	Yes	No	No	49	53	No	Yes	No	No
259	Troscaigh Thoir	43	61	Yes	Yes	Yes	Yes	43	61	Yes	Yes	Yes	Yes
260	Maoilin	34	59	No	Yes	Yes	No	34	60	No	Yes	Yes	No
261	Maoilin	36	58	No	Yes	Yes	No	36	59	No	Yes	Yes	No
262	Maoilin	36	59	No	Yes	Yes	No	36	59	No	Yes	Yes	No
263	Maoilin	35	61	Yes	Yes	Yes	Yes	36	62	Yes	Yes	Yes	Yes

Receiver Location Reference	Description	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Design Year 2039.		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)		Predicted Noise Level. Do Minimum. dB L_{den}	Predicted Noise Level. Do-Something. dB L_{den}	(a)	(b)	(c)	
264	Maoilin	34	59	No	Yes	Yes	No	34	60	No	Yes	Yes	No
265	Maoilin	36	57	No	Yes	Yes	No	36	58	No	Yes	Yes	No
266	Maoilin	36	59	No	Yes	Yes	No	36	60	No	Yes	Yes	No
267	Maoilin	34	60	No	Yes	Yes	No	35	60	No	Yes	Yes	No
268	Maoilin	35	60	No	Yes	Yes	No	35	60	No	Yes	Yes	No
269	Maoilin	34	60	No	Yes	Yes	No	35	61	Yes	Yes	Yes	Yes
270	Coolagh	58	61	Yes	Yes	Yes	Yes	59	61	Yes	Yes	Yes	Yes

Model Results - Year 2024

On review of the modelled results and subsequent analysis, a total of 92 of the modelled locations satisfy the requirements for noise mitigation i.e. the predicted road traffic noise level is above 60dB L_{den} and noise levels are increased by 1dB or more as a direct result of the proposed road development. Noise mitigation is therefore deemed necessary at these locations based on the TII criteria. The number of properties determined to require noise mitigation excludes properties which will be demolished as part of the proposed road development but includes those that are to be acquired.

Model Results – Year 2039

On review of the modelled results and subsequent analysis, a total of 106 of the modelled locations satisfy the requirements for noise mitigation i.e. the predicted road traffic noise level is above 60dB L_{den} and noise levels are increased by 1dB or more as a direct result of the proposed road development. Noise mitigation is therefore deemed necessary at these locations based on the TII criteria. The number of properties determined to require noise mitigation excludes properties which will be demolished as part of the proposed road development but includes those that are to be acquired.

Summary of Receptors Requiring Mitigation

Analysis of the modelled results indicates that during the Design Year of 2039, 106 properties meet the three criteria for noise mitigation. These are distributed across the length of the proposed road development including the mainline, link roads and along existing roads which will be upgraded as part of the proposed road development.

Whilst the 106 properties identified satisfy the requirement for noise mitigation, the suitability and or practicality of noise mitigation for each location may not be possible at all locations. Further discussion on the recommended mitigation measures for the operational phase are included in **Section 17.6.3**.

17.5.4.2 Operational Vibration

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. Perceptible road traffic vibration can therefore be largely avoided by maintenance of the road surface.

17.6 Mitigation Measures

17.6.1 Introduction

Mitigation measures for the construction and operational phases are set out below in order to reduce potential impacts as far as practicable to within the adopted design goals for noise and vibration.

17.6.2 Construction Phase

17.6.2.1 Noise

The contract documents will clearly specify the construction noise criteria included in this chapter which the construction works must operate within. 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+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise* and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001. These measures will ensure that:

- 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 that 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, the contractor will be required to manage the works to comply with the limits detailed in **Table 17.1** using methods outlined in *BS 5228-1:2009+A1 2014. Part 1 - Noise*

BS 5228 *-1:2009+A1 2014* includes guidance on several aspects of construction site practices, which include, but are not limited to:

- Selection of quiet plant
- Control of noise sources
- Screening

- Hours of work
- Liaison with the public
- Monitoring

Further comment is offered on these items in the following paragraphs and in **Appendix A.17.2**, however specific control measures relating to construction activities undertaken by the contractor will be set out within the construction noise and vibration management plan. Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work and noise monitoring. The contractor will be required to conduct construction noise predictions prior to works taking place and put in place the most appropriate noise control measures depending on the level of noise reduction required at any one location.

Selection of Quiet Plant

The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item of plant will be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action will be to identify whether or not said item can be replaced with a quieter alternative.

For static plant such as compressors and generators used at work areas such as construction compounds etc., the units will be supplied with manufacturers' proprietary acoustic enclosures where possible.

The contractor will evaluate the choice of piling, excavation, breaking or other working method taking into account various ground conditions and site constraints. Where possible, where alternative lower noise generating equipment that would economically achieve, in the given ground conditions, equivalent structural / excavation / breaking results, these will be selected to minimise potential disturbance.

The decision regarding the type of pile, excavation technique, rock breaking, crushing etc. to be used on a site will normally be governed by other engineering, environmental constraints. In these instances, it may not be possible for technical reasons to replace a noisy process by a quieter alternative (e.g. rotary bored piling over driven piles). Even if it is possible, the adoption of a quieter method may prolong the overall process (e.g. manual rock breaking versus blasting); the net result being that the overall disturbance to the community will not necessarily be reduced.

General Comments on Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, consideration will be given to noise control "at source". This refers to the modification of an item of plant, or the application of improved sound reduction methods in consultation with the supplier or the best practice use of equipment and materials handling to reduce noise.

In practice, a balance may need to be struck between the use of all available techniques and the resulting costs of doing so. It is therefore proposed to adopt the

concept of "*Best Available Techniques"*. as defined in EC Directive 96/61. In this context *"best"* means *"the most effective in achieving a high general level of protection of the environment as a whole"*.

The expression *"available techniques"* means *"those techniques developed on a scale which allows implementation…., under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the operator carrying on the activity"*.

The term *"techniques"* includes *"both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned"*.

Thus, the concept of Best Available Techniques requires a degree of balance between the attainment of environmental benefits and the likely cost implications. In the identification of Best Available Techniques, regard will be had to a wide range of factors, however, emphasis will be given to *"practical suitability"* and the need *"to reduce an emission and its impact on the environment as a whole"*.

Proposed techniques will also be evaluated in light of their potential effect on occupational health and safety. The following outline guidance relates to practical noise control at source techniques which relate to specific site considerations:

- For mobile plant items such as cranes, dump trucks, excavators and loaders, the installation of an acoustic exhaust and/or maintaining enclosure panels closed during operation can reduce noise levels by up to 10dB. Mobile plant will be switched off when not in use and not left idling
- For piling plant, noise reduction can be achieved by enclosing the driving system in an acoustic shroud. For steady continuous noise, such as that generated by diesel engines, it is possible to reduce the noise emitted by fitting a more effective exhaust silencer system or utilising an acoustic canopy to replace the normal engine cover
- For percussive tools such as pneumatic concrete breakers, rock drills and tools a number of noise control measures include fitting muffler or sound reducing equipment to the breaker 'tool' and ensuring any leaks in the air lines are sealed. Erection of localised screens around breaker or drill bit when in operation in close proximity to noise sensitive boundaries are other suitable forms of noise reduction
- For concrete mixers, control measures will be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum
- For all materials handling, the contractor will ensure that best practice site noise control measures are implemented including ensuring that materials are not dropped from excessive heights and drop chutes/dump trucks are lined with resilient materials. This is an important consideration for site compounds where materials are loaded and unloaded. Site compounds in close proximity to noise sensitive areas (refer to **Table 17.10**) will incorporate a strict noise control policy relating to materials handling

- Where compressors, generators and pumps are located in areas in close proximity to noise sensitive properties/ areas and have potential to exceed noise criterion, these will be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation
- Resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can be controlled by fixing resilient materials in between the surfaces in contact
- Demountable enclosures can also be used to screen operatives using hand tools and may be moved around site as necessary
- All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures

Screening

Typically screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen, its mass, and its position relative to both the source and receiver.

The length of the screen should in practice be at least five times the height, however, if shorter sections are necessary then the ends of the screen will be wrapped around the source.

BS 5228 -*1:2009+A1 201* states that on level sites the screen should be placed as close as possible to either the source or the receiver. The construction of the barrier will be such that there are no gaps or openings at joints in the screen material. In most practical situations the effectiveness of the screen is limited by the sound transmission over the top of the barrier rather than the transmission through the barrier itself. In practice, screens constructed of materials with a mass per unit of surface area greater than 10kg/m^2 will give adequate sound insulation performance. As an example, the use of a standard 2.4m high construction site hoarding will provide a sufficient level of noise screening once it is installed at a suitable position between the source and receiver. Annex B of *BS 5228-1:2009+A1:2014* (Figures B1, B2 and B3) provide typical details for temporary and mobile acoustic screens, sheds and enclosures that can be constructed on site from standard materials.

In addition, careful planning of the site layout will also be considered. Within site compounds, the placement of site buildings such as offices and stores between the site and sensitive locations can provide a good level of noise screening. Similarly, in some instances materials such as topsoil or aggregate along the route of the proposed road development can provide a degree of noise screening if placed between the source and the receiver.

Hours of Work

Construction activity will mostly take place during daytime hours Monday to Friday and Saturdays (ref **Section 17.2.2.1**). Depending on the noise emission levels experienced and associated noise impact, the contractor will be flexible and able to

conduct certain works at hours which reflect periods when the neighbouring properties have lower sensitivities to noise.

It will be necessary to work overtime (including weekends) and night shifts at certain critical stages during the project. Over the expected 36-month construction phase there will be up to 10 weeks of night time working along different sections of the proposed road development primarily to facilitate bridge works over existing roads.

Consideration will be given to the scheduling of activities in a manner that reflects the location of the site and the nature of neighbouring properties. Each potentially noisy event/activity will be considered on its individual merits and scheduled according to its noise level, proximity to sensitive locations and possible options for noise control. In situations where a particularly noisy activity is scheduled e.g. activities identified in **Table 17.9** (rock breaking/crushing/impact piling etc.) or other activities of similar noise level, the use of other on-site activities will be scheduled to ensure control cumulative noise levels.

Liaison with the Public

On typical road construction sites, the major sources of noise are essentially mobile and the noise received at any control points will therefore vary from day to day as work proceeds. The duration of piling, excavation, breaking and other high noise or vibration activities works is usually short in relation to the length of construction work as a whole, and the amount of time spent working near to sensitive areas can represent only a part of the overall period. It is important, therefore, that clear forms of communication are established between the contractor and noise sensitive areas in proximity so that residents or building occupants are aware of the likely duration of activities likely to generate higher noise or vibration.

A designated noise liaison officer will be appointed to site during construction works. All noise complaints will be logged and followed up in a prompt fashion by the liaison officer.

Monitoring

During the construction phase noise monitoring will be undertaken at the nearest sensitive locations to ensure construction noise limits outlined in **Table 17.1** are not exceeded. Noise monitoring will be conducted in accordance with the International Standard ISO 1996: *Acoustics – Description, measurement and assessment of environmental noise* Part 1 (2016) and Part 2 (2017). The selection of monitoring locations will be based on the nearest sensitive buildings to the working area which will progress along the length of the road construction.

It is recommended that noise control audits are conducted at regular intervals throughout the construction programme in conjunction with noise monitoring. The purpose of the audits will be to ensure that all appropriate steps are being taken to control construction noise emissions and to identify opportunities for improvement, where required.

17.6.2.2 Blasting and Air Overpressure

Air overpressure from a blast is difficult to control because of its variability, however, much can be done to reduce the effect and the control of the blast design at source.

In terms of blast design control, specific guidance will be obtained from the recommendations contained within *BS 5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Vibration* in relation to blasting operations in addition to experienced blast control techniques used by the contractor. These will include some or all of the following:

- All blasting will be undertaken by professionally trained blast contractors
- Restriction of hours within which blasting can be conducted (09:00 – 18:00hrs)
- Trial blasts will be tested in less sensitive areas to assist in blast designs and identify potential zones of influence
- Explosive charges will be properly confined by a sufficient amount of stemming
- Blasting contractors will ensure that the minimum amount of primer cord is used, and that no primer cord is located above ground
- Profiling will be carried out after each blast in order to ensure the geometry of the rock face can be established, enabling the optimum burden and spacing to be applied for subsequent blasts
- The design, execution and completion of any blasting within 150metres of any existing structure shall require special considerations. This will include the use of pre and post condition structural surveys by a competent structural engineer
- Ground vibration and air over pressure (AOP) will be recorded simultaneously for each blast at the most sensitive locations, depending on the works area being blasted
- When blasting moves into a new area, an initial low level blast will be carried out (i.e. a low Maximum Instantaneous Charge (MIC)) and monitoring will be carried out simultaneously at a number of sensitive properties in different directions in order to generate specific scaled distance graphs
- The scaled distance graphs will be used to determine the optimum MIC for subsequent blasts area in order control vibration and AOP limits below the relevant limit values (as set out in **Section 17.2.1**) at the nearest sensitive buildings

In line with best practice mitigation measures from vibration sources, good communication and public relations are a key factor in reducing any startle effects to residents. In this instance, a Public Communications Strategy will be implemented by the contractor prior to the commencement of any blast works. In such cases, the following recommended mitigation measures are proposed:

- Relevant nearby residents will be notified before any work and blasting starts (e.g. a minimum of 24-hour written notification)

- The firing of blasts will be undertaken, where possible, at similar times to reduce the 'startle' effect
- Ongoing circulars will be issued informing people of the progress of the blasting works
- The implementation of an onsite documented complaints procedure will be maintained by the contractor
- The use of independent monitoring will be undertaken by external bodies for verification of results

17.6.2.3 *Vibration*

The TII Guidelines recommend that in order to ensure that there is no potential for vibration damage during construction, vibration from construction activities should be limited to the values set out in **Table 17.3**.

On review of the likely vibration levels associated with construction activities, it may be concluded that the construction of the proposed road development is not expected to give rise to vibration that is either significantly intrusive or capable of giving rise to structural or cosmetic damage to buildings.

In the case of vibration levels giving rise to human discomfort, in order to minimise such impacts, the following measures shall be implemented during the construction period:

- A clear communication programme will be established to inform adjacent building occupants in advance of any potential intrusive works which may give rise to vibration levels likely to exceed perceptible levels. The nature and duration of the works will be clearly set out in all communication circulars
- Alternative less intensive working methods and/or plant items shall be employed, where feasible
- Appropriate vibration isolation shall be applied to plant, where feasible
- Cut off trenches to isolate the vibration transmission path shall be installed where required
- In the case of impact piling or demolition works for instance, a reduction in the input energy per blow shall be considered where required
- Monitoring will be undertaken at identified sensitive buildings, where proposed works have the potential to be at or exceed the vibration limit values

Property Condition Surveys

Property condition surveys will be offered for all buildings within 50m of the proposed development boundary and those within 150m of proposed blasting works along the proposed road development. Property condition surveys will also be carried out at buildings and structures considered appropriate relative to their proximity to the works. Such property condition surveys shall be carried out by a Chartered Surveyor or Chartered Structural Engineer. Such property condition

surveys, subject to the written agreement of relevant property owners, shall be carried out in two stages as the follows:

- the first stage shall consist of pre-construction condition surveys including photographic records which shall be carried out prior to the commencement of construction
- the second stage shall consist of post-construction condition surveys which shall include photographic records

Disturbance of Particularly Vibration-Sensitive Equipment and Processes

The location of potentially vibration sensitive activities have been identified for manufacturing facilities within the Parkmore and Racecourse Business Parks. This location is in proximity to an area where blasting will take place as part of the proposed tunnel at Ballybrit. The most effective form of mitigation for this type of sensitive process is through on-going consultation with the property owners as the design and construction of the proposed road development progresses. This will involve baseline vibration monitoring and the use of trial blasts using an initial low level charge with simultaneously vibration measurements undertaken at the building. This information will be used to determine acceptable vibration levels for the facility relating to the sensitivity of the operating equipment. The results of this trial assessment will then set appropriate agreed limits values at the facility in question which will be monitored during subsequent blasts or other excavation methodologies. Where no safe limit is determined, the timing and scheduling of blasts will be undertaken in consultation with the facility when no sensitive operations are taking place. Given the short time period over which an individual blast takes place (i.e. a number of seconds), this approach is deemed to be feasible.

17.6.3 Operational Phase

The following section details the mitigation measures deemed practicable to achieve the design goals previously defined in **Section 17.2**.

The mitigation measures required to reduce traffic noise levels are specified based on the predicted noise levels for the Design Year of 2039. The results of the modelling exercise show that noise mitigation is required for 106 properties along the proposed route of the proposed road development for this Design Year.

Options to reduce operational noise levels along the proposed road development include the use of a Low Noise Road Surface (LNRS) to reduce noise generated at source and the use of noise barriers to reduce noise levels along the propagation path between the source (proposed road development) and the specific receivers (houses, schools, churches etc.). These screens may be constructed as earth bunds, proprietary noise barriers or a combination of both.

As part of the assessment, therefore, the use of a low noise road surface (LNRS) providing a mean reduction in traffic noise level of -2.5dB compared to Hot Rolled Asphalt (HRA) has been modelled along the length of the mainline of the proposed road development and the main junction slip roads accessing the N59 Moycullen Road, N84 Headford Road, N83 Tuam Road and existing N6 in addition to the N59 Link Road North and South as part of the proposed road development. **Table 17.14**

summarises the noise barrier requirements for the proposed road development required in addition to the use of a low noise road surface.

Table 17.14: Likely Extent of Noise Screening

Receiver No.	Structure Name	Start Chainage	End Chainage	Height (m)	Location	Lateral Siting / Type
7 & 6	NB00/01	0+015	0+120	2	R336 West of Bearna West Roundabout	Westbound/Standard
8	NB00/02	0+000	0+100	2	R336 East of Bearna West Roundabout	Eastbound/ Standard
27	NB01/01	1+030	1+145	2	Proposed Road Development Mainline	Eastbound/ Standard
40	NB01/02	1+520	1+735	2	Proposed Road Development Mainline	Westbound/ Standard
63a/63b	NB04/01	4+370	4+450	2.5	Proposed Road Development Mainline	Eastbound/ Standard
	NB04/02	0+095	0+130	2	Cappagh Road North of Cappagh Road Junction	Northbound/ Standard
	NB04/03	0+080	0+090	2	Cappagh Road North of Cappagh Road Junction	Northbound/ Standard
66a/66b	NB04/04	4+460	4+535	1.5	Proposed Road Development Mainline	Westbound/ Standard
	NB04/05	0+185	0+225	2.5	Cappagh Road South of Cappagh Road Junction	Southbound/ Standard
	NB04/06	0+140	0+185	2.5	Cappagh Road South of Cappagh Road Junction	Southbound/ Standard
74a/74b/75a	NB05/01	5+525	5+615	3.5	Proposed Road	Westbound/ Standard

Receiver No.	Structure Name	Start Chainage	End Chainage	Height (m)	Location	Lateral Siting / Type
					Development Mainline	
	NB05/02	0+080	0+110	3	Ballymoneen Road south of Ballymoneen Road Junction	Northbound/ Standard
	NB05/03	0+000	0+060	2.5	Ballymoneen Road south of Ballymoneen Road Junction	Northbound/ Standard
80a/80b	NB05/04	5+660	5+750	2.5	Proposed Road Development Mainline	Eastbound/ Standard
	NB05/05	0+145	0+160	2	Ballymoneen Road north of Ballymoneen Road Junction	Southbound/ Standard
	NB05/06	0+170	0+225	2	Ballymoneen Road north of Ballymoneen Road Junction	Southbound/ Standard
86	NB05/07	5 +910	6+110	2	Proposed Road Development Mainline	Westbound/ Standard
96	NB06/01	6+400	6+555	2	Proposed Road Development Mainline	Eastbound/ Standard
106	NB06/02	6+870	7+100	2	Proposed Road Development Mainline	Westbound / Standard
107	NB07/01	7+165	7+210	2.5	Proposed Road Development Mainline	Eastbound/ Standard
	NB07/02	0+000	0+250	2.5	N59 Letteragh Junction EB diverge	Eastbound/ Standard
		7+210	7+260			

Receiver No.	Structure Name	Start Chainage	End Chainage	Height (m)	Location	Lateral Siting / Type
109/110	NB07/03	7+180	7+440	2	Proposed Road Development Mainline	Westbound/ Standard
120a/120b	NB07/04	1+415	1+470	2	N59 Link Road South	Southbound/ Standard
	NB07/05	0+105	0+175	2	Letteragh Road L1323	Eastbound/ Standard
255a	NB07/06	0+030	0+065	2	Letteragh Road L1323	Eastbound/ Standard
	NB07/07	0+000	0+025	2	Letteragh Road L1323	Eastbound/ Standard
135/137/145/146a/ 146b/149/150/ 151b/151a/155	NB08/01	0+060	0+000	2.5	N59 Letteragh Junction WB diverge	Westbound /Absorptive
		8+010	8+070			
	NB08/02	8+070	8+280	2.5	Proposed Road Development Mainline	Westbound /Absorptive
	NB08/03	8+280	8+540	3	Proposed Road Development Mainline	Westbound/ Absorptive
140/142	NB08/04	8+100	8+230	3.5	Proposed Road Development Mainline	Eastbound /Absorptive
	NB08/05	8+230	8+375	4	Proposed Road Development Mainline	Eastbound/ Absorptive
	NB08/06	8+375	8+405	3.5	Proposed Road Development Mainline	Eastbound/ Absorptive
148a/153/156/158	NB08/07	8+545	8+850	2.5	Proposed Road Development Mainline	Eastbound/ Reflective
	NB08/08	8+850	9+500	2	Proposed Road Development Mainline	Eastbound/ Reflective
151/155	NB08/09	8+540	8+760	2.5	Proposed Road Development Mainline	Westbound/ Reflective

Receiver No.	Structure Name	Start Chainage	End Chainage	Height (m)	Location	Lateral Siting / Type
158	NB08/10	8+760	8+790	2	Proposed Road Development Mainline	Westbound/ Reflective
158/160	NB08/11	8+850	9+500	2	Proposed Road Development Mainline	Westbound/ Reflective
144/147/148a	NB08/12	8+405	8+525	3	Proposed Road Development Mainline	Eastbound/ Absorptive
	NB08/13	8+525	8+545	2.5	Proposed Road Development Mainline	Eastbound/ Reflective
158	NB08/14	8+800	8+850	2	Proposed Road Development Mainline	Westbound/ Reflective
168	NB09/01	9+990	10+100	1.5	Proposed Road Development Mainline	Eastbound/ Reflective
170/251a/251b	NB10/01	10+420	10+780	3	Proposed Road Development Mainline	Westbound/ Reflective
173/177/178	NB11/01	11+910	12+120	3.5	Proposed Road Development Mainline	Eastbound/ Reflective
174a	NB11/02	11+980	12+120	2.5	Proposed Road Development Mainline	Westbound/ Reflective
182/183	NB12/01	12+140	12+350	3	Proposed Road Development Mainline	Eastbound/ Absorptive
174a/174b/176	NB12/02	0+180	0+350	2	N84 Headford Road Junction WB diverge	Westbound/ Reflective
177a/177b	NB12/03	0+050	0+080	2	N84 Headford Road	Northbound/ Reflective

Receiver No.	Structure Name	Start Chainage	End Chainage	Height (m)	Location	Lateral Siting / Type
173/177a	NB12/04	0+090	0+150	2	N84 Headford Road	Northbound/ Reflective
191/192/193	NB12/05	12+910	13+020	2.5	Proposed Road Development Mainline	Westbound/ Absorptive
194/195/196	NB12/06	12+870	13+050	3.5	Proposed Road Development Mainline	Eastbound/ Absorptive
174a/174b/176	NB12/07	12+140	12+350	2.5	Proposed Road Development Mainline	Westbound/ Absorptive
192/193/198a	NB13/01	13+020	13+165	3	Proposed Road Development Mainline	Westbound/ Absorptive
194/195/196	NB13/02	13+050	13+120	3	Proposed Road Development Mainline	Eastbound/ Absorptive
197	NB13/03	13+160	13+370	2	Proposed Road Development Mainline	Eastbound/ Reflective
203/204/206/208	NB13/04	13+360	13+640	3	Proposed Road Development Mainline	Westbound/ Reflective
	NB13/05	13+590	13+935	3.5	Proposed Road Development Mainline	Westbound/ Absorptive
	NB13/06	0+240	0+000	3	N83 Tuam Road Junction WB merge	Westbound/ Reflective
		13+640	13+840			
212/213b	NB13/07	13+620	13+960	3.5	Proposed Road Development Mainline	Eastbound/ Absorptive
224-235	NB15/01	15+200	15+720	2.5	Proposed Road Development Mainline	Eastbound/ Reflective

The proposed noise mitigation set out above have been designed to sufficiently reduce traffic noise levels at or below the traffic noise design goal of 60dB L_{den}, where relevant.

The combined mitigation measures associated with the use of a LNRS surface in addition to physical noise screening has been assessed to provide the most suitable available noise mitigation at the nearest sensitive locations. Discussion on the residual impacts taking account of the proposed mitigation measures are outlined in **Section 17.7.2**.

17.7 Residual Impacts

17.7.1 Introduction

The residual impacts associated with the construction and operational phase are considered taking account of the proposed mitigation measures. These are discussed in the following sections.

17.7.2 Construction Phase

During the construction phase of the proposed road development noise levels at properties closest to working areas will be temporarily increased. The assessment has indicated that construction activities can, for the majority of activities 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 proposed road development. The most appropriate noise mitigation measures for each work area will be determined taking account of the various control measures included within **Section 17.6.2**, **Appendix A.17.3** and the CEMP in **Appendix A.7.5**. The various mitigation measures will be selected in order to control construction noise levels to within the limit values included in **Table 17.1**.

Once the various mitigation measures are put in place and the limit values complied with, noise impacts associated with the construction phase will be of moderate to major, short term impact. Highest noise impacts will occur during periods of excavation, particularly in areas where sections of hard rock are to be excavated. As noted within the earlier section, the use of drill and blast methods will likely be chosen in these areas. Whilst high noise levels are associated with an individual blast, the effects are momentary and the blast designs will be strictly controlled to ensure the AOP and PPV levels are within the specified limit values. The use of this form of rock breaking will expedite the level of rock extraction in any one any and hence reducing overall exposure times and overall impacts. Mechanical breaking, crushing and excavation of rock and materials will be strictly controlled through the use of control of noise at source, screening, scheduling of works to ensure noise limit values at the closest sensitive properties are not exceeded.

The assessment has indicated that the use of standard construction activities can operate comfortably within the recommended vibration limits for standard residential and other light-framed buildings. With the adoption of best practice methodologies for the control of vibration from blasting, potential vibration impacts

at the most sensitive premises can be adequately mitigated to within acceptable levels.

17.7.3 Operational Phase

The residual impacts associated with the proposed road development have been assessed for each modelled location. A full set of calculated residual noise levels for the 299 receiver locations are included in **Table A.17. 2.1** in **Appendix A.17.3**.

Table 17.15 overleaf presents the calculated residual noise levels for those locations where the conditions for mitigation were identified.

Table 17.15: Calculated Residual Noise Levels for Locations Requiring Noise Mitigation

Receiver Location Reference	Description	Opening Year 2024		Design Year 2039		Comment
		Predicted Noise Level		Predicted Noise Level		
		Do-Minimum	Do-Something	Do-Minimum	Do-Something	
		(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	
7	R336 West of Bearna West Roundabout	57	56	58	57	Meets design goal.
8	R336 East of Bearna West Roundabout	58	56	59	57	Meets design goal.
13	Na Foraí Maola Thoir	35	59	36	60	Meets design goal.
27	Na Foraí Maola Thiar (to be acquired)	44	58	44	59	Meets design goal.
40	Troscaigh Road	38	55	38	56	Meets design goal.
46	Troscaigh- Ann Gibbons Road	34	58	34	59	Meets design goal.
63a	Cappagh Road North	49	60	49	61	0.5dB above design goal. Mitigation in place.
63b	Cappagh Road North	49	58	49	59	Meets design goal.
65a	Cappagh Road North	47	56	48	57	Meets design goal.
65b	Cappagh Road North	39	58	39	58	Meets design goal.
66a	Cappagh Road South	44	58	45	59	Meets design goal.
66b	Cappagh Road South	48	59	48	60	Meets design goal.
67a	Cappagh Road South	45	59	45	59	Meets design goal.
74a	Ballymoneen Road South	50	59	51	59	Meets design goal.
74b	Ballymoneen Road South	35	59	35	59	Meets design goal.
75a	Ballymoneen Road South	52	59	52	60	Meets design goal.

Receiver Location Reference	Description	Opening Year 2024		Design Year 2039		Comment
		Predicted Noise Level		Predicted Noise Level		
		Do-Minimum	Do-Something	Do-Minimum	Do-Something	
		(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	
76	Ballymoneen Road North	51	60	51	60	Meets design goal.
79	Ballymoneen Road North	53	61	53	62	2dB above design goal. Dominated by traffic along Ballymoneen Road, property located outside the proposed development boundary
80a	Ballymoneen Road North	53	61	53	62	2dB above design goal. Dominated by traffic along Ballymoneen Road. Property access restricts additional mitigation
80b	Ballymoneen Road North	47	60	47	60	Meets design goal.
86	Árd na Gaoithe - Ballymoneen	39	57	39	57	Meets design goal.
88	Árd na Gaoithe - Ballymoneen	40	56	40	56	Meets design goal.
95	Clybaun Road North	42	56	42	57	Meets design goal.
96	Clybaun Road North	45	57	45	57	Meets design goal.
106	Between Rahoon & Letteragh Road	36	58	37	59	Meets design goal.
107	Letteragh Road North	43	58	46	59	Meets design goal.
108	Letteragh Road North	42	57	44	58	Meets design goal.
109	Letteragh Road South	42	57	44	58	Meets design goal.
110	Letteragh Road South	43	59	44	60	Meets design goal.
116	Knocknabrona (to be acquired)	36	59	37	60	Meets design goal.
118	Knocknabrona (to be acquired)	36	58	37	58	Meets design goal.

Receiver Location Reference	Description	Opening Year 2024		Design Year 2039		Comment
		Predicted Noise Level		Predicted Noise Level		
		Do-Minimum	Do-Something	Do-Minimum	Do-Something	
		(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	
120a	Letteragh Road South	45	58	48	59	Meets design goal.
120b	Letteragh Road South	44	58	46	59	Meets design goal.
134	Barnacranny	41	54	41	55	Meets design goal.
136	Barnacranny	50	58	51	59	Meets design goal.
138	The Heath	44	59	44	60	Meets design goal.
139	N59 Moycullen Road/ Árd na Locha	61	61	62	61	In line with Do Minimum scenario. No further mitigation
140	Barnacranny	49	60	50	61	1dB above design goal. Substantial mitigation in place.
142	N59 Moycullen Road/ Árd na Locha	51	58	51	58	Meets design goal.
144a	Árd an Locha (to be acquired)	55	58	55	59	Meets design goal.
144b	Árd an Locha (to be acquired)	58	58	58	59	Meets design goal.
145	The Heath	47	57	47	58	Meets design goal.
146a	Árd an Locha	46	56	46	57	Meets design goal.
146b	Árd an Locha	50	59	51	59	Meets design goal.
147a	Árd an Locha	59	60	60	60	Meets design goal.
148a	N59 Moycullen Road/ Aughnacurra	62	61	62	61	In line with Do Minimum scenario.
149	Circular Road Upper Dangan	47	56	48	57	Meets design goal.

Receiver Location Reference	Description	Opening Year 2024		Design Year 2039		Comment
		Predicted Noise Level		Predicted Noise Level		
		Do-Minimum	Do-Something	Do-Minimum	Do-Something	
		(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	
150	St. James' National School Upper Dangan	48	56	48	56	Meets design goal.
151a	Upper Dangan /N59 Moycullen Road	60	62	60	62	2dB above design goal. Traffic along local road (N59 Moycullen Road), minor difference between Do-Nothing and Do-Something scenarios
151b	Upper Dangan /N59 Moycullen Road	57	60	58	60	Meets design goal.
152	Aughnacurra	49	54	49	54	Meets design goal.
153	Aughnacurra (to be acquired)	56	59	57	60	Meets design goal.
154	Aughnacurra	51	57	52	58	Meets design goal.
155	Upper Dangan/N59 Moycullen Road	61	62	62	63	Along N59 Moycullen Road, minor increase.
156	Aughnacurra	45	56	45	57	Meets design goal.
157	N59 Moycullen Road	64	63	64	63	Reduced to below / in line with Do Min. Dominated by N84 Headford Road Traffic
158	NUIG	49	59	50	60	Meets design goal.
160	NUIG	46	57	46	58	Meets design goal.
162	N59 Moycullen Road/NUIG	59	60	60	60	Meets design goal.
163	Dangan House	43	55	44	56	Meets design goal.
165	Menlo Castle	45	55	45	56	Meets design goal.

Receiver Location Reference	Description	Opening Year 2024		Design Year 2039		Comment
		Predicted Noise Level		Predicted Noise Level		
		Do-Minimum	Do-Something	Do-Minimum	Do-Something	
		(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	
167	Menlough/ Bóthar Nua	42	56	43	57	Meets design goal.
168	Coolough Road	42	59	42	59	Meets design goal.
170	Menlough / Seanbothar	55	60	55	61	0.5dB above design goal, not significant.
173	Ballindooley Boithrin / N84 Junction	56	60	57	61	1dB above design goal, not significant.
174b	N84 Headford Road Junction South	58	60	59	60	Meets design goal.
176	N84 Headford Road Junction South	56	58	56	59	Meets design goal.
177a	N84 Headford Road Junction	62	61	62	61	Reduced to below / in line with Do Min
177b	N84 Headford Road Junction	64	63	64	63	Reduced to below / in line with Do Min
178	Ballindooley Boithrin / N84 Junction	52	57	52	58	Meets design goal.
181	N84 Headford Road Junction	68	68	69	69	Reduced to Do Min level. Dominated by N84 Headford Road Traffic
183	N84 Headford Road Junction	62	62	62	62	Reduced to Do Min level. Dominated by N84 Headford Road Traffic
187	Bóthar an Chóiste	51	57	52	57	Meets design goal.
188	Bóthar an Chóiste	49	59	49	60	Meets design goal.
190	Bóthar an Chóiste	49	58	49	59	Meets design goal.
191	Castlegar	47	57	47	58	Meets design goal.
192	Castlegar	48	58	48	59	Meets design goal.

Receiver Location Reference	Description	Opening Year 2024		Design Year 2039		Comment
		Predicted Noise Level		Predicted Noise Level		
		Do-Minimum	Do-Something	Do-Minimum	Do-Something	
		(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	
193	Castlegar	48	55	48	56	Meets design goal.
194	School Road North	50	60	50	60	Meets design goal.
195 b	School Road (to be acquired)	59	62	59	62	2dB above design goal. Property to be acquired. Substantial mitigation in place.
196	School Road North	49	58	50	59	Meets design goal.
197	Castlegar School	58	58	58	58	Meets design goal.
198a	Castlegar/ School Road South (to be acquired)	54	60	54	61	0.5dB above design goal. Property to be acquired
203	Castlegar	49	57	49	57	Meets design goal.
204	Castlegar / N83 Tuam Road	52	57	52	58	Meets design goal.
206	Castlegar / N83 Tuam Road	59	60	59	61	Minor increase due to traffic along N83 Tuam Road
207b	Castlegar/ N83 Tuam Road South	61	60	62	60	Reduced to below Do Min. Dominated by N83 Tuam Road.
208	Castlegar / N83 Tuam Road	56	60	56	61	1dB above design goal. Substantial mitigation in place
209	City North Park Link Road	58	58	58	59	Meets design goal.
212a	N83 Tuam Road North (rear)	53	59	53	60	Meets design goal.
212b	N83 Tuam Road North (front)	55	60	55	61	1dB above design goal.

Receiver Location Reference	Description	Opening Year 2024		Design Year 2039		Comment
		Predicted Noise Level		Predicted Noise Level		
		Do-Minimum	Do-Something	Do-Minimum	Do-Something	
		(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	(dB) L_{den}	
213b	N83 Tuam Road North/Ceapach na Boirne	63	62	63	63	In line with Do Minimum scenario.
224	Racecourse Ave, Ballybrit	53	56	53	57	Meets design goal.
233	Ballybrit Crescent	58	58	58	58	Meets design goal.
234b	Ballybrit Crescent	53	56	54	56	Meets design goal.
235	Ballybrit Crescent	55	58	55	59	Meets design goal.
236	Ballybrit Crescent	53	55	53	56	Meets design goal.
242	Monivea Road R339 East	56	58	56	58	Meets design goal.
246	Coolagh Village	56	59	57	60	Meets design goal.
251a	Menlough / Seanbothar	42	57	42	58	Meets design goal.
251b	Menlough / Seanbothar	47	58	47	59	Meets design goal.
257	Cappagh Road South	45	59	45	59	Meets design goal.
259	Troscaigh Thoir	43	58	43	59	Meets design goal
263	Maoilin	35	59	36	59	Meets design goal
269	Maoilin	34	58	35	59	Meets design goal
270	Coolagh	58	59	59	59	Meets design goal

17.7.3.1 Residual Noise Level

The results of the assessment have indicated that along the length of the proposed road development, traffic noise levels at or below 60dB L_{den} can be achieved, and/or the Do-Something noise levels can be reduced to the equivalent Do-Nothing traffic noise levels at the majority of locations with the recommended mitigation measures in place.

There are a small number of instances where a residual noise level of 1 to 2dB above the design goal remains. These locations primarily relate to properties which are to be acquired (R195, 198a), remain dominated by traffic along the local road network which falls outside the proposed development boundary (R79, R206), or where access onto the local road restricts physical additional mitigation (R63a, R80a). There are a small number of properties along the proposed road development where a residual noise level of 61 to 62dB L_{den} is calculated (R140, 151a, 155, 170, 173, 208 and 212). Whist these exceedances are strictly above the design goal, reducing traffic noise levels to at or below 60dB L_{den} at these properties will require substantial additional barrier lengths and heights over and above those in place in order to achieve an insignificant change to the overall noise level at a property.

The 2004 TII noise guidance document notes the following with respect to achievement of the noise design goal:

> *"The Authority accepts that it may not always be sustainable to provide adequate mitigation in order to achieve the design goal. Therefore, a structured approach should be taken in order to ameliorate as far as practicable."*

The 2014 noise guidance document notes that:

> *"in some cases the attainment of the design goal may not be possible by sustainable means".*

This guidance document also notes that caution should be exercised specifying substantial screening where small benefits (<3dB) are only achieved, given a change of 3dB(A) is the smallest change that would give a reliable difference in public response. Specifically, the TII 2014 document goes on to note that:

> *"It may be unsustainable to increase barrier dimensions significantly where the result would be a reduction of 1dB or less, as such a reduction would be close to imperceptible in a laboratory situation, and would not result in a difference in public response in the real world environment."*

In this instance, the extent of screening deemed feasible to achieve the target design goal at the relevant properties has been assessed, taking into account a level of proportionality with respect to changes in noise levels.

17.7.3.2 Evaluation of Residual Impacts

Section 17.7.3.1 presents the residual noise levels once noise mitigation has been included along the length of the proposed road development including a low noise road surface and an extensive number of acoustic barriers. As noted in the previous section, with the inclusion of the noise mitigation measures, noise levels are at or below the TII operational noise design goal of 60dB L_{den} at the majority of assessment locations (properties, schools, churches etc.) or have been reduced to within or below the pre-existing noise level.

In line with the methodology outlined in **Section 17.2.5.3**, in order to evaluate the significance of noise impacts, the following approach has been undertaken.

- Baseline noise levels (or Calculated Do-Minimum noise levels where road traffic dominates) are compared against the calculated Do-Something noise levels to determine the increase in noise levels
- The significance of change is assigned to each location based on the magnitude of change ratings from the DMRB short term table (Year of Opening) and long-term table (Design Year)
- Comment on the absolute noise levels against annoyance levels from population response studies

Table 17.16 summarises the number of properties categorised within each rating band for the year of opening and the Design Year based on the DMRB assessment tables only.

Table 17.16: Change in Noise Levels

Short-Term Impacts – Year of Opening			**Long-Term Impacts - Design Year**		
Noise Change, dB	**Magnitude**	**No of assessed properties**	**Noise Change, dB**	**Magnitude**	**No of assessed properties**
0	No Change/Reduction	99	0	No Change/Reduction	83
0.1 - 0.9	Negligible	18	0.1 – 2.9	Negligible	45
1 – 2.9	Minor	17	3 – 4.9	Minor	28
3 – 4.9	Moderate	31	5 – 9.9	Moderate	90
5+	Major	134	10+	Major	53
Total		299			299

During the Year of Opening (2024), the assessment has concluded that, 134 of the modelled receptors will experience a 'Major' short-term noise impact, which relates to any noise increase above 5dB. A total of 31 locations will experience a 'Moderate' noise impact as a result of the change in the noise environment. At the remaining locations, the impacts are categorised as 'No Change' to 'Minor'.

During the Design Year of 2039, the assessment has concluded that 53 of the modelled receptors will experience a 'Major' long-term noise impact in accordance with the DMRB, which relates to any noise increase above 10dB. A total of 90

locations will experience a 'Moderate' noise impact as a result of the change in the noise environment. At the remaining locations, the impacts are categorised as 'No Change/Reduction' to 'Minor'. Assessment locations where a reduction in noise levels are calculated relate to properties along the existing road network where traffic volumes will be reduced as a result of the proposed road development.

Further analysis of the absolute noise levels for properties assigned a Moderate and Major change in noise levels for the two assessment years is presented in **Tables 17.17** and **17.20**, in order to provide context on the likely level of annoyance response relating to road traffic noise level exposure based on the EEA exposure-response studies, as discussed **in Section 17.2.5.3**.

Table 17.17: Assessment of Absolute Noise Level Annoyance Levels relating to Moderate Change in Noise Levels – 2024

Locations with Moderate Change in Noise Levels - Opening Year – 2024					
Change in Noise Level, Impact Rating	**Calculated Noise Levels**	**No properties**	**% Population 'Annoyed'**	**% Population 'Highly Annoyed'**	**Receptor Type, Comments**
Moderate	48	1	9	3	Residential
	49	1	10	3	Residential
	50	3	11	4	Residential
	51	1	12	4	Residential
	52	1	13	5	Residential
	53	1	15	5	Residential
	54	4	16	6	Residential
	55	3	18	6	Residential
	56	4	19	7	Residential
	57	2	21	8	Residential. 1 Amenity & Community facility (Moderate sensitivity)
	58	1	22	9	Residential
	59	4	24	9	Residential. 1 property to be acquired
	60	3	26	10	Residential
	61	1	27	11	Residential property to be demolished
	62	1	29	12	Residential property to be acquired

Reference to **Table 17.17** above indicates that where a 'Moderate' change in noise levels has been determined in accordance with the DMRB short-term assessment table, absolute noise levels are calculated in the range of 49 to 60dB L_{den} (excluding properties being acquired or demolished as part of the proposed road development).

The majority of assessment locations are residential properties (high sensitivity) and all residential properties in this category are below the TII design goal of 60dB L_{den}.

There is one amenity/community area at NUIG Sporting Campus categorised as moderate sensitivity. The calculated noise level in this area is 57dB L_{den} which is considered an acceptable noise level for outdoor amenity use.

Table 17.18: Assessment of Absolute Noise Level Annoyance Levels relating to Major Change in Noise Levels – 2024

Locations with Major Change in Noise Levels - Opening Year – 2024					
Change in Noise Level, Impact Rating	**Calculated Noise Levels**	**No properties**	**% Population Annoyed**	**% Population Highly annoyed**	**Receptor Type, Comments**
Major	49	2	10	3	Residential
	50	2	11	4	Residential
	51	3	12	4	Residential
	52	4	13	5	Residential
	53	9	15	5	Residential & 1 nursing home
	54	14	16	6	Residential
	55	14	18	6	Residential. 1 property to be acquired. 1 property to be demolished, 1 amenity area, 1 commercial
	56	14	19	7	Residential
	57	23	21	8	Residential, 1 property to be acquired
	58	18	22	9	Residential, 2 properties to be acquired
	59	16	24	9	Residential, 1 property to be acquired. 1 amenity area
	60	9	26	10	Residential, 1 property to be acquired
	61	4	27	11	Residential, 1 property to be demolished
	62	1	29	12	Commercial, building to be demolished

Locations with Major Change in Noise Levels - Opening Year – 2024					
Change in Noise Level, Impact Rating	**Calculated Noise Levels**	**No properties**	**% Population Annoyed**	**% Population Highly annoyed**	**Receptor Type, Comments**
	63	1	31	14	Residential, building not habitable

During the Opening Year, where a 'Major' change in noise levels has been determined in accordance with the DMRB short-term assessment table, absolute noise levels are calculated in the range of 49 to 61dB L_{den} (excluding properties being acquired or demolished as part of the proposed road development).

The majority of assessment locations are residential properties (high sensitivity) and all residential properties not being demolished in this category are below the TII design goal of 60dB L_{den} with the exception of 4 properties, 1 of which remains unoccupied and 3 of which are dominated by traffic along local roads.

There is one nursing home in this impact category (high sensitivity) with an absolute noise level calculated at 53dB L_{den} which is below a level whereby noise levels are considered intrusive or at a level that would cause any significant annoyance to the general population. There are two amenity areas of moderate sensitivity i.e. Menlo Castle and NUIG Sporting Campus with a calculated level of 55dB L_{den} and 59dB L_{den} respectively. The NUIG location is immediately adjacent to the alignment of the proposed road development. There is 1 commercial property (Dangan House) with a low sensitivity with a calculated noise level of 55dB L_{den}.

Table 17.19: Assessment of Absolute Noise Level Annoyance Levels relating to Moderate Change in Noise Levels – 2039

Locations with Moderate Change in Noise Levels - Opening Year – 2039					
Change in Noise Level, Impact Rating	Calculated Noise Levels	No properties	% Population Annoyed	% Population Highly annoyed	Receptor Type, Comments
Moderate	49	2	10	3	Residential
	50	2	11	4	Residential
	51	6	12	4	Residential
	52	1	13	5	Residential
	53	6	15	5	Residential & 1 nursing home
	54	7	16	6	Residential
	55	6	18	6	Residential
	56	11	19	7	Residential (1 property to be acquired, 1 to be demolished) 1

Locations with Moderate Change in Noise Levels - Opening Year – 2039					
Change in Noise Level, Impact Rating	Calculated Noise Levels	No properties	% Population Annoyed	% Population Highly annoyed	Receptor Type, Comments
					amenity area, 1 commercial
	57	9	21	8	Residential, 1 property to be acquired
	58	8	22	9	Residential, 1 amenity area
	59	13	24	9	Residential
	60	8	26	10	Residential, 1 amenity area
	61	7	27	11	Residential, 1 to be acquired
	62	3	29	12	Residential
	64	1	33	15	Building not habitable

Reference to **Tables 17.19** above indicates that where a 'Moderate' change in noise levels has been determined in accordance with the DMRB long-term assessment table for the design year, absolute noise levels are calculated in the range of 49 to 62dB L_{den} (excluding properties being acquired or demolished as part of the proposed road development).

The property types are predominately residential and hence are high sensitivity receptors. There are 10 residential properties with a residual noise level in the range of 61 to 62dB L_{den} (Refer to **Table 17.17** for specific receiver details). For all other residential properties where a moderate change in noise level is determined, the absolute noise level is below the 60dB L_{den} design goal.

There is one nursing home in this impact category (high sensitivity) with an absolute noise level calculated at 53dB L_{den}. There is one amenity area (Menlo Castle) of moderate sensitivity and 1 commercial property (Dangan House) with a low sensitivity, with a calculated level of 56dB $L_{den.}$ There are two assessment locations within the NUIG Sporting Campus (moderate sensitivity) with calculated noise levels in the range of 58 to 60dB $L_{den.}$ It should be noted, these locations are calculated in close proximity to the road alignment. Noise levels in this area reduce at the playing areas and amenity walking areas located further north and south of the proposed road alignment.

Table 17.20: Assessment of Absolute Noise Level Annoyance Levels relating to Major Change in Noise Levels – 2039

Locations with Major Change in Noise Levels - Opening Year – 2039					
Change in Noise Level, Impact Rating	**Calculated Noise Levels**	**No properties**	**% Population Annoyed**	**% Population Highly annoyed**	**Receptor Type, Comments**
Major	54	4	16	6	Residential
	55	6	18	6	Residential
	56	7	19	7	Residential
	57	8	21	8	Residential
	58	11	22	9	Residential, 1 property to be acquired
	59	10	24	9	Residential, 1 property to be acquired
	60	5	26	10	Residential, 1 property to be acquired
	61	1	27	11	Residential. Property to be demolished
	63	1	31	14	Commercial. Property to be demolished

During the design year, where a 'Major' change in noise levels has been determined in accordance with the DMRB long-term assessment table, absolute noise levels are calculated in the range of 54 to 60dB L_{den} (excluding properties being acquired or demolished as part of the proposed road development). All properties in this category which are not being acquired or demolished are residential and are all below the TII design goal of 60dB L_{den}.

Summary of Residual Impacts

Taking into account the proposed noise mitigation measures, the calculated residual noise levels, the increase in noise levels, and the absolute noise level under consideration, the impact of the residual noise impacts associated are determined as follows:

- Operational noise levels have been designed to not exceed the TII design goal of 60dB L_{den} at the majority of the noise sensitive locations along the proposed road development
- Absolute noise levels associated with both 'Moderate' and 'Major' changes in noise levels are in the range of 48 to 62dB $L_{den.}$ The percentage of the population typically highly annoyed by road traffic noise in this range is 3 to 12% respectively. This represents a low percentage of the population likely to

experience high levels of annoyance when exposed to the range of noise levels under consideration

- Whilst a higher number of locations are determined to experience a 'Major' change in noise levels during the opening year, the absolute noise level under consideration are below a level that would pose high levels of annoyance to the typical population in accordance with published data
- During the design year, the number of properties determined to experience a 'Major' change in noise levels is significantly reduced compared to the opening year due to the threshold values for impact ratings in the long-term period
- Taking account of the factors above, it is considered that residual noise impacts across the full extent of the proposed road development are determined to be imperceptible to significant, with the majority of properties overall, experiencing an imperceptible to moderate impact

Comment on Schools Along the Proposed Road Development

There are two schools located in proximity to the proposed road development, St. James' National School in Bushypark and Castlegar School off School Road. Both schools have been assessed in terms of their noise impacts. Calculated noise levels at St James' National School are 56dB L_{den} taking account of noise mitigation in this area. This represents a minor increase above the pre-existing noise environment and is an acceptable external noise levels for school buildings.

Calculated noise levels at Castlegar school are made along the southern façade and rear facades facing the proposed road development. Taking account of the screening provided by the extensive cutting in this area, the proposed low noise road surface and noise barrier, residual noise levels are calculated in the range of 56 to 58dB $L_{den.}$ Taking account of baseline noise levels measured at the school and adjacent properties along School Road, this represents a minor change in the noise environment and is an acceptable external noise levels for school buildings.

Reduction in Traffic Along Existing Road Network

The proposed road development will result in a reduction in traffic volumes along the existing road network, particularly along routes traversing Galway City Centre.

It is possible to determine the approximate change in noise levels between the Do Minimum and Do Something scenarios using the traffic volumes calculated for the wider road network within Galway City. Using the same formulae described in **Section 17.5.3.2**, the reduction in traffic noise levels along the existing road network across Galway City is calculated and presented in **Table 17.21**.

Table 17.21: Calculated Reduction in Traffic Noise Levels along Existing Road Network - 2039

Road Link	Do Minimum		Do Something		Estimated Reduction in Traffic Noise Level, dB
	AADT	% HGV	AADT	% HGV	
N6 South of Briarhill	31,459	7%	18,553	6%	-3
N6 Near Ballybrit Business Park	25,974	7%	15,440	5%	-3
N6 between N83 and R865	26,749	6%	18,599	3%	-3
N6 Between N84 and N83	20,691	5%	11,442	4%	-3
N6 East of Quincentenary Bridge	24,315	6%	23,059	5%	-1
N6 - On Quincentenary Bridge	34,546	7%	24,437	5%	-3
R338 at Westside Playing fields	14,061	5%	7,538	1%	-7
Western Distributor Road between Clybaun Road and R338	11,657	2%	7,975	1%	-3
Western Distributor Road between Clybaun Road and Ballymoneen Road	8,959	1%	7,153	0%	-2
R337 Kingston Road. Kingston	11,955	4%	7,097	0%	-6
R336 Salthill Road Upper Galway Golf Course.	11,677	2%	9,648	2%	-1
R336 Bearna Road. Bearna Woods	16,273	2%	4,321	0%	-9
R336. Bearna Road. Bearna. Creagan Bus Stop	12,666	3%	2,951	0%	-10
Boleybeg Road. Between Cappagh Road and Ballymoneen Road	1,937	1%	713	1%	-3
N59. Thomas Hynes Road. Between Hazel Park and Cherry Park	6,642	2%	5,121	0%	-4
N59. Upper Newcastle Road. Between R338 and Corrib Village	12,920	2%	10,810	0%	-4
N59. Barnacranny. Between Chesnut Lane and Circular Road	18,050	2%	14,687	0%	-4
N84. South of Ballindooley. Ballindooley Lough	14,298	6%	17,754	3%	-1
R338. Dublin Road. West of Junction with Coast Road.	18,606	8%	17,703	7%	-1
R338. Dublin Road. Between Renmore Road and Michael Collins Road	17,742	7%	17,005	5%	-1
R336. Tuam Road. Mervue Business Park	16,980	7%	13,146	6%	-2
Wolfe Tone Bridge	18,074	4%	14,613	4%	-1
O'Briens Bridge	9,725	4%	9,010	3%	-1
Salmon Weir Bridge	17,910	1%	14,644	2%	-1
Eglington Street	5,420	3%	4,728	2%	-2

Road Link	Do Minimum		Do Something		Estimated Reduction in Traffic Noise Level, dB
	AADT	% HGV	AADT	% HGV	
Cappagh Road - North of GCRR	548	0%	257	0%	-3
N6 East of Ballybrit	26,992	7%	17,179	4%	-3
N59 South of Link to Interchange	18,050	2%	14,687	0%	-4
Gort Na Bró South of Rahoon Road	2,927	0%	2,110	0%	-1
Western Distributor Road - East of Gort Na Bró	11,779	2%	8,065	1%	-3

Referring to **Table 17.21** the estimated reduction in traffic noise levels along the existing road network across Galway City is in the range of 1 to 10dB. The greatest reduction in noise levels will be experienced along sections of the R336, R337, R338 and the N59 Roads with estimated traffic noise reductions ranging between 4 and 10dB. There are extensive areas of high sensitive locations along and in proximity to these routes including high numbers of residential areas, educational buildings and hospitals which will therefore experience a moderate to major positive impact as a result of the proposed road development.

Referring the Galway City Noise Action Plan (2013 – 2018), sections of the N6, R336, R338, N84 and N59 which are identified as areas qualifying for noise management due to high traffic noise levels (>70dB L_{den} and > 57dB L_{night}) will experience a reduction in noise levels as a result of the proposed road development and hence will achieve part of the Noise Action Plan objectives.

The reduction in high volumes of traffic traversing the city centre will result in a positive moderate to major noise impact to an extensive number of noise sensitive properties along a large portion of the existing road network.

Night-Time Noise Levels

The TII guidelines do not prescribe any night-time noise limit values within its guidance document. The L_{den} parameter by its nature, however is a composite parameter relating to noise levels over day, evening and night-time periods. The 60dB L_{den} deign goal included in the TII documents for road projects therefore includes noise levels over all three periods.

The DMRB Volume 11 Section 3 Part 7 (2011), notes that night-time noise levels at or below 55dB L_{night} are not considered for impact rating. This is based on information contained in the WHO Night Noise Guidelines (2009) which sets an interim target level of 55dB L_{night} across Europe. The assessment notes that where locations exceed a night-time noise level of 55dB $L_{night,}$ the impact rating relating to changes in the noise environment are assessed using the DMRB long-term assessment table.

The Galway City and Galway County Noise Action Plans both set an onset noise level of 57dB L_{night} for areas where noise management should be put forward for consideration.

Night-time noise levels are calculated as part of the L_{den} calculation procedure and are presented separately in **Appendix A.17.3** for each assessment location. There are a total of 33 properties included as part of this assessment which exceed a night-time noise level of 55dB L_{night}. All of these properties are along existing national and regional routes namely the N6, N83, N84 and N59 and R446. At 19 of these properties, night-time noise levels will be reduced as a result of the proposed road development and hence will experience a positive impact. At the remaining 14 properties, night-time noise levels are increased by 0.2 to 2.8dB L_{night} with an impact rating of negligible.

Specific comment in relation to night-time noise levels and associated health impacts are discussed in **Chapter 18, Human Beings, Health and Population**.

17.7.4 Cumulative Impacts

The traffic data used as part of the noise impact assessment is based on future modelled scenarios taking account of other committed and proposed road developments below which have the potential to generate traffic volumes within the study area:

- M17 Galway to Tuam Road Project (operational)
- N18 Oranmore to Gort Road Project (operational)
- N17 Tuam Bypass (operational)
- M6 Motorway (operational)
- N59 Maam Cross to Oughterard Road Project (consented and pre-construction)
- N59 Maigh Cuilinn (Moycullen) Bypass Road Project (consented and pre-construction)
- Galway Transport Strategy (GTS), which includes the following:
    - Investigation of prospective sites to the east of the city for Park and Ride
    - Bearna Greenway
    - Galway to Oughterard (part of the Galway to Clifden) Greenway
    - Galway City to Oranmore (part of the Galway to Dublin) Cycleway

Further details on the traffic modelling forecasts are set out in **Chapter 6, Traffic Assessment and Route Cross Section**.

The cumulative traffic noise impacts have been assessed at each of the receptor locations considered as part of this assessment. During the Do-Nothing scenario, road traffic flows along the existing road network have been modelled and the cumulative traffic noise level calculated. For the modelled Do-Something scenarios, road traffic along the existing road network coupled with traffic along the proposed road development are combined to obtain a cumulative traffic noise level. The assessment takes account of any alignment alterations to the existing roads and junction and the re-distribution of traffic along the existing road network as a result of the proposed road development.

In this regard the cumulative road traffic noise impacts are incorporated into the calculated operational noise levels set out in **Table 17.13** and **Table 17.15**.

In relation to cumulative construction impacts, other committed or proposed construction projects have been reviewed in the vicinity of Galway City and County including the N59 Maam Cross to Oughterard Road Project (consented and pre-construction), N59 Moycullen Bypass (consented and pre-construction), M6(M17/M18) Motorway Service Area (pre-planning. All of these projects are set back at considerably distances from the proposed road development such that if under construction at the same time, no cumulative noise and vibration impacts would occur.

Whilst there is the potential to be other small local construction activities across the study area during the construction phase, for the purposes of this assessment it has been assumed that works associated with the proposed road development will be the dominant noise and vibration source at any one location.

17.8 Summary

An assessment relating to the potential noise and vibration impacts of the proposed road development has been determined for both the construction phase and the operational phase.

During the construction phase, the assessment has determined that noise impacts will be negative moderate short-term and in some instances negative significant and momentary depending on the activities involved. The use of best practice noise control measures, hours of operation, scheduling of works within appropriate time periods, strict construction noise limits and noise monitoring during this phase will ensure impacts are controlled to within the adopted criteria. Similarly, vibration impacts during the construction phase will be well controlled through the use of low impact equipment and adherence to strict limit values which will be subject to monitoring at the nearest sensitive buildings.

During the operational phase, noise levels will be increased at the majority of noise sensitive locations along the length of the proposed road development. Whilst noise levels of varying increases and impact magnitudes are calculated at the assessment locations, the incorporation of a low noise road surface and the use of noise barriers along the proposed roadside boundary will reduce noise levels to within the design goal of 60dB L_{den} or to the pre-existing Do Minimum noise levels at the majority of noise sensitive locations. Residual noise levels at a small number of locations will remain above the 60dB L_{den} design goal by 1 to 2dB. The assessment has concluded that changes in road traffic noise levels will be negligible to major in accordance with DMRB guidance. The overall noise impact at the assessment locations taking account of the change in the noise environment, the absolute noise levels under consideration and the typical population response to the absolute noise levels under consideration across the study area is determined to be imperceptible to significant, with the majority of properties overall experiencing a slight to moderate impact

Overall, noise levels will be increased at properties along the route of the proposed road development once operational and a change in the noise environment will occur. The proposed road development, however, has been designed to reduce operational noise levels to within national design guidelines through the incorporation of detailed noise mitigation measures. The number of properties along its route is relatively low compared to those within the city centre which are

currently exposed to significantly higher noise levels from passing road traffic. The reduction in high volumes of traffic traversing the city centre will result in a moderate to major positive noise impact to an extensive number of noise sensitive properties along the existing road network.

17.9 References

BS 5228. (2009 *+A1 2014*) *Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise.*

BS 5228. (2009*+A1 2014*) *Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration*.

BS 6472. (2008) *Guide to evaluation of human exposure in buildings - Part 2: Blasting.*

European Communities *Noise Emission by Equipment for Use Outdoors) Regulations*, 2001.

Design Manual for Roads and Bridges (DMRB). Volume 11 *Environmental assessment Section 3 environmental assessment techniques. Part 7 hD 213/11 – revision 1 – Noise and Vibration*.

EEA. 'Good Practice Guide on Noise Exposure and Potential Health Effects' (EEA Technical Report 11/2010).

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