Chapter 14
Noise and Vibration

Contents

14. Noise and Vibration

14.1. Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies, describes and presents an assessment of the likely significant noise and vibration effects of the proposed DART+ South West Project on the receiving environment during both the construction and operational phases of the proposed Project.

The assessment presented is informed by, and should be read in conjunction with, the following key chapters of the EIAR:

- Chapter 4 Project Description;
- Chapter 5 Construction Strategy;
- Chapter 6 Traffic and Transportation;
- Chapter 7 Population;
- Chapter 8 Biodiversity;
- Chapter 9 Land and Soils;
- Chapter 15 Landscape & Visual;
- Chapter 21 Architectural Heritage; and
- Chapter 23 Human Health.

14.1.1. Noise

14.1.1.1. Airborne Noise

In air sound pressure levels are expressed in decibels (dB) relative to 20 microPascals on a logarithmic scale. In terms of sound pressure levels, audible sound ranges from 0 dB (i.e. the threshold of hearing) to the threshold of pain at 120dB. A doubling/halving of pressure equates to a 3 dB increase/decrease in decibel level. Typically, under normal circumstances, a 3 dB change in environmental noise level is the smallest noticeable to the human ear. A 10 dB increase/decrease in sound level normally equates to a subjective doubling/ halving of noise.

The frequency of sound is the rate at which a sound wave oscillates and is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250 Hz. A mechanism known as "A-weighting" has been adopted in order to account for this non-linearity of the human ear. Sound levels expressed using "A-weighting" are typically denoted dB(A). An indication of the level of common sounds on the dB(A) scale is presented in Figure 14-1 (based on guidance taken from: Environmental Protection Agency Office of Environmental Enforcement (OEE) - Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4).

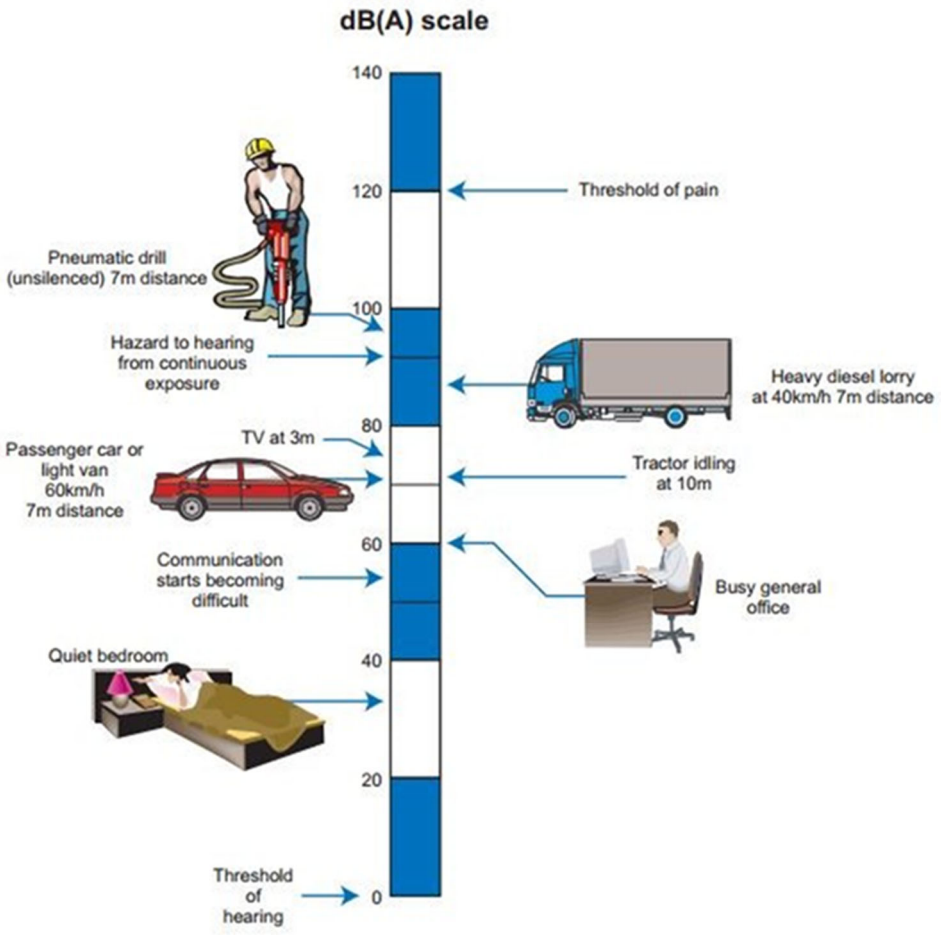

Figure 14-1 A-weighted dB scale

Environmental noise impacts are assessed using the L_{Aeq} metric which is a measure of the 'equivalent' sound energy and is a combination of the noise level and the duration of the noise event. The L_{Aeq} metric is the 'equivalent' noise level over a defined period and in this project takes into account the cumulative noise impact of multiple trains with different noise emissions.

The L_{Aeq} metric is therefore stated for a specific time period, e.g. 16 hours for the day period ($L_{Aeq,\ 16\ hours}$) and 8 hours for the night ($L_{Aeq,\ 8\ hours}$, or L_{night}) period in this report. Different L_{Aeq} limits are applied during the daytime and night-time.

14.1.1.2. Ground Borne Noise

Railway-induced vibration can be associated with ground borne noise, particularly if running under dwellings. The relative significance of ground borne noise and vibration depends on the soil type[1]. Dowding (1996)[2] proposed four classes of earth materials for assessing the effects of noise and vibration. The land and soils are described in Chapter 9 of this EIAR and comprise in the main Dublin Boulder Clay over limestone. Boulder Clay is regarded by Dowding (1996) as a 'hard' soil which will result in dominant frequencies around 50 Hz, i.e. low frequency.

[1] Wiss (1981), Construction Vibrations: State of the Art, Journal of the Geotechnical Engineering Division, ASCE, Vol. 107, Issue 2
[2] Dowding, C., Construction Vibrations, Prentice Hall, New Jersey

The proposed Project has one underground section through the Phoenix Park Tunnel, but no residential buildings are located over this section.

14.1.2. Vibration

Vibration sources on this Project include construction related vibration from activities such as piling and the use of heavy construction equipment. During the operational phase, vibration can be generated from rail traffic.

Vibration from rail traffic is most often generated by the contact between the train wheel and the railway track. Generally, the magnitude of the ground vibration reduces with distance from the track, however the magnitude of vibration may increase inside tall buildings due to resonances of the building structures. In spite of this, vibration caused by passing trains is at too low a level to cause even cosmetic damage to buildings.

The human body is quite sensitive to vibration, which can lead to annoyance at levels that do not cause any damage to a structure or impairment to a person. The most common vibration criterion for construction vibrations is expressed in terms of Peak Particle Velocity (PPV) expressed in millimetres per second (mm/s). For the operational phase guidance will be taken from BS6472-1:2008 using the Vibration Dose Value (VDV) expressed in $m/s^{1.75}$.

14.2. Legislation, Policy and Guidance

The key legislation and guidance referenced in the preparation of the EIAR is outlined in Chapter 1: Introduction (Sections 1.5, 1.6 and 1.7). In summary, the Transport (Railway Infrastructure) Act 2001 (as amended) provides for the making of a Railway Order application (also referred to herein as “the proposed Project”) by Córas Iompair Éireann (CIÉ) to An Bord Pleanála. The European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743 of 2021) gives further effect to the transposition of the EIA Directive (EU Directive 2011/92/EU as amended by Directive 2014/52/EU) on the assessment of the effects of certain public private projects on the environment by amending the Transport (Railway Infrastructure) Act 2001 (‘the 2001 Act’). An examination, analysis and evaluation is carried out by An Bord Pleanála in order to identify, describe and assess, in the light of each individual case, the direct and indirect significant effects of the proposed project (comprising inter alia railway works), including significant effects derived from the vulnerability of the activity to risks of major accidents and disasters relevant to it, on: population and human health; biodiversity, with particular attention to species and habitats protected under the Habitats and Birds Directives; land, soil, water, air and climate; material assets, cultural heritage and the landscape, and the interaction between the above factors.

As stated in the introduction, this chapter of the EIAR identifies, describes and presents an assessment of the likely significant noise and vibration effects of the proposed DART+ South West Project on the receiving environment during both the construction and operational phases of the proposed Project.

14.2.1. Legislation

Specifically in relation to Noise & Vibration, the following principal legislation relevant to the assessment is set out in the following primary European and National legislation:

EU Legislation

- EU Directive 2011/92/EU as amended by Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment;
- Commission Directive (EU) 2015/996 of 19 May 2015 establishing common noise assessment methods according to Directive 2002/49/EC; and
- European Council Directive 2002/49/EC relating to the assessment and management of environmental noise (the Environmental Noise Directive).

National Legislation

- The Transport (Railway Infrastructure) Act 2001 (as amended and substituted);
- The European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743 of 2021) which give further effect to transposition of the EIA Directive by amending the Transport (Railway Infrastructure) Act 2001;
- European Communities (Environmental Noise) Regulations (S.I. No. 549 of 2018);
- EC (Environmental Noise) Regulations 2006 (S.I. No. 140 of 2006); and
- EC Noise Emission by Equipment for Use Outdoors (Amendment) Regulations (S.I. No. 241 of 2006).

14.2.2. Policy

The assessment has had due regard to relevant policy that includes the following:

- Dublin Local Authorities including Dublin City Council (DCC), Dun Laoghaire Rathdown County Council (DLRCC), South Dublin County Council (SDCC) and Fingal County Council (FCC). Dublin Agglomeration Third Environmental Noise Action Plan 2018 – 2023; and
- Kildare County Council Third Noise Action Plan 2019 – 2023.

14.2.3. Guidance

The assessment has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out in the following sections. In addition to specific noise and vibration guidance documents, the following guidelines were considered and consulted in the preparation of this chapter:

- Environmental Protection Agency (EPA), Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2022);
- World Health Organization (WHO) Environmental Noise Guidelines for the European Region (2018);
- TII Code of engineering practice for works on, near, or adjacent the Luas light rail system (TII 2016);

- TII's Environmental Assessment and Construction Guidelines, including the Good Practice Guide for the Treatment of Noise during the Planning of National Road Schemes (National Roads Authority 2014);
- Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1 (2004); and
- The Netherlands national computation method published 'Reken- en Meetvoorschrift Railverkeerslawaai '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996, Calculation and Measurement Regulations Rail traffic noise (RMR); The Minister of Housing: Spatial Planning and the Environment.

Standards

There are no statutory standards in Ireland relating to noise and vibration limit values for construction works or for environmental noise relating to the operational phase. In the absence of specific statutory Irish guidelines, the assessment has made reference to non-statutory national guidelines, where available, in addition to international standards and guidelines relating to noise and / or vibration impact for environmental sources:

- British Standard (BS) 4142:2014+A1:2019: Methods for rating and assessing industrial and commercial sound;
- 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 6472-1:2008 Guide to Evaluation of human exposure to vibration in buildings, Part 1 Vibration sources other than blasting;
- BS 7385-2:1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration;
- European Standard (EN) EN 16272-1:2012 Railway Applications - Track - Noise Barriers and Related Devices Acting on Airborne Sound Propagation - Test Method for Determining the Acoustic Performance - Part 1: Intrinsic Characteristics - Sound Absorption in the Laboratory Under Diffuse Sound Field Conditions;
- European Standard (EN) EN 16272-2:2012 Railway Applications - Track - Noise Barriers and Related Devices Acting on Airborne Sound Propagation - Test Method for Determining the Acoustic Performance - Part 2: Intrinsic Characteristics - Airborne Sound Insulation in the Laboratory Under Diffuse Sound Field Conditions;
- International Organisation for Standardisation (ISO) ISO 1996-1:2016 Acoustics - Description, measurement and assessment of environmental noise. Part 1: Basic quantities and assessment procedures;
- ISO 1996-2:2017 - Description, measurement and assessment of environmental noise - Part 2: Determination of sound pressure levels;

- ISO 4866:2010 Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures;
- ISO 2631-1:1997 - Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 1: General requirements;
- ISO 2631-2:2003 - Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 2: Part 2: Vibration in buildings (1 Hz to 80 Hz);
- ISO 8041-1:2017 Human response to vibration — Measuring instrumentation — Part 1: General purpose vibration meters;
- ISO 9613-2:1996 - Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation;
- ISO 14837-1:2005 Mechanical vibration — Ground-borne noise and vibration arising from rail systems — Part 1: General guidance;
- ISO 17534-1:2015 Acoustics — Software for the calculation of sound outdoors — Part 1: Quality requirements and quality assurance; and
- ISO/TR 17534-3:2015 Acoustics — Software for the calculation of sound outdoors — Part 3: Recommendations for quality assured implementation of ISO 9613-2 in software according to ISO 17534-1.

14.3. Methodology

The noise and vibration impact assessment has followed the overall methodology and guidance relating to the EIA process and preparation as set out in Chapter 1 Introduction of this EIAR. The impact of the proposed Project arising from noise and vibration effects has been assessed for both the construction and operational phases by considering the requirement to use heavy plant and machinery during the construction of additional tracks, electrification of the northern tracks, replacement/upgrade of bridge structures, construction of other key infrastructure e.g. substations etc. as well as from construction traffic off-site. Impacts arising from operational phase rail noise on the proposed alignment as well as noise emissions from fixed plant have also been considered.

This assessment is undertaken in line with best practice assessment procedures for environmental noise impact. The proposed Project has been divided into four distinct geographic zones along the length of the corridor (Zones A to D) as outlined in Chapter 4 Project Description and summarised below. The proposed Project is described from west to east along the railway corridor.

- Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station (refer to Section 4.6);
- Zone B - Park West & Cherry Orchard Station to Heuston Station (incorporating Inchicore Works) (refer to Section 4.7);
- Zone C - Heuston Yard & Station (incorporating New Heuston West Station) (refer to Section 4.8); and

- Zone D - Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line) (refer to Section 4.9).

Key elements of the construction phase include the construction of additional track from Park West & Cherry Orchard Station to Heuston Station with bridge replacements at Le Fanu Road Bridge (OBC7), Kylemore Road Bridge (OBC5A), Khyber Pass Footbridge (OBC5), deck replacement at Sarsfield Road Under-Bridge (UBC4), bridge replacement at Memorial Road Bridge (OBC3) and a new replacement bridge deck at Glasnevin Cemetery Road Bridge (OBO10). There will also be a new cut and cover buried portal structure (OBC1A) at South Circular Road Junction and replacement of ballast with new slab track in the Phoenix Park Tunnel. The widening of the track corridor and the bridge replacements will include substantial groundworks including piling. Some of the proposed works are common to all sections of the proposed Project and include:

- Track level changes;
- Overhead line equipment (OHLE) will be required to provide electrical power to the DART network´s electrified train fleet including the construction of six substations;
- Signalling upgrades and additional signalling;
- New/replacement retaining walls, improved boundary walls and fencing; and
- Utility diversions, vegetation management and other ancillary works.

14.3.1. Study Area

The proposed Project is linear in nature consisting of interventions and general linear works required to modernise and electrify the existing railway line as outlined in Chapter 4 Project Description. There are no national guidelines for the assessment of rail noise, therefore the baseline survey will generally follow the methodology for National Road Schemes. This is considered appropriate given the linear nature of the proposed Project. As such, the sources of noise associated with the operation of the railway line will consider noise sensitive locations within 250m of the railway line and consider representative baseline monitoring where there are different soundscapes along the route.

In relation to the construction phase, the key study areas during construction will include areas where surface construction works will take place, including construction compounds, ancillary structures (modifications to bridge structures), junction layouts, substation locations and traffic haul routes. As such, the assessment of construction noise will consider noise sensitive locations up to 250m from construction noise sources.

14.3.2. Survey Methodology

14.3.2.1. Desktop Survey

The following data sources have informed the assessment as outlined in Table 14.1.

Table 14.1: Summary of Key Datasets

Title	Source	Year
GeoDirectory	https://www.geodirectory.ie	2021

Title	Source	Year
Construction traffic flow data	EIAR Chapter 6	2022
Rail movement data (level of service)	Iarnród Éireann	2022
Terrain data	OSI mapping and Lidar (Murphy's) survey data	2021

14.3.2.2. Field Surveys

Site visits by acousticians were carried out in November 2020, March and April 2022 to assess the proposed route and identify potential noise and vibration sensitive areas.

A series of site-specific baseline noise surveys were undertaken between November 2021 and May 2022 to characterise the existing noise and vibration environment and to provide baseline noise data for the validation of the noise model. Further details on the baseline surveys can be found in Section 14.4.1 and Section 14.4.2.

Unattended baseline noise measurements were carried out at representative locations along the length of the project over a period of 24 hours at each location. The surveys were undertaken using a noise monitoring terminal installation (unattended measurement). All measurements were taken using Type 1 Precision Digital Sound Level Meters and associated hardware. The meter was calibrated before and after each round of measurements to ensure that no unacceptable deviation from the accredited calibration occurred during the measurement period and that results presented are reliable and accurate. The survey methodology was in accordance with ISO 1996-1:2016 – Description and Measurement of Environmental Noise.

Ground vibration measurements were measured at three key locations including a variety of train types and speeds along with transmission characteristics at the sites. The vibration monitoring was carried out using a Bruel & Kjaer VMT Type 3680 attended Vibration Monitoring Terminal.

14.3.3. Noise and Vibration Impact Assessment Criteria

The following terminology is used in this assessment:

- Noise Impact – the differences in the acoustic environment before and after the implementation of the proposals (also known as the magnitude of change). This includes any change in noise level to any standard benchmark;
- Noise effect – The consequence of the noise impact. This may be in the form of a change in the annoyance caused, a change in the degree of intrusion or disturbance caused by the acoustic environment, or the potential for the change to alter the character of an area such that there is a perceived change in quality of life. This will be dependent on the receptor and its sensitivity; and
- Significance of effect - the evaluation of the noise effect and deciding whether or not that impact is significant.

14.3.3.1. Noise and Vibration Sensitive Receptors

There is currently no statutory guidance document on the sensitivity of receptors in Ireland. Sensitive receptors, in the context of noise and vibration, are typically residential premises but can also include schools, places of worship and other noise sensitive locations. Site and project specific considerations play a part in determining the sensitivity of a receptor.

The sensitivity of receptors to noise and vibration commonly used for noise impact assessments in Ireland is defined in Table 14.2.

Table 14.2: Criteria to Define Receptor Sensitivity

Sensitivity	Description	Examples of Receptors	Modifiers
High	Receptors where people or operations are particularly susceptible to noise	Residential, including private gardens where appropriate. Hospitals/residential care homes. Schools during the daytime Quiet outdoor areas used for recreation. Places of worship.	Magnitude and Character of Baseline Noise and period of occupancy
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance	Offices /Bars/Cafes/Restaurants where external noise may be intrusive Community facilities and amenity areas. Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, fishing and golf). Wildlife refuges. Recording studios and concert halls are also included in this category.	
Low	Receptors where distraction or disturbance from noise is low	Buildings not occupied during the daytime . Sports grounds when spectator noise is a normal part of the event. Night Clubs.	
Negligible	Receptors where distraction or disturbance from noise is negligible.	All other areas such as those used primarily for industrial or agricultural purposes.	

The majority of receptors which have the potential to be affected by noise and vibration impacts arising from the proposed Project are the residents of dwellings in the vicinity of the proposed Project. Residents, due to the nature and use of residential receptors are deemed to have ‘High’ sensitivity. Community facilities along with commercial developments are considered ‘Medium’ sensitivity during daytime periods with the sensitivity reducing to ‘Low’ during evening for commercial developments. At night-time periods both community facilities and commercial developments are considered low sensitivity as they have reduced occupancy or are unoccupied.

Receptors with lower sensitivity to noise include other industrial developments.

14.3.3.2. Construction Noise Criteria

There are no published statutory guidelines on noise levels from construction sites in Ireland. However, Dublin City Council's "Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition" (hereinafter referred to as DCC GPG) outlines a risk assessment methodology directly applicable to the specific construction activities on the proposed Project.

The duration, nature and extent of construction activities associated with the construction phase of the proposed Project categorise it within the high-risk category. The monitoring section (S.6) of the DCC GPG document identifies that for high-risk category sites:

> *'The ABC Method detailed in Paragraph E.3.2 of BS 5228-1:2009 shall be used to determine acceptable noise levels for day, evening and night time work.'*

The proposed Project spans three local authority boundaries including Dublin City Council (DCC), South Dublin County Council (SDCC) and Kildare County Council (KCC). SDCC and KCC do not use an equivalent noise risk assessment procedure. The approach used by DCC has been applied across the full extent of the proposed Project to ensure a uniform approach for the construction noise assessment.

The ABC method outlined in section E3.2 *of BS 5228-1:2009+A1:2014* has been used for the purposes of controlling noise. The approach adopted calls for the designation of a noise sensitive receptor into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a potential significant noise impact is associated with the construction activities. These thresholds apply to residential buildings.

Table 14.3 outlines the applicable noise threshold of potential significant effect (TPSE) at the nearest noise sensitive locations. The determination of what category to apply is dependent on the existing ambient (L_{Aeq}) noise level (rounded to the nearest 5 dB) at the nearest noise sensitive property. For weekday daytime, if the ambient noise level is less than the Category A threshold limit, the Category A threshold limit (i.e. 65 dB) applies. If the ambient noise level is the same as the Category A threshold limit, the Category B threshold limit (i.e. 70 dB) applies. If the ambient noise level is more than the Category A threshold limit, the Category C threshold limit (i.e. 75 dB) applies.

Table 14.3: Threshold of Potential Significant Effect at Nearest Sensitive Receptors

Assessment Category and Threshold Value Period (L_{Aeq})	Noise Threshold Value, in decibels (dB)		
	Category A[A]	Category B[B]	Category C[C]
Night-time (23.00 – 07.00)	45	50	55
Evenings and weekends[D]	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00 – 13.00)	65	70	75

NOTE 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.

NOTE 3 Applied to residential receptors only.

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

The thresholds apply to residential buildings and receptors with a high sensitivity as described in Table 14.2. For commercial buildings (offices, industrial facilities, sport clubs etc.) which are less noise sensitive, Category C values from Table 14.3 apply. Over-runs/emergency work may be required on occasion particularly where, for health and safety reasons or due to engineering requirements, a specific work item needs to be completed before the worksite can be left in a safe state, or there is a risk of an engineering or structural failure if the works are not completed.

14.3.3.3. Construction Traffic Noise Criteria

There is currently no Irish legislation that limits noise levels from construction traffic to a limit value. Hence the impact of off-site traffic associated with construction phase of the proposed Project has been assessed with respect to the UK Highways Agency publication, Design Manual for Roads and Bridges LA111 – Noise and Vibration Revision 2, UK Highways Agency (2020). This document presents details on the classification of magnitude of noise impacts and noise level changes and associated magnitude of impact are presented in Table 14.4.

Table 14.4: Noise Level - Magnitude of Impact (Highway Agency, UK)

Magnitude of Impact	Increase in Baseline Noise Level of Closest Public Road Used for Construction Traffic (dB)
Major	Greater than or equal to 5.0
Moderate	Greater than or equal to 3.0 and less than 5.0
Minor	Greater than or equal to 1.0 and less than 3.0
Negligible	Less than 1.0

The thresholds will apply to residential buildings and receptors with a high sensitivity as described in Table 14.2. Commercial buildings (offices, industrial facilities, sport clubs, etc.) are considered less noise sensitive and can tolerate greater increases in baseline noise level.

14.3.3.4. Construction Vibration Criteria

There is no statutory Irish guidance relating to the maximum permissible vibration level that may be generated during the construction phase of a project. In absence of specific vibration limits, appropriate vibration emission criteria relating to permissible construction vibration levels for a development of this scale may be found in BS5228-2:2009+A1:2014 Code of Practice of Noise and Vibration Control on Construction and Open Sites Part 2: Vibration.

Human beings are known to be sensitive to vibration, the threshold of perception being typically in the Peak Particle Velocity (PPV) range of 0.14 mm/s to 0.3 mm/s. Vibrations above these values can disturb, startle, cause annoyance or interfere with work activities. At higher PPV levels (>15 mm/s) vibrations can lead to concerns about possible (not probable) structural damage. Guidance of effects of vibration levels are set out in Table 14.5 and Table 14.6.

Table 14.5: Guidance on Human Perception of Vibration Levels

Vibration Level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.

Vibration Level	Effect
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Limits of transient vibration, above which cosmetic damage to property could occur, are given numerically in Table 14.6 (Ref: BS5228-2:2009+A1:2014). Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 14.6 and major damage to a building structure can occur at values greater than four times the tabulated values.

Table 14.6: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak Particle Velocity (PPV) (mm/s) in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Unreinforced or light framed structures. Residential or light commercial buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above.

14.3.3.5. Operational Rail Noise Criteria

There is no statutory Irish guidance specifying airborne noise levels from rail operations. In absence of specific noise limits, reference has been made to guidance documents on environmental noise and precedence from other urban rail projects. The proposed operational rail noise criteria are presented in Table 14.7.

Table 14.7: Operational Rail Noise Criteria

Operational Rail Noise Criteria	
Daytime (07:00 – 23:00)	**Night-time (07:00 – 23:00)**
55 dB $L_{Aeq,16hr}$	45 dB $L_{Aeq,8hr}$

As the proposed Project is an existing track already exposed to significant levels of rail noise, it may not be possible to achieve the operational noise criteria in Table 14.7 in many areas. In these instances, mitigation measures will be explored to reduce the noise impact where practicable. However, it may not always be sustainable to provide adequate mitigation in order to achieve the noise criteria. Therefore, a structured approach will be taken in order to ameliorate as far as practicable rail traffic noise through the consideration of measures such as noise barriers or boundary treatments.

In absence of specific statutory Irish guidance specifying airborne noise levels from rail operations, reference has been made to Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1 (2004) as the TII guidelines provide guidance on a structured approach to ameliorate as far as practicable road traffic noise. This approach has been

adapted for rail noise. Mitigation measures are deemed necessary when the following three conditions are satisfied at designated sensitive receptors:

a) the rail noise level the proposed scheme together with other rail traffic in the vicinity is greater than the operational rail noise criteria;

b) the relevant noise level is at least 1dB more than the expected rail noise level without the proposed scheme in place; and

c) the contribution to the increase in the relevant noise level from the proposed scheme is at least 1dB.

14.3.3.6. Operational Fixed Plant Noise Criteria

A development of this nature will also include a range of mechanical and electrical plant to service the rail operations. British Standard BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound provides a method of assessing the impact of a source of industrial or commercial sound. BS 4142 uses a 'rating level', which is based on a comparison between the sound which is being assessed and the background sound which would exist without it. The rating level is then modified by any corrections for the character of the sound, be that tonal, impulsive, or intermittent.

BS 4142 states… *"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound levels and the context in which the sound occurs."* BS 4142 goes on to state:

- Typically, the greater the difference between the specific sound and background sound level, the greater the magnitude of the impact;
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact depending on the context; and
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this an indication of the specific sound having a low impact, depending on the context.

14.3.3.6.1. WHO Environmental Noise Guidelines for the European Region

The World Health Organisation (WHO) published Environmental Noise Guidelines for the European Region in October 2018. The objective of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise from transportation (road traffic, railway and aircraft), wind turbine noise and leisure noise. The guidelines set out recommended exposure levels for environmental noise in order to protect population health. The guidelines recommend L_{den} and L_{night} levels above which there is risk of adverse health risks for each source type.

The WHO guideline values are recommended to serve as the basis for a policy-making process to allow evidence based public health orientated recommendations. They are not intended to be noise limits and the WHO document states the following regarding the implementation of the guidelines:

"The WHO guideline values are evidence-based public health-oriented recommendations. As such, they are recommended to serve as the basis for a policy-making process in which policy options are considered. In the policy decisions on reference values, such as noise limits for a possible standard or legislation, additional considerations – such as feasibility, costs, preferences and so on – feature in and can influence the ultimate value chosen as a noise limit. WHO acknowledges that implementing the guideline recommendations will require coordinated effort from ministries, public and private sectors and nongovernmental organizations, as well as possible input from international development and finance organizations. WHO will work with Member States and support the implementation process through its regional and country offices."

The WHO (2018) cites moderate quality evidence that there is an absolute risk of 10% of the population being 'highly annoyed' by railway noise at a level of 53.7 dB L_{den}. Annoyance is an indirect health effect, and this threshold has not been adopted by any country for railway noise. It will be a decision for national and local policy makers to adopt the WHO guidelines and propose noise limits. The noise criteria proposed in Table 14.7 are therefore considered appropriate for this assessment.

14.3.3.7. Operational Vibration Criteria

There is no statutory Irish guidance relating to the maximum permissible vibration level that may be generated during the operational phase of a project of this nature. In absence of specific vibration limits, appropriate vibration emission criteria vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings for a development of this scale may be found in BS6472-1:2008 Guide to evaluation of human exposure to vibration in buildings - Vibration sources other than blasting. BS6472-1 provides Vibration Dose Value (VDV) ranges presented in Table 14.8 are used to estimate the probability of adverse comment which might be expected for human beings exposed to vibration within buildings.

Table 14.8: Vibration Dose Value Ranges from BS6472-1:2008

Place and Time	Low probability[1] of adverse comment m/s$^{1.75}$	Adverse comment possible m/s$^{1.75}$	Adverse comment probable[2] VDV m/s$^{1.75}$
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

1) Below these ranges adverse comment is not expected.
2) Above these ranges adverse comment is very likely.

Note: For offices and workshops, multiplying factors of 2 and 4 respectively should be applied above vibration dose value ranges for a 16 h day.

The VDV ranges in Table 14.8 apply where no existing appreciable level[3] of vibration exists. However, the proposed development is along an existing rail corridor and adjacent to an industrial zone a change-based criteria is also presented in Table 14.9.

[3] Where there is an appreciable existing level of vibration and daytime and night-time vibration dose vales (VDVs) exceed 0.2 m.s$^{-1.75}$ and 0.1 m.s$^{-1.75}$ respectively.

Table 14.9: Operational Vibration Impact Criteria

BS 6472-1 Rating	In absence of appreciable Existing Level of Vibration		Appreciable Existing Levels of Vibration
	Daytime (07:00 – 23:00) ($m/s^{1.75}$)	Night-time (23:00 – 07:00) ($m/s^{1.75}$)	% increase or decrease in VDV
Adverse comment not expected	≤ 0.2	≤ 0.1	≤ 25
Low probability of adverse comment	> 0.2 – 0.4	> 0.1 – 0.2	25 – 40
Adverse comment possible	> 0.4 – 0.8	> 0.2 – 0.4	> 40 – 100
Adverse comment probable	> 0.8 – 1.6	> 0.4 – 0.8	> 100 - 185
	> 1.6	> 0.8	> 185

There are no standard criteria for assessing the potential impact of vibration on sensitive equipment or processes. Generally, the majority of such equipment is not adversely affected at the levels of vibration that occur from railways. The levels of vibration and shock experienced by computer installations in their normal environment (e.g. due to footfalls and door slams) are far higher than those experienced as a result of environmental vibration. The data centre at Con Colbert House has been specifically considered in this context.

14.3.4. Impact Significance

14.3.4.1. EPA Guidance on the Assessment of Impacts

The significance of noise and vibration impacts means the importance of the outcome of the noise and vibration effects on the receptors. The significance is a function of the magnitude and quality of the effect, positive or adverse, the geographical extent and duration of the effect, the frequency and likelihood of the effect occurring and the sensitivity of the receptor. The significance is assessed by weighing up these attributes and categorising it according to the generalised degree of impact significance set out in the EPA 2022 guidance as shown in Figure 14-2.

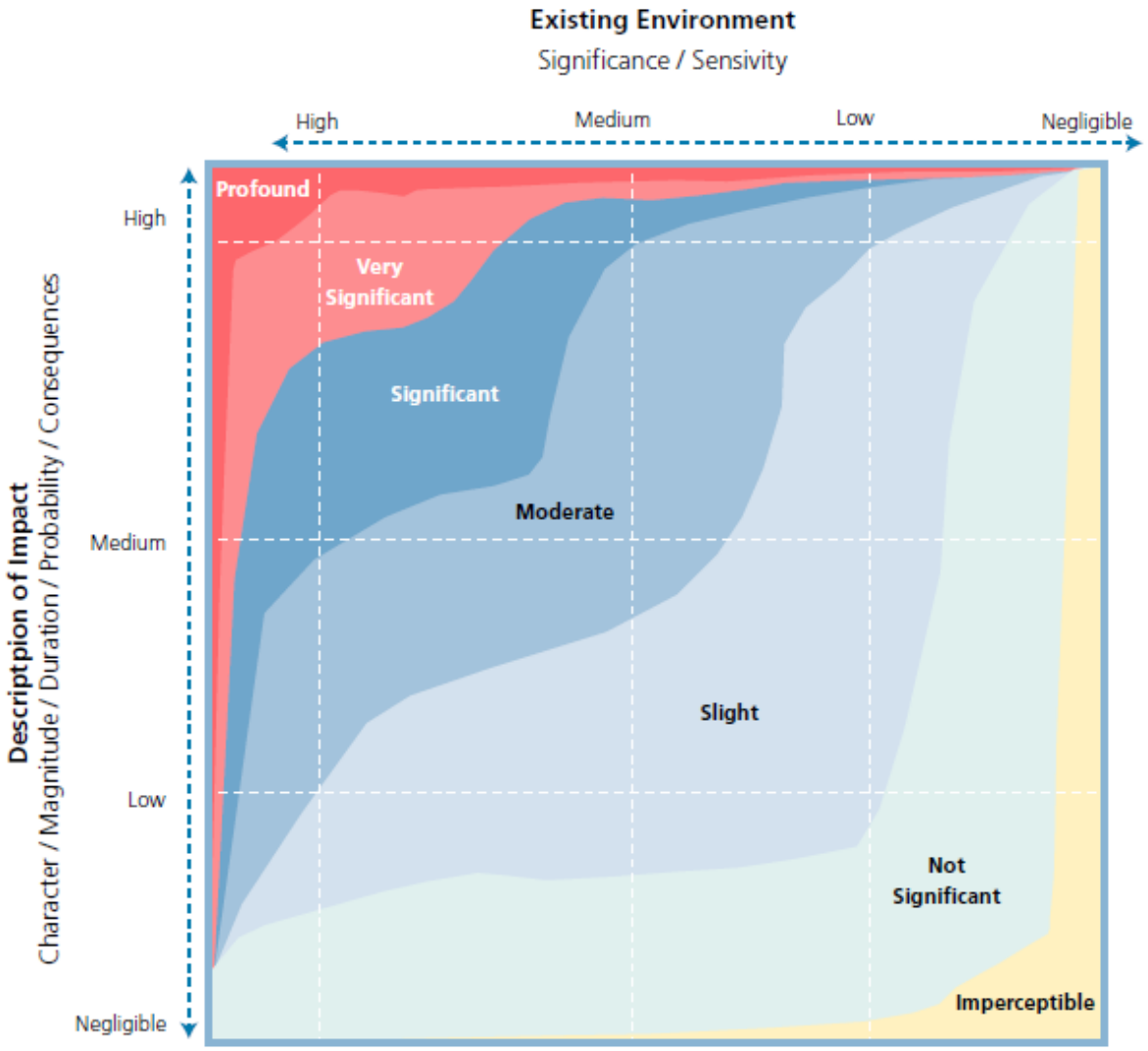

Figure 14-2 Classification of the significance of impacts (from EPA, 2022)

Determining Significance

The significance of effect is dependent on both the magnitude of impact and the sensitivity of the receptor in question. The magnitude of the impact is outlined in Section 14.3.3. The significance of the effect is determined as a function of the sensitivity of the receptor and the magnitude of impact the receptor is exposed to using the matrix presented in Figure 14-2. The sensitivity of receptors is outlined in Table 14.2.

A four-point scale of significance of effect is presented in Table 14.10. The final assessment for each effect needs to be based upon expert judgement due to the wide range of the significance of the effect. The EPA Guidelines (2022) uses a seven-point scale and includes factors such as the likelihood, duration and frequency of activities that are considered in this context. For the purposes of this assessment, any effects with a significance level of slight or less have been concluded to be not significant. Effects of moderate significance are further assessed using the EPA Guidelines (2022) scale to determine overall significance in EIA terms.

Table 14.10 Matrix Used for the Assessment of the Significance of the Effect

		Magnitude of Impact			
		Negligible	**Low**	**Medium**	**High**
Sensitivity of Receptor	**Negligible**	Imperceptible	Imperceptible - Not Significant	Imperceptible - Not Significant	Imperceptible - Slight
	Low	Imperceptible - Not Significant	Not Significant - Slight	Not Significant - Moderate	Slight - Profound
	Medium	Imperceptible - Not Significant	Not Significant - Slight	Slight - Significant	Moderate - Profound
	High	Not Significant - Slight	Not Significant - Significant	Moderate - Very Significant	Significant - Profound

14.3.4.2. Construction Noise

Section 14.3.3.2 outlined construction noise criteria in BS 5228. The 'ABC' method in BS 5228 is used to determine the construction noise impact during all periods. Using the baseline noise measurement data, it was determined that the appropriate construction noise threshold value for determining the potential significant effects for residential receptors in the vicinity of the proposed Project varies from Category A (i.e. 45 dB L_{Aeq} during night-time periods) to Category C (i.e. 55 dB L_{Aeq} during night-time periods) depending on location of the receptor. For assessing the significance of effect, reference has been made to the EPA Guidelines (2022) and specifically the DMRB which states:

> *"Construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:*
>
> 1) 10 or more days or nights in any 15 consecutive days or nights; or

A total number of days exceeding 40 in any 6 consecutive months." Table 14.11 presents the construction noise significance rating.

Table 14.11: Construction Noise – Significance of the Impact

Noise Levels	DMRB Magnitude	EPA Magnitude of Impact	Significance Rating	Modifier
≤ Baseline noise level	Negligible	Negligible	Imperceptible / Not Significant	Depends on BS 5228 threshold value, baseline noise levels, duration and frequency.
> Baseline noise level and ≤ BS 5228 threshold	Minor	Low	Slight/ Moderate	
> BS 5228 threshold to ≤BS 5228 threshold + 5 dB	Moderate	Medium	Moderate/ Significant	
> BS 5228 threshold +5 to + 10 dB	Major	High	Significant/ Very Significant	
> BS 5228 threshold + 10 dB			Very Significant / Profound	

Due to the nature and duration of the proposed Project, the maximum permissible construction noise levels will be exceeded during certain construction phases, particularly at receptor locations which form the boundary with work sites or where longer-term night-works will be required. Due to the potential for exceedances at these locations and taking account of the duration of the works, reference is made to BS 5228 for determining the requirement for temporary rehousing.

14.3.4.3. Criteria for Eligibility of Temporary Rehousing

Reference is made to Section E.4 of BS 5228-1:2009+A1:2014 for thresholds and criteria for temporary re-housing (TRH).

Temporary rehousing, or the reasonable costs thereof, will be offered to eligible owners/ occupiers where the construction of the proposed Project causes, or is expected to cause, a measured or predicted airborne construction noise level that exceeds either of the following at property lawfully occupied as a permanent dwelling:

- A noise level 10 dB above any of the trigger noise levels presented in Table 14.12 for the corresponding times of day; or
- A noise level 10 dB or more above the existing pre-construction ambient noise level for the corresponding times of day.

Whichever of the above is the higher; and for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months.

Table 14.12: Criteria for Eligibility of Temporary Accommodation

Time	Relevant Time Period	Average Time, T	Temporary Accommodation Trigger Level, dB $L_{Aeq,T}$ *
Monday to Friday	07:00 – 08:00	1 hr	70
	08:00 – 18:00	10 hr	75
	18:00 – 19:00	1 hr	70
	19:00 – 22:00	3 hr	65
	22:00 – 07:00	1 hr	55
Saturday	07:00 – 08:00	1 hr	70
	08:00 – 13:00	5 hr	75
	13:00 – 14:00	1 hr	70
	14:00 – 22:00	3 hr	65
	22:00 – 07:00	1 hr	55
Sunday and Public Holidays	07:00 – 21:00	1 hr	65
	21:00 – 07:00	1 hr	55

* All noise levels are predicted or measured at a point 1 m in front of the most exposed of any windows and doors in any façade of any eligible dwelling.

14.3.4.4. Construction Traffic Noise

Section 14.3.3.3 outlined the DMRB magnitude of impact criteria used to determine the construction traffic noise impact. For assessing the significance of effect, reference is made to the EPA Guidelines (2022) and the DMRB with the same criteria used for construction noise and construction traffic noise. Table 14.13 presents the construction traffic noise significance rating.

Table 14.13: Construction Traffic Noise – Significance of the Impact

Noise Level Increase	DMRB Magnitude	EPA Magnitude of Impact	Significance Rating	Modifier
Less than 1.0	Negligible	Negligible	Imperceptible/ Not Significant	Depends on baseline noise levels, duration, and frequency.
1.0 to 2.9	Minor	Low	Slight/ Moderate	
3.0 to 4.9	Moderate	Medium	Moderate/ Significant	
Greater than or equal to 5.0	Major	High	Significant/ Very Significant	
			Very Significant / Profound	

14.3.4.5. Construction Vibration

Section 14.3.3.4 outlined guidance on effects of vibration levels on humans and limits of transient vibration, above which cosmetic damage could occur. For assessing the significance of effect, reference is made to the EPA Guidelines (2022) and specifically the DMRB which states:

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

Table 14.14 presents the construction vibration significance rating.

Table 14.14: Construction Vibration – Significance of the Impact

Vibration Level	DMRB Magnitude	EPA Magnitude of Impact	Significance Rating	Determination
Less than 0.3 mm/s	Negligible	Negligible	Imperceptible/ Not Significant	Depends on duration, occurrence, and frequency.
Greater than or equal to 0.3 mm/s and less than 1.0 mm/s	Minor	Low	Slight/ Moderate	
Greater than or equal to 1.0 mm/s and less than 10 mm/s	Moderate	Medium	Moderate/ Significant	
Greater than or equal to 10 mm/s	Major	High	Very Significant / Profound	

14.3.4.6. Operational Rail Noise

As outlined in Section 14.3.3.5, there is no statutory Irish guidance specifying airborne noise levels from rail operations. In absence of specific noise limits, reference has been made to guidance documents on environmental noise and precedence from other urban rail projects.

The aim is to avoid significant adverse impacts on health and quality of life from noise as a result of the new development or a change to a development. Where operational rail noise is below the 55 dB $L_{Aeq,16hr}$ daytime and 45 dB $L_{Aeq,8hr}$ night-time, no adverse effects from operational rail noise are likely.

Where operational rails noise levels are above 55 dB $L_{aeq,16hr}$ Daytime and 45 dB $L_{Aeq,8hr}$ Night-time, the impact rating is dependent on the magnitude above the criteria and the increase above the existing rail noise and/or baseline noise environment.

Where pre-existing noise levels are already high (well above the noise criteria), a small change in noise levels will not be noticeable and a larger change may cause disturbance and be significant. The scale of the impact will depend on the degree of noise change. If the ambient noise is level is currently low (below the threshold), then the scale of impact is dependent on the extent to which the predicted noise levels exceed the thresholds. The noise level criteria, associated magnitude of impact and initial significance rating for high sensitivity receptors is summarised in Table 14.15.

Table 14.15: Operational Rail Noise – Significance of the Impact

Predicted Noise Level above the Noise Criteria / Baseline / Change in Rail Noise (dB)	EPA Magnitude of Impact	Initial Significance Rating	Modifier
Less than 1.0	Negligible	Not Significant	Depends on the absolute level, acoustic context, difference in noise level and likely perception of change by residents, duration, and frequency.
1.0 to 2.9	Low	Slight/ Moderate	
3.0 to 4.9	Low/Medium	Moderate/Significant	
5.0 to 9.9	Medium	Significant/ Very Significant	
Greater than or equal to 10.0	High	Profound	

Where the sensitivity of a receptor is medium or low, the magnitude of impact reduces (See Table 14.16) and initial significance rating changes.

Table 14.16: Magnitude of Impact Against Receptor Sensitivity

	Receptor Sensitivity			
	High	Medium	Low	Negligible
EPA Magnitude of Impact	High	Medium	Low	Negligible
	Medium	Low	Negligible	Negligible
	Low	Negligible	Negligible	Negligible
	Negligible	Negligible	Negligible	Negligible

14.3.4.7. Operational Fixed Plant Noise

As outlined in Section 14.3.3.6, BS 4142:2014+A1:2019 provides guidance on a method of assessing the impact of a source of industrial or commercial sound. The noise level change criteria associated magnitude of impact and significance rating is summarised in Table 14.17.

Table 14.17: Operational Fixed Plant Noise - Significance of the Impact

Predicted Noise Level against Background Noise Level	BS 4142 Rating	EPA Magnitude of Impact	Initial Significance Rating	Modifier
Less than background	Low Impact	Negligible	Not Significant	Depends on the absolute level, acoustic context, difference in noise level and likely perception of
Less than 1.0	-			
1.0 to 2.9		Low	Slight/ Moderate	

Predicted Noise Level against Background Noise Level	BS 4142 Rating	EPA Magnitude of Impact	Initial Significance Rating	Modifier
3.0 to 4.9		Low/Medium	Moderate/Significant	change by residents, duration, and frequency.
5.0 to 9.9	Adverse Impact	Medium	Significant/ Very Significant	
Greater than or equal to 10.0	Significant Adverse Impact	High	Very Significant /Profound	

14.3.4.8. Operational Vibration

Section 14.3.3.7 outlined guidance on effects of vibration magnitude on humans within buildings. For assessing the significance of effect, reference is made to the EPA Guidelines (2022), BS 6472-1:2008 and the DMRB.

Table 14.18: Operational Vibration – Significance of the Impact

BS 6472-1 Rating	In absence of appreciable Existing Level of Vibration $m/s^{1.75}$		Appreciable Existing Levels of Vibration	Impact Classification	Significance Rating
	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	% increase in VDV		
Adverse comment not expected	≤ 0.2	≤ 0.1	≤ 25	Negligible	Imperceptible / Not Significant
Low probability of adverse comment	> 0.2 – 0.4	> 0.1 – 0.2	25 – 40	Low	Slight/ Moderate
Adverse comment possible	> 0.4 – 0.8	> 0.2 – 0.4	> 40 – 100	Medium	Moderate/ Significant
Adverse comment probable	> 0.8 – 1.6	> 0.4 – 0.8	> 100 - 185	High	Significant/ Very Significant
Adverse comment very likely	> 1.6	> 0.8	> 185		Very Significant / Profound

14.3.5. Consultation

The overall project stakeholder and public consultation undertaken in respect of the Project is set out in the Public Consultation No. 1 Findings Report (for PC1) and Public Consultation No. 2 Findings Report (for PC2) which are included in Volume 4, Appendix 1.3 and 1.4. All feedback was collated, including feedback specific to the EIAR topic 'Noise and Vibration'. This feedback has informed this chapter including the baseline and impact assessment presented.

Specific consultation was also undertaken with key stakeholders in relation to EIA Scoping. A summary of the issues raised in relation to the scope of the EIA is included in Volume 4, Appendix 1.2. Feedback

on the scope and level of detail of the assessment, data sources and methodologies as they pertain to the EIAR topic 'Noise and Vibration' have been reviewed and have influenced this chapter of the EIAR.

Specific consultation was also undertaken with representatives of various Departments in Kildare, South Dublin and Dublin City, Councils. This included a combination of presentations, workshops and meetings to discuss the project, technical design issues and environment and planning matters.

Nine pre-application meetings were held with ABP to explain the project and present technical and environmental information. A summary of the information presented and the environmental issues discussed at the nine meetings is provided in Volume 4, Appendix 1.6. Feedback relevant to the topic 'Noise and Vibration' has been reviewed and has influenced this chapter of the EIAR.

14.3.6. Difficulties Encountered / Limitations

This chapter of the EIAR has been prepared based upon the best available information and in accordance with current best practice and relevant guidelines.

There were no technical difficulties encountered in the preparation of this chapter of the EIAR.

14.4. Receiving Environment

As outlined in Chapter 4 Project Description, the project has been divided into four main geographic areas (Zones A to D), which delineate the rail corridor from west to east.

Zone A: Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

The existing railway line extends east through a farmed landscape from Hazelhatch & Celbridge Station and passes through the townland of Stacumny and onwards towards Adamstown Station. The surrounding noise environment comprises of existing rail noise from commuter, intercity and freight trains. There are several locations where local and regional roads cross the railway lines and traffic noise will be experienced at nearby noise sensitive locations. At Adamstown, Adamstown Avenue runs parallel to sections of the railway line and traffic noise will be experienced at nearby noise sensitive locations. Further east in the Ronanstown and Clondalkin areas, in addition to rail noise and road traffic noise from local and regional roads, there is noise from activity at nearby commercial and industrial facilities. Moving further east towards Park West, road traffic noise from the M50 dominates the noise environment at nearby noise sensitive locations.

Zone B: Park West & Cherry Orchard Station to Heuston Station incorporating Inchicore Works

This zone stretches from Park West & Cherry Orchard Station to Heuston Yard. The western end of this section begins at Park West & Cherry Orchard Station and runs east. The noise environment comprises existing rail noise from commuter, intercity and freight trains, road traffic noise from local and regional roads as noise from the M50 motorway for receptors at the western end. There is also industrial and commercial noise from several industrial parks in the area.

Moving further east towards Inchicore, the noise environment comprises rail noise, road traffic noise and industrial and commercial noise including activity at Inchicore works. Travelling east to Kilmainham, the R148 dual carriageway (Chapelizod Bypass / Con Colbert Road) runs parallel to railway tracks. The R148 intersects with the R111 (South Circular Road). Road traffic is the dominant noise source for nearby noise sensitive locations.

Zone C: Heuston Yard & Station (incorporating New Heuston West Station)

This zone includes Heuston Station and Heuston Yard including the site for the proposed Heuston West Station. The area extends west to east from St John's Road Bridge (OBC0A) eastwards to include the existing Heuston Station and from the CIÉ boundary along the Chapelizod Bypass northwards to the CIÉ boundary on the banks of the River Liffey. The noise environment comprises existing rail noise from commuter, intercity and freight trains, activity at Heuston station and road traffic noise from the R148 (Saint John's Road West). For noise sensitive receptors along the northern extent of this zones boundary, the noise environment includes road traffic noise from the R109 (Conyngham Road).

Zone D: - Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line)

This zone commences on the south bank of the River Liffey (adjacent to the northern boundary of the Heuston Yard) and extends north east terminating at Glasnevin Junction. There are noise sensitive locations to the southern end of this zone and the existing noise environment comprises rail noise from commuter and freight trains and road traffic noise from the R109 (Conyngham Road).

The area to the north is the Phoenix Park large amenity area. The main source of noise is associated with road traffic travelling through the Phoenix Park, wildlife within the park and human activity. Beyond the Phoenix Park Tunnel is the Grangegorman and Stoneybatter areas. To the east of the existing railway line is An Garda Síochána Headquarters and McKee Barracks. The remainder of the buildings either side of the railway line predominantly are dwelling houses or apartment blocks all the way to Royal Canal Way. The existing noise environment comprises rail noise from commuter and freight trains. There are also regional roads which cross the railway line and traffic noise will be experienced at nearby noise sensitive locations. The noise environment for noise sensitive receptors near the Royal Canal Way will also comprise noise from industrial facilities, Luas light rail traffic and noise from industrial facilities and rail noise from both Maynooth line commuter and intercity trains and traffic noise from the R135 (Finglas Road).

14.4.1. Baseline Noise Survey

The baseline noise survey provides quantification and an understanding of the acoustic environment adjacent to and in proximity to the proposed Project. The purpose of the noise monitoring surveys was to:

- Determine the background and ambient noise levels at representative Noise Sensitive Receptors (NSRs) along the route of the proposed Project;
- Evaluate the noise climate in the Noise and Vibration Study Area;
- Define the applicable construction noise threshold in accordance with British Standard BS5228-1, Code of Practice of Noise Control on Construction and Open Sites; and
- Determine the significance rating when baseline noise levels are higher than operational rail noise.

14.4.1.1. Baseline Noise Survey - Overview

A baseline study was undertaken at 18 no. of locations. Unattended measurements were undertaken for a period of 24-hours between November 2021 and May 2022 to characterise the baseline noise

environment at selected sensitive locations along the length of the proposed Project to determine existing noise levels. All measurements were undertaken in accordance with ISO 1996 Acoustics – Description and Measurement of Environmental Noise, Part 1 (ISO 1996-1:2016) and Part 2 (ISO 1996-2:2017).

14.4.1.1.1. Noise Monitoring Locations

Eighteen noise monitoring locations were identified for obtaining representative ambient and background noise levels near the proposed development. Details of the noise monitoring locations are provided in Table 14.19 and locations are shown in Volume 3A of this EIAR. Photos of the equipment in-situ are presented in Volume 4, Appendix 14.1 of this EIAR.

Table 14.19: Noise Monitoring Location Details

Monitoring Location	ITM Co-ordinates		Location Description	Survey Dates
	Easting	Northing		
NML1	714514	736772	Monitor Located in rear garden of residential property on Claremont lawns off Finglas Road. Monitor is approximately 150m from Finglas Road.	06/01/22 - 07/01/22
NML2	713867	736532	Located In rear garden of residential property along St Attracta Road on the side nearest the tracks approximately 50m from tracks. Monitor is approximately 100m from Faussagh Avenue.	16/02/22 - 17/02/22
NML 3	713691	736082	Located in rear garden of a residential property along Quarry Road. The monitoring location is approximately 125m from the main Quarry Road.	13/01/22 - 14/01/22
NML 4	713450	735434	Gated laneway behind the residential properties of Glenbeigh Road, located off the R806. The monitoring location is approximately 60m from R806.	18/01/22 - 19/01/22
NML 5	713319	734988	Monitor at Park Lodge Apartments. Located at apartment balcony where there is line of sight to entrance of the tunnel. Approximately 42m from R101	01/12/21 - 02/12/21
NML 6	712928	734422	Located at River Park apartments placed on pole at the ramp to car park. Approximately 35m from R109	04/04/22 - 05/04/22
NML 7	712880	734251	Located on balcony at the block of the apartments at the court apartment block with visibility of the tracks, Apartment block on Waterloo avenue. Approximately 230m from R109 – Conyngham Road	30/11/21 - 01/12/21
NML 8	712582	733878	Located on third floor balcony of apartment block with view of train tracks at Kilmainham square off Con Colbert Road. Constant road noise from R148 – Chapelizod Bypass. Horizontal setback approximately 40m from rail tracks.	10/01/22 - 11/01/22
NML 9	712582	733879	Located on ninth floor balcony of apartment block with view of train tracks at Kilmainham square off Con Colbert Road. Constant road noise from R148 – Chapelizod Bypass Horizontal setback approximately 40m from rail tracks.	09/01/22 - 10/01/22
NML 10	712039	733795	Located within the grounds of Con Colbert House – West Building at ground level placed nearest wall to the tracks. Constant RTN from Chapelizod bypass	13/04/22 - 14/04/22

Monitoring Location	ITM Co-ordinates		Location Description	Survey Dates
	Easting	Northing		
			approximately 35m and Inchicore Road approximately 45m.	
NML 11	711622	733699	Located in yard at Dan Ryan truck rental on Sarsfield Road monitor placed by wall nearest train tracks.	06/01/22 - 07/01/22
NML 12	711364	733630	Located on a low level balcony nearest train tracks at Seven Oaks Apartments with view of the trains passing. Approximately 90m from R833 and approximately 95m for Landen Road roundabout	15/02/22 - 16/02/22
NML 13	710348	733275	Monitor located in rear garden of a residential property along Landen Road. Monitor approximately 30m from Landen Road.	18/01/22 - 19/01/22
NML 14	710073	733188	Monitor located in rear garden of a residential property along Kylemore Road. Monitor approximately 20m from Kylemore Road.	12/01/22 - 13/01/22
NML 15	709515	733013	Monitor located in rear garden of a residential property on Clover Hill Road off Le Fanu Drive. Monitor raised to high elevation clearing obstructions between garden and passing train tracks.	18/01/22 - 19/01/22
NML 16	708086	732788	Monitor located in rear garden of a residential property along Barnville Park. Monitor approximately 70m from Park West Avenue. Approximately 400m off the M50.	12/01/22 - 13/01/22
NML 17	703880	732794	Monitor located in rear garden of a residential property along Tullyhall Drive in Adamstown. Road between tracks and noise survey location, traffic noise from road between house and tracks.	25/01/22 - 26/01/22
NML 18	698344	731304	Monitor location at Hazelhatch station, within the carpark placed on the lamp post. Carpark between tracks and noise survey location. Monitoring Location approximately 90m from R405.	09/01/22 - 10/01/22

14.4.1.1.2. Noise Monitoring Equipment and Procedure

The unattended noise measurements were undertaken using Bruel & Kjaer (B&K) 2250 Class 1 Sound Level Meters with associated outdoor microphone kit B&K UA-1404. The microphones were mounted at a height of 1.2 – 1.5m above floor/ground level. Measurements were a combination of free-field and façade measurements depending on the monitoring location. Free-field measurements positions were at least 3.5m from any reflecting façade. Façade measurements were converted to free-field levels using the procedure in ISO 1996 Annex B. The sound level meters were calibrated before and after the survey using a B&K 4132 Class 1 Acoustic Calibrator and the drift in calibration was within acceptable range (as per criterion in BS 4142:2014+A1:2019).

The following parameters were recorded during each monitoring period:

- **L_{Aeq}** The continuous equivalent A-weighted sound pressure level. This is an 'average' of the sound pressure level;
- **L_{Amax}** This is the maximum A-weighed sound level measured during the sample period;
- **L_{Amin}** This is the minimum A-weighted sound level measured during the sample period;
- **L_{A10}** This is the A-weighted sound level that is exceeded for noise for 10% of the sample period; and
- **L_{A90}** This is the A-weighted sound level that is exceeded for 90% of the sample period.

The 'A' suffix for the noise parameters denotes the fact that the sound levels have been 'A-weighted' in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to 20 microPascals.

14.4.1.2. Baseline Noise Survey Results

The L_{Aeq} and L_{A90} noise data at each monitoring location is presented in Volume 4, Appendix 14.1 of this EIAR. The baseline noise data recorded at each monitoring location was analysed as follows:

Data was divided into two data sets: daytime (07:00 – 23:00 hrs) and night-time (23:00- 07:00 hrs).

No rainfall was recorded during the survey. (Best practice requires that measurements taken during rainfall be removed from each data set).

Wind speeds were below 5 m/s during the survey. (Best practice requires that measurements taken during wind speeds greater than or equal to 5 m/s are removed from each data set).

Periods of measured noise data affected by extraneous irregular noise events were identified and removed. Some data during night-time periods at locations NML 3 and NML 18 were omitted as the variation in noise levels did not follow the diurnal trend. Table 14.20 presents a summary of noise monitoring results.

Table 14.20: Noise Monitoring Results - $L_{Aeq,16hr}$ Daytime and $L_{Aeq,8hr}$ Night-time

Noise Monitoring Location	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$
NML 1	54.3	45.7
NML 2	52.9	45.5
NML 3	56.7	58.0
NML 4	51.6	43.4
NML 5	56.3	45.8
NML 6	63.7	53.9
NML 7	58.6	52.0
NML 8	64.0	59.1
NML 9	69.8	65.4
NML 10	63.8	60.0
NML 11	65.7	59.1
NML 12	60.6	55.5
NML 13	61.5	55.2
NML 14	64.7	59.9
NML 15	62.9	57.1
NML 16	67.4	57.8
NML 17	66.2	58.0
NML 18	54.7	51.3

These noise levels have been used to determine the current noise levels experienced at locations representative of the most exposed dwellings to noise sources within the proposed Project as well as existing noise sources.

The ABC method outlined in section E3.2 of BS5228-1:2009+A1:2014 has been used for the assessment of construction noise. The measured ambient (L_{Aeq}) noise levels have been used determine the threshold of potential significant effect in keeping with the requirement set out in BS 5228. The daytime noise levels indicate that the appropriate category for determining the potential significant effects varies from Category A (i.e. 65 dB L_{Aeq} during daytime periods) to Category C (i.e. 75 dB L_{Aeq} during daytime periods) for residential receptors depending on the receptor location. A similar exercise was undertaken for evening and night-time periods.

14.4.2. Baseline Vibration Survey

The baseline vibration survey provides quantification and an understanding of the vibration levels adjacent to and in proximity to the proposed Project. The purpose of the vibration monitoring surveys was to:

- Determine the baseline vibration levels at the nearest sensitive receptors to the proposed Project;
- Evaluate the vibration climate in the Noise and Vibration Study Area;
- Quantify how vibration propagates vertically through a modern high rise building structure and horizontally at distance from the railway track; and

- Quantify the variation in vibration levels from different train types and train speeds.

14.4.2.1. Baseline Vibration Survey

The baseline vibration survey identified sensitive locations which may be disturbed by vibrations from the railway and the existing rail vibration levels was established at these selected locations. The baseline study was undertaken at three areas adjacent to the proposed Project. For two of the areas, horizontal and vertical measurement locations were monitored simultaneously. Measurements were undertaken in accordance with ISO 4866:2010 Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures. The measurement instrumentation was a Bruel and Kjaer Vibration Monitoring Terminal Type 3680 using a triaxial geophone and recording both Peak Particle Velocity and Vibration Dose Value. The geophone was mounted on three spikes to ensure good base contact and weighed down with a sandbag.

Baseline results are presented for velocity and acceleration. For consistency with Table 14.14 and Table 14.18, the results are presented in mm/s (PPV) and $ms^{-1.75}$ (VDV). It is important to note that the minimum sensitivity of the VDV measurements is 0.0001 $ms^{-1.75}$. With low vibrations from passing trains the vast majority of measurements are at this low level. For comparison, the thresholds classified as negligible in Table 14.18 are 0.2 $ms^{-1.75}$ for daytime and 0.1 $ms^{-1.75}$ for night-time. With such low vibration levels, relative increases over existing level criteria do not apply.

14.4.2.1.1. Vibration Monitoring Locations

Three vibration monitoring locations were identified for obtaining representative environmental vibration levels near the proposed development in addition to quantifying vibration levels from existing trains. Attended measurements were undertaken with details of train passes recorded for the passage of 20 trains at each location. Details of the vibration monitoring locations are provided in Table 14.21 and locations are shown in Volume 3A of this EIAR. Detailed monitoring results are presented in Volume 4, Appendix 14.1 of this EIAR.

Table 14.21: Vibration Baseline Survey Details

Monitoring Location	ITM Co-ordinates		Location Description	Survey Dates
	Easting	Northing		
Con Colbert House	712041 712068	733796 733741	VMT1 was located outside Con Colbert House at foundation level approximately 6m horizontal distance from the nearest track. Train vibrations were noticeable but levels were not of concern at VMT 1. VMT2 was located inside at main building server room. Traffic/HGVs on Con Colbert Road can be a source of vibration at Con Colbert House. Self-induced vibration from servers and footfall in the building are the main vibration source at VMT2	13/04/2022 10:52 – 13:31 (external) 12:00 – 12:23 (internal)
Adamstown Park	702146 702147 702146	732864 732877 732897	VMT1 located 10m from the nearest track. VMT2 located 20m from the nearest track. VMT3 located 40m from the nearest track on footpaths. HGV vehicles and traffic	05/05/2022 13:30 – 14:39

Monitoring Location	ITM Co-ordinates		Location Description	Survey Dates
	Easting	Northing		
			occasionally interrupted the measurement sequence.	
Kilmainham Square	712534 712534 712534	733868 733868 733868	VMT1 on the ground floor of the building nearest the tracks of Kilmainham square VMT2 on the 2nd floor and VMT3 on the 6th floor. Footfall in the building occasionally interrupted the measurement sequence.	05/05/2022 10:20 – 11:59

14.4.2.2. Baseline Vibration Survey - Results

Baseline vibration measurements were carried out at three locations. Three vibration monitoring stations were monitored at Kilmainham Square on different floors. Three vibration monitoring stations were monitored at Adamstown Park at different horizontal distances from the railway line. Two locations were monitored at Con Colbert House, one external and one in the server room. Observations were made of train passings so that the data could be correlated to the measurement logs. Data for train passings were combined at each location to identify average vibration levels during a train passing and the periods between train passings. Detailed monitoring results are presented in Volume 4, Appendix 14.1 of this EIAR. Table 14.22 presents a summary of the baseline vibration survey results.

VML 1 and VML 2 were located at a data centre at Con Colbert House, with VML 1 approximately six metres from the nearest track. This location was identified as vibration sensitive due to the concentration of servers in the building and proximity to the planned works to replace Memorial Bridge.

VML 3, VML 4 and VML 5 were located at Adamstown Park and spaced at locations that were 10 metres, 20 metres and 40 metres from the nearest track horizontally.

VML 6, VML 7 and VML 8 were located at Kilmainham Square on three different floors of the apartment block vertically over the same location.

Due to the low levels of vibrations arising from trains passing the measured values at greater horizontal and vertical distances from the railway tracks are determined by other sources such as footfall, road traffic and events such as doors shutting. Where measurements related to train passing events only at Adamstown the measurements were used to determine a vibration attenuation coefficient for Dublin boulder clay.

Table 14.22 Baseline Vibration Survey Results

Monitoring Location	Description	PPV (mm/s) With Trains	PPV (mm/s) No Trains	VDV ($m/s^{1.75}$) With Trains	VDV ($m/s^{1.75}$) No Trains
VML 1	Con Colbert House (External - ground level)	0.170	0.020	0.059	0.052
VML 2	Con Colbert House (Server Room - 1st floor)	0.150	0.12	0.01	0.005
VML 3	Adamstown Park (10 m from tracks – footpath)	0.090	0.010	0.042	0.011

Monitoring Location	Description	PPV (mm/s) With Trains	PPV (mm/s) No Trains	VDV ($m/s^{1.75}$) With Trains	VDV ($m/s^{1.75}$) No Trains
VML 4	Adamstown Park (20 m from tracks – footpath)	0.049	0.010	0.018	0.032
VML 5	Adamstown Park (40 m from tracks – footpath)	0.030	0.015	0.011	0.015
VML 6	Kilmainham Square (ground floor)	0.130	0.010	0.092	0.018
VML 7	Kilmainham Square (second floor)	0.060	0.010	0.039	0.019
VML 8	Kilmainham Square (Sixth floor)	0.040	0.010	0.028	0.009

* Low VDV baseline levels without trains cannot be calculated due to low levels at minimum equipment sensitivity

14.5. Evolution of the Environment in the absence of the Project (Do Nothing)

Annex IV of the EIA Directive sets out the information required to be included in an EIAR. This includes: "*a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the Proposed Project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*".

In the event that the proposed Project does not proceed, an assessment of the future baseline conditions has been carried out and is described within this section. As outlined in Chapter 4 Project Description, the future level of service for a Do Minimum scenario (proposed level of service with future capacity delivered with existing infrastructure) has been assessed.

In the "Do Minimum" scenario the interventions for the modernisation of the railway corridor and areas outside of CIÉ lands for the Project would not be undertaken and includes the continued use of the existing railway line.

The continued use of the railway line would require the use of diesel fuelled units (as no electrification infrastructure exists). The frequency of services and speeds on the line may be altered, as it has been historically, to accommodate the constraint of the two tracks. This change in frequency and operation will give rise to an increase in railway noise levels.

One further impact arising in the Do Minimum scenario is the requirement for additional maintenance of the tracks due to wear and tear on both the tracks and the carriage wheels. Maintenance activities include adjustments to the ballast, grinding of the rails in situ and grinding of the wheels of the rolling stock, an activity which is carried out offsite in maintenance depots. The ballast adjustments and rail grinding must be carried out at night-time due to the need for line closures. In the Do Minimum scenario the frequency of maintenance activities will be significantly higher than in the Do Something scenario.

Therefore, current noise and vibration levels from rail operations and associated maintenance works are considered to be lower than a future Do Minimum scenario.

14.6. Description of Potential Impacts

This section includes an assessment of the specific direct and indirect impacts that the proposed Project may have during both the construction and operational phases, in the absence of any remedial or reductive measures.

14.6.1. Potential Construction Noise Impacts

Short-term increases in noise impacts will occur during the construction phase of the proposed Project due to the requirement to use heavy plant and machinery. There is generally a higher tolerance for short-term construction related noise than that which causes annoyance over the long term. This is reflected in the construction noise guidelines in Section 14.3.3.2.

A detailed description of the proposed construction works and proposed working hours is presented in Chapter 5 Construction Strategy of this EIAR. The main works to be carried out include:

- Advanced Works;
- Establishment of construction compounds;
- Demolition of buildings;
- Earthworks;
- Construction of retaining walls including piling and soil nailing/ wall anchoring;
- Bridge demolition and construction;
- Permeant Way works including track lowering;
- Construction of Substations;
- Construction and Installation of OHLE supports;
- Heuston Station Works (including the construction of Heuston West Station); and
- Construction Traffic.

Construction noise predictions have been undertaken for the proposed construction activities at all noise sensitive receptors in the noise and vibration study area using a three-dimensional model. Predictor LimA, Version 2021.1 noise modelling software, which meets ISO/TR 17534-3:2015 quality assurance standards, was used to create the model. The method for calculating outdoor noise attenuation used by the Predictor LimA software is the international standards ISO 9613-2:1996 – Attenuation of sound during propagation outdoors - Part 2: General method of calculation. Table 14.23 provides a summary of the construction noise model inputs.

Table 14.23: Summary of Construction Model Inputs

Item	Input
Noise Source	BS 5228-1:2009+A1:2014 Code of Practice of Noise and Vibration Control on Construction and Open Sites Part 1: Noise. Manufacturers Datasheets. Information provided by design team and client.
	Traffic flows (as outlined in Chapter 6: Traffic and Transportation).

Item	Input
Noise Receptor	Receiver Heights of 1.5 m and 4 m except for multistorey dwellings and apartments blocks where additional heights were assessed.
Model Parameters	Relative Humidity 70% (ISO 9613).
	Temperature 10°C (ISO 9613).
	Ground absorption 0 for acoustically hard surfaces and 0.5 for all other acoustically soft surfaces.
	Lidar data
	ISO 9613-2 downwind propagation noise model.

Noise levels have been assessed over the daytime (07:00 to 19:00hrs), evening (19:00 to 23:00hrs) and night-time (23:00hrs to 07:00hrs) periods as relevant for the construction works in accordance with the proposed construction working hours for the proposed Project as outlined in Chapter 5 Construction Strategy.

14.6.1.1. Mobilising and Site Enabling Works

14.6.1.1.1. Advanced Works

Site Clearance

Prior to works commencing vegetation such as trees, climbing plants, shrubs or vines will be removed. Site clearance to remove any unwanted materials, structures and equipment will also be required. The following locations will require site clearance:

- Zone A – Vegetation clearance associated with full site clearance at construction compound locations and substation locations only. There may be some localised vegetation loss associated with utility diversions;
- Zone B – Full vegetation clearance along the corridor to accommodate the four tracking;
- Zone C – Vegetation clearance associated with construction compound locations and substation locations within Zone C and also area for Heuston West Station; and
- Zone D – The extent of the vegetation clearance is along the length of the Phoenix Park Tunnel Branch Line where soil nailing is shown on the technical design drawings in Volume 3A and cover the full height of the slopes to allow for soil nailing and new mesh facing to be installed.

The plant required for site clearance activities will vary depending on the location and it will include but not be limited to the plant items in Table 14.24.

Table 14.24: Plant for Site Clearance

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Tracked excavator	C.2.5	Clearing Site	104.4
Dozer*	C.2.1	Clearing Site	103.3
Wood chipper	Manufacturers datasheet	QuadTrak 160 Chipping wood	116
Mulcher	Manufacturers datasheet	BE TMS 2300 Mulcher	114.6
Chainsaw	Manufacturers datasheet	Stihl MS461 Chainsaw	117
Stump grinder	Manufacturers datasheet	Barreto 30SG Stump Grinder	107
Tractor with front end loader	C.4.14 Wheeled Backhoe loader	Distribution of Material	94.8
Road lorry (full)*	C.6.21	Delivery / Removal of Material	108.6
Vibratory Roller	C.4.53	Rolling and Compaction	104.5
Lorry with lifting boom	C.4.53	Lifting material	104.9
* - Drive-by maximum sound level			

The predicted noise levels at various distances from site clearance activities is shown in Table 14.25.

Table 14.25: Site Clearance - Predicted Noise Levels

Activity	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Site Clearance	81	73	66	62	60
Site Clearance excluding Tree Felling and Processing Activities	74	65	58	55	52

The predicted construction noise level from site clearance activities is greater than 70 dB L_{Aeq} when activities occur less than 33m from noise sensitive receptors. In practice, the actual noise levels are expected to be lower as not all plant will be operated simultaneously at the closest location to noise sensitive locations.

The plant items with the potential for greatest impact are the tree felling and processing activities (chainsaw, mulcher, chipper and stump grinder). There is potential for elevated noise levels greater than 70 dB L_{Aeq} at noise sensitive locations when activities are within 33m of the proposed works where there is direct line of sight with receptor locations. When tree felling and processing activities are not occurring, predicted construction noise level from site clearance activities are greater than 70 dB L_{Aeq} at distances less than 15m from noise sensitive locations. It is also assumed that there is direct line of sight between the activity and the sensitive receptors. Where there is no direct line of sight, predicted noise levels can be up to 10 dB lower.

It is likely that the elevated noise levels will occur for brief and temporary periods. The magnitude of impact is low to medium, and the significance of effect is assessed to be not significant. Mitigation measures are discussed in Section 14.7.1.

Ground Investigations

Preliminary ground investigation works have been undertaken to inform the preliminary design of the works to date. Further intrusive ground investigation will be required to advance the design for construction. This will include but not be limited to the following along the length of the corridor:

- Hand dug inspection pits;
- Cable percussive boreholes with rotary follow-on;
- Rotary boreholes;
- Geobor S Rotary boreholes;
- Windowless sample boreholes;
- Vacuum Excavator; and
- Geophysical survey.

Ground investigation works will take place both on-track and off-track. On-track works will require the use of vacuum excavator. Table 14.26 presents a list of the noisiest plant required for ground investigation works. The vacuum excavator is the noisiest item of plant.

Table 14.27 presents predicted noise levels at various distance ranges from the ground investigation activities.

Table 14.26: Plant for Ground Investigation

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Cable Percussive Drilling	C.2.43	Ground Investigation Drilling	101.8
Rotary Boreholes	C.3.18	Assumed Rotary boreholes / Geobor S Rotary boreholes	102.5
Dynamic Probe	File Measurement*	Dynamic Sampling (also known as windowless sampling, light percussion boring)	103.6
Vacuum Excavator	File Measurement*	Ballast Removal	116.1

*Refers to on-site noise measurements for on-track GI works provided by a 3rd party

When activities are occurring off track the predicted noise does not exceed the 70 dB L_{Aeq}. As the setback distance increases, the predicted noise level decreases. The impact is low to medium at the closest noise sensitive locations where there is partial line of sight to the source. There is potential for noise levels in excess of 70 dB L_{Aeq} when there is direct line of sight, and this would result in a medium impact but as the duration of the activity is expected to be brief, the significance of effect is moderate.

Where ground investigation works are on-track, the use of a vacuum excavator is required. The use of a vacuum excavator results in an increase in noise levels with exceedances in a noise limit of 70 dB L_{Aeq} at distances up to 42m away from the activity where there is direct line of sight with the noise sensitive location. Where line of sight is obscured, the distance reduces to less than 25m. The vacuum excavator typically operates for 20 - 30 minutes at each exploratory hole location. There is potential for periods of high noise levels but given the brief duration of the activity, the significance of effect is not

likely to be significant. Nonetheless, there is potential for elevated noise levels and mitigation measures are discussed in Section 14.7.1.

Table 14.27: Ground Investigation - Predicted Noise Levels

Activity	Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
		10m	25m	50m	75m	100m
Ground Investigation excluding Vacuum Excavator	Partial Line of light	70	61	55	51	49
Ground Investigation including Vacuum Excavator	Line of Sight	82	74	68	65	62
	Partial Line of light	76	70	65	62	60

14.6.1.1.2. Site Enabling Works – Site Compounds

The linear nature of the project, the complexity of its urban location and therefore constrained access points, necessitates several temporary construction compounds to be provided along the length of the line, local to the works sites for shorter periods. The locations of these construction compounds, the land on which they are located, and their function are set out in Chapter 5 of this EIAR. Each of these locations will generate vehicular trips which will contribute to road traffic on the local road network. This is discussed in Section 14.6.1.9. The external and internal haul routes proposed to facilitate these construction vehicles are illustrated in Chapter 5 Construction Strategy of this EIAR.

Site enabling works at the construction compounds have been modelled and Table 14.28 presents the likely plant required as part of the activity. This phase of works is expected to last up to one month. It is expected that the duration for most site compounds will be less than that as some of the locations are relatively clean, have limited growth and undulation. Nonetheless, the intensity of the activity will vary over this period.

Table 14.28: Plant for Site Enabling Works – Site Compounds

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Tracked excavator	C.2.5	Clearing Site	104.4
Road lorry (full)*	C.6.21	Delivery / Removal of Material	108.6
Dump truck (tipping fill)	C2.30	Tipping Fill	107.1
Lorry with lifting boom	C.4.53	Lifting material	104.9
Dozer	C.5.12	Spreading Chipping and Fill	104.7
Vibratory Roller	C.5.28	Rolling and Compaction	104.5
* - Drive-by maximum sound level			

The predicted noise levels at various set back distances from site compound activities is shown in Table 14.29. The predicted construction noise level from site clearance activities is greater than 70 dB L_{Aeq} when activities occur less than 14m from noise sensitive receptors. In practice, not all activities will occur simultaneously, and actual noise levels are expected to be lower than the predicted levels. There is potential for periods of high noise levels but given the brief duration of the activity, it is not

likely to be significant. Nonetheless, there is potential for elevated noise above 70 dB L_{Aeq} for receptors within 14m of the proposed works and mitigation measures are discussed in Section 14.7.1.

Table 14.29: Site Enabling Works – Site Compounds - Predicted Noise Levels

Activity	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Site Enabling Works – Site Compounds	71	68	66	65	64

Once the site compounds have been established, they will be used to provide office and welfare facilities for site staff. The construction compound will also provide facilities for material storage, laydown and maintenance of construction plant, and potential fabrication areas. In general, the noise emissions from these activities will be less than that associated with the site enabling works. However, at some compound locations crushing and screening processes, fabrication warehouse and areas, and material transfer may be undertaken. Crushing and screening is proposed at a compound location at Kylemore and Table 14.30 presents the plant required as part of the crushing and screening activity.

Table 14.30: Plant for Crushing and Screening

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Tracked crusher	C.1.14	Crushing Rock	109.4
Screen stockpiler	C.10.15	Screen and grading of material	109.1
Articulated dump truck	C.6.26	Dumping Load	107.2
Articulated dump truck*	C.6.18	Distribution of Material	114.0
Wheeled loader	C.10.5	Loading material	107.8
* - Drive-by maximum sound level			

The proposed location is adjacent to commercial units with the nearest commercial unit over 50m away and the nearest residential dwelling is greater than 100m away. The predicted noise level at the nearest dwelling is 62 dB L_{Aeq} and is below the daytime construction noise limit. The magnitude of impact is low and the significance of effect is slight. However, there is potential for this activity to occur over an extended period and mitigation measures are proposed to reduce the noise impact from this activity, and these measures are outlined in Section 14.7.1.

14.6.1.1.3. Structure Demolition

As part of the proposed Project demolition of bridge structures, boundary and retaining walls and buildings are required. Demolition is classified as a static activity and the demolition of bridge structures is covered in Section 14.6.1.3.1 as part of the bridge construction works. Demolition of buildings and other structures is discussed in this section. Further details on demolition or removal of buildings and structures can be found in Chapter 4 Project Description. Table 14.31 presents the likely plant associated with this activity.

Table 14.31: Plant for Building Demolition Works

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Pulverizer mounted on excavator	C.1.4	Demolition of structure	103.8
Wheeled excavator	C.5.11	Loading of material	100.7

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Road lorry (full)*	C.6.21	Lorry for removal of waste material	108.6
Backhoe mounted hydraulic breaker	C.5.1	Breaking foundations	116.6
* - Drive-by maximum sound level			

Table 14.32: Demolition - Predicted Noise Levels

Activity	Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
		10m	25m	50m	75m	100m
Demolition	Partial Line of Sight	78	68	61	56	53
	Line of Sight	-	76	65	59	54

The predicted construction noise level from demolition activities where there is partial line of sight with the receptor location is greater than 70 dB L_{Aeq} when activities occur less than 20m from noise sensitive receptors. The distance increases to 37m when there is line of sight. In practice, not all activities will occur simultaneously, and actual noise levels are expected to be lower than the predicted noise levels. The plant item with the potential for greatest impact is the hydraulic breaker and the predicted noise levels are of the order of 10dB lower when the hydraulic breaker is not operating. However, the hydraulic breaker will be required for brief periods but will generally be operating at ground level. With the hydraulic breaker operating, there is potential for elevated noise levels in excess of 70 dB L_{Aeq} at receptor locations within 20m and 37m of the proposed works when there is line of sight and partial line of sight, respectively. Overall, the magnitude of impact from this activity at the nearest noise sensitive locations is low to medium and the significance of effect is slight to moderate. Measures to mitigate the noise impact are discussed in Section 14.7.1.

14.6.1.2. Earthworks

Earthworks are required along the length of the Project. The two main options to be used for earth moving will be by road and by rail. However, the main movement will be by road. Movement of material by road will require haul roads within a safe zone on the railway. This may require excavation at the top or base of cut slopes and may require temporary retaining walls e.g. trench sheets. The movement of material will result in an increase in traffic volumes on the surrounding road network and this is considered as part of the construction traffic impacts in Section 14.6.1.8. Approximate earthworks volumes are presented in Chapter 5 Construction Strategy.

Table 14.33 presents the likely plant associated with this activity. The distance to noise sensitive locations will vary throughout the earthwork's activity period.

Table 14.33: Plant for Earthworks

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Tracked excavator (x2)	C.2.19	Ground excavation/earthworks	105.5
Articulated Dump Truck*	C.2.33	Distribution of Material	108.5
Roller (rolling fill)	C.2.37	Rolling and Compaction	107.5
Dozer	C.2.11	Earthworks	107.0
Water Pump	C.4.88	Dewatering	96.8

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
* - Drive-by maximum sound level			

The predicted noise levels at various distances from earthworks activities are shown in Table 14.34. The predicted construction noise level from earthworks activities where there is partial line of sight with the receptor location is greater than 70 dB L_{Aeq} when activities occur less than 18m from noise sensitive receptors. The distance increases to 30m when there is line of sight. In practice, not all activities will occur simultaneously, and actual noise levels are expected to be lower than the predicted noise levels.

Table 14.34: Earthworks - Predicted Noise Levels

Activity	Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
		10m	25m	50m	75m	100m
Earthworks	Partial Line of Sight	74	68	63	60	58

There is potential for elevated noise levels above 70 dB L_{Aeq} at noise sensitive locations within 18m and 30m of the proposed works when there is line of sight and partial line of sight respectively. Given the linear nature of this activity, the significance of effect at the nearest noise sensitive locations will range from slight to moderate and will be temporary in duration. Mitigation measures are discussed in Section 14.7.1.

14.6.1.3. Structures

14.6.1.3.1. Bridges

As part of the proposed Project, six existing bridges will be replaced / upgraded along the length of the proposed Project. Further details on the bridge structures can be found in Chapter 4 Project Description.

The tasks and plant will vary depending on the bridge structure being modified and construction activities will include but not be limited to the plant items in Table 14.35.

Table 14.35: Bridge Construction Works

Task	Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Demolition	Wheeled mobile crane	C.5.37	Removal of deck and other sections of the bridge	103.7
	Pulverizer mounted on excavator	C.1.4	Demolition of structure	103.8
	Wheeled excavator	C.5.11	Loading of material	100.7
	Road lorry (full)*	C.6.21	Lorry for removal of waste material	108.6
	Backhoe mounted hydraulic breaker	C.5.1	Breaking foundations	116.6
Preparation of Hardstanding Areas	Road Lorry(full)*	C.6.21	Distribution of material	108.6
	Dump truck (tipping fill)	C2.30	Tipping Fill	107.1
	Tracked excavator	C.2.19	Ground Excavation/earthworks	105.5
	Dozer	C.5.12	Spreading chipping/fill	104.7

Task	Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
	Vibratory roller	C.5.27	Rolling and Compaction	94.6
Substructure	Tracked excavator	C.5.35	Trenching/Excavation/Earthworks	102.7
	Road lorry (full)*	C.6.21	Distribution of Material	108.6
	Road roller*	C.5.19	Rolling and Compaction	107.7
	Crawler mounted rig	C.3.22	Continuous flight auger piling – cast in situ	107.8
	Lorry with lifting boom	C.4.53	Lifting material	104.9
	Wheeled mobile crane	C.5.37	Lifting	103.7
	Truck mounted concrete pump + boom arm	C.4.30	Pumping concrete	107.5
	Hand-held circular saw (petrol-cutting concrete)	C.4.72	Cutting Concrete	107.2
Superstructure	Lorry with lifting boom	C.4.53	Lifting material	104.9
	Wheeled mobile crane (80T)	C.4.39	Lifting	104.7
	Wheeled mobile Telescopic crane (400T)	C.4.38	Lifting	106.2
	Truck mounted concrete pump + boom arm	C.4.30	Pumping Concrete	107.5
	Hand-held pneumatic breaker	C.1.6	Breaking concrete	111.5
	Hand-held circular saw (petrol-cutting concrete	C.4.72	Cutting concrete	107.2
	Poker vibrator	C.4.34	Vibrate concrete	96.7
	Road lorry (full)*	C.6.21	Delivery of material	108.6
* - Drive-by maximum sound level				

The predicted noise levels at various distances from bridge construction activities are shown in Table 14.36. At a distance greater than 25m, the predicted noise levels are less than 70 dB L_{Aeq} during all activities. In practice, not all plant for a given activity will operate simultaneously, and actual noise levels are expected to be lower than the predicted noise levels.

Table 14.36: Bridge Works - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Demolition	77	70	65	62	60
Hardstandings	67	62	59	57	56
Substructure	75	68	63	60	57
Superstructure	75	69	65	62	60

There is potential for elevated noise levels above 70 dB L_{Aeq} at noise sensitive locations within 25m of the proposed works. At some of the nearest noise sensitive locations, there is potential for temporary significant effects. Measures to mitigate the noise impact are discussed in Section 14.7.1.

14.6.1.3.2. Retaining Structures

A variety of retaining wall types are required along the length of the rail corridor to accommodate track widening. The retaining wall types vary in accordance with soil conditions, proximity to buildings and height of required retention. These include bored secant pile wall, trench wall, gabion basket wall and king post retaining wall solutions. Details on the location, chainage, wall type and height are outlined in Chapter 4 Project Description.

For the secant piled walls, a piling platform will be required. For larger retained heights (above 4m), the use of ground anchors to provide the horizontal support to the retaining wall will also be utilised. The installation of soil nails and ground anchors are also assessed later in this section.

Table 14.37 presents the likely plant associated with this preparing a piling platform, secant piling, trench walls, gabion walls, king post walls and soil nailing/wall anchors.

Table 14.37: Retaining Structures Construction Works

Task	Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Preparation of Piling Platform and Hardstanding	Articulated Dump Truck*	C.2.33	Distribution of material	108.5
	Articulated Dump truck (tipping fill)	C2.32	Tipping Fill	102.0
	Tracked excavator	C.2.19	Ground Excavation/earthworks	105.5
	Dozer	C.5.12	Spreading chipping/fill	104.7
	Vibratory roller	C.5.27	Rolling and Compaction	94.6
Secant Piled Walls	Tracked excavator	C.5.35	Trenching/Excavation/Earthworks	102.7
	Road lorry (full)*	C.6.21	Distribution of Material	108.6
	Crawler mounted rig	C.3.22	Continuous flight auger piling – cast in situ	107.8
	Lorry with lifting boom	C.4.53	Lifting material	104.9
	Wheeled telescopic crane	C.4.39	Lifting	104.7
	Truck mounted concrete pump + boom arm	C.4.30	Pumping concrete	107.5
	Welding-Rig and Hand tools	C.3.31	Welding	100.9
	Hand-held circular saw (petrol-cutting concrete)	C.4.72	Cutting Concrete	107.2
Trench Walls	Lorry with lifting boom	C.4.53	Lifting material	104.9
	Wheeled mobile crane	C.4.39	Lifting	104.7
	Road lorry (full)*	C.6.21	Delivery of material	108.6
	Hand-held pneumatic breaker	C.1.6	Breaking concrete	111.5

Task	Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
	Hand-held circular saw (petrol-cutting concrete	C.4.72	Cutting concrete	107.2
	Truck mounted concrete pump + boom arm	C.4.30	Pumping Concrete	107.5
	Poker vibrator	C.4.34	Vibrate concrete	96.7
Gabion Walls	Excavator	C.2.19	Material Excavation/ Backfill	105.5
	Dumper*	C.4.4	Distribution of material	103.5
	Vibratory Roller	C.5.26	Compaction	105.1
	Wheeled Loader	C.10.12	Loading of Gabion baskets	109.5
King Post Walls	Excavator	C.2.19	Material Excavation/ Backfill	105.5
	Dumper*	C.4.4	Distribution of material	103.5
	Crawler mounted rig	C.3.22	Continuous flight auger piling – cast in situ	107.8
	Wheeled telescopic crane	C.4.39	Lifting posts and concrete pre-stressed panels	104.7
	Truck mounted concrete pump + boom arm	C.4.30	Pumping Concrete	107.5
	Lorry with lifting boom	C.4.53	Lifting material	104.9
Soil Nailing and Ground Anchors	Tracked hydraulic drilling rig	C.6.35	Boring holes for soil nails	113.7
	Truck mounted concrete pump + boom arm	C.4.30	Grouting	107.5
	Excavator	C.2.19	Material Excavation	105.5
* - Drive-by maximum sound level				

The predicted noise levels at various distances from retaining wall and ancillary activities is shown in Table 14.38. Where activities occur within 10m of the noise sensitive receptors, predicted noise levels can reach up to 80dB and higher for secant piling, trench wall works and soil nailing/wall anchoring. To reduce the duration of the secant piling activity, it is proposed to use two piling rigs with a minimum productivity of 3 piles per day. As the works progress the intensity of the activity will first increase and then decrease at any specific location. There is potential for temporary significant to profound effects at the nearest noise sensitive receptors. Assuming all plant is operating simultaneously in close proximity to a given noise sensitive location, secant piling will remain above the noise limit until a setback distance of 55m is reached. If line of sight is blocked this distance will reduce.

Trench walls are proposed adjacent to Heuston West Station and this activity will be undertaken as part of the wider station building works. The total duration for the Heuston West Station works is 6 months. There is potential for elevated noise levels during specific tasks but overall noise impact is assessed to be medium with a moderate significance of effect.

The gabions walls proposed are confined to the Phoenix Park Tunnel Branch Line which is in deep cut. The predicted noise levels presented in Table 14.38 are below 70 dB L_{Aeq} where line of sight is blocked. Furthermore, the distance between the location of the gabion walls and the nearest noise sensitive

locations is greater than 10m. The magnitude of impact is assessed to be low, and the significance of effect is slight.

King post walls are proposed at various locations between Park West and Glasnevin. The predicted noise levels presented in Table 14.38 are above 70 dB L_{Aeq} when activities are within 25m of noise sensitive locations. Given the larger spacing between piles (range 1.5 to 2 m) for the king post walls versus the secant piled walls, the magnitude of impact will be lower as it is expected that king post walls will be constructed at a faster rate and duration of the activity adjacent to a given noise sensitive location will be reduced. The magnitude of impact is assessed as medium but the short duration results in a moderate significance of effect.

For the secant piling works and wall anchoring works in close proximity to noise sensitive locations, the magnitude of impact is high and there is potential for significant to profound temporary significance of effect at noise sensitive locations given the high noise levels and extended duration of the activity at some locations. Mitigation measures are discussed in Section 14.7.1.

Table 14.38: Retaining Wall Structures and Ancillary Activities - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Piling Platform	73	67	62	60	58
Secant Piles	82	74	68	64	62
King Post Walls	77	70	65	62	60
Trench Walls	80	71	64	60	57
Gabion Walls	66	56	48	44	41
Soil Nailing/ Wall Anchors	82	74	68	65	62

14.6.1.4. Permanent Way

14.6.1.4.1. Track Lowering and Changes to Horizontal Alignment

The permanent way works comprise track lowering and changes to the horizontal alignment. Track lowering will be required from Park West & Cherry Orchard to Heuston and along parts of the Phoenix Park Tunnel to Glasnevin Junction (Phoenix Park Tunnel Branch Line). In some cases, the track lowering will be nominal and the most practical solution may be to reduce the track ballast by the required amount as outlined in Chapter 5 Construction Strategy.

Further details on track alignment can be found in Chapter 4 and 5 of this EIAR.

Table 14.39 presents the plant required for track lowering and horizontal alignment. Not all the stages outlined in Table 14.39 are applicable to all locations where track lowering or horizontal alignment changes are proposed. For completeness the full list of activities where changes in the track alignment occurred were assessed.

Table 14.39: Typical Construction Plant for Track Lowering and Horizontal Alignment

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
Rail Cutting and removal	Rail Cutting Machine	C.4:73	111.5
	Road-Rail Excavator	C.2.7	97.6
	Kirow Crane (30T)	C.4.43	97.8

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
Removal of Ballast	Tracked excavator	C.2.19	105.5
	Loading Stone	C.10.10	112.2
	Articulated Dump Truck*	C.2.33	108.5
Excavation of substrata	Articulated Dump Truck*	C.2.33	108.5
	Road-Rail Excavator	C.2.24	101.1
	Loading soil	C.10.8	108.2
	Vibratory roller*	C.5.21	108.4
Installation of drainage	Mini tracked excavator (trenching)	C.4.67	101.8
	Articulated Dump Truck*	C.2.33	108.5
	Road-Rail Excavator	C.2.7	97.6
	Road-Rail Excavator / Kirow Crane	C.4.43	97.8
	Vibratory roller*	C.2.40	100.7
	Truck mounted concrete pump and boom arm	C.4.30	107.5
	Truck with lifting arm	C.4.53	104.9
Construction of new track bed	Articulated Dump Truck (Tipping Fill)	C.2.32	102.0
	Tracked excavator	C.2.7	97.6
	Roller (rolling fill)	C.2.37	107.5
	Articulated Dump Truck*	C.2.33	108.5
	Kirow Crane (30T)	C.4.43	97.8
	Hand-held Welder	C.3.31	100.9
	Tamping Machine	File Measurement**	119.0

* - Drive-by maximum sound level
** - Night-time Noise Monitoring Survey at Sandmount Crossing (20/10/2019)

The predicted noise levels at various distances from track lowering and track alignment is shown in Table 14.40.

Table 14.40: Track Lowering and Horizontal Alignment - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Rail Cutting and Removal	75	69	65	63	61
Removal of Ballast	72	67	63	61	59
Excavation of substrata	73	67	63	60	58
Installation of Drainage	73	66	62	59	57
New Track Bed	76	70	66	63	61

The predicted noise levels show that for some activities there is potential for noise levels in excess of 70 dB L_{Aeq} when activities are within 25m of noise sensitive locations. Track laying is expected to progress at 1km per week including welding, so the duration of impact at any specific location will be

brief. The plant items with the greatest potential are the tamping machine with rail cutting and loading of ballast to a lesser extent. The tamping machine is constantly moving (albeit slowly) so the impact will be brief. Similarly, rail cutting is intermittent and the duration of the impact will be brief. Loading of ballast will occur over a longer duration, however, measures to mitigate the noise impact are discussed in Section 14.7.1. Overall, the magnitude of impact at the nearest noise sensitive locations is assessed to be medium and the significance of effect is assessed to be moderate.

Where tracks tie into running lines, activities will need to be undertaken during weekend and night-time possession. Further details are presented in Section 14.6.1.8.

14.6.1.4.2. Drainage

It is proposed that a new drainage system will be put in place as part of the new tracking arrangement between Park West & Cherry Orchard Station and Heuston Station. This activity has been considered as part of the changes to horizontal alignment discussed above.

Between Phoenix Park Tunnel and Glasnevin junction the proposed works include the lowering of the track in some areas but no major changes to the drainage system are expected, apart from re-adjusting the current pipe and chamber levels to the new track profile. This has been considered as part of the track lowering works.

As part of the new drainage system, stormwater attenuation tanks are required to collect and store excess surface water run-off from large storm events. Two new underground attenuation tanks are proposed for Inchicore Works area and a further located adjacent to the new Heuston West Station. There is also a pumping station that drains the excess of water on the cutting located immediately between the Royal Canal and Luas Twin Arch (OBO8) and the Maynooth Line Twin Arch (OBO9) structures, lowering of the existing pumping station is required in addition to an enlargement of the existing wet well chamber.

Table 14.41 presents a list of the plant/equipment likely to be used during the construction of attenuation tanks.

Table 14.41: Typical Construction Plant for Construction of Attenuation Tanks

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Tracked excavator	C.2.19	Ground excavation/earthworks	105.5
Wheeled backhoe loader	C.4.66	Ground excavation/earthworks/slinging	96.9
Road lorry (full)*	C.6.21	Distribution of Material	108.6
Dumper*	C.4.4	Distribution of Material	103.5
Vibratory Roller*	C.2.39	Rolling and Compaction	101.5
Water Pump	C.4.88	Dewatering	96.8
Mini tracked excavator	C.4.67	Ground excavation/earthworks	101.8
* - Drive-by maximum sound level			

The predicted noise levels at various distances from drainage works is shown in Table 14.42. The predicted construction noise level from activities where there is line of sight with the receptor location is less than 70 dB L_{Aeq} when activities occur greater than 10m away. The predicted noise impact for noise sensitive location in proximity to the attenuation tanks proposed at Inchicore will be lower as the setback distance is approximately 50m away. However, there will be periods where the attenuation

tank works at Heuston West will be closer than 10m at some noise sensitive locations and there is potential for noise levels above 70 dB L_{Aeq}. Overall, the magnitude of impact is assessed to be medium and the significance of effect is assessed to moderate. However, considering other activities occurring concurrently, it is likely that there will be a temporary significant effect at some noise sensitive locations. Measures to mitigate this impact will be implemented and these are discussed in Section 14.7.1.

Table 14.42: Attenuation Tank Works - Predicted Noise Levels

Activity	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Attenuation Tank Works	69	66	64	62	61

14.6.1.5. Electrification

The Project is being electrified from Hazelhatch & Celbridge Station to Heuston Station and to Glasnevin Junction via the Phoenix Park Tunnel Branch Line where it joins with the DART+ West Project. The electrification works will require:

- Substations; and
- Overhead Line Equipment (OHLE).

14.6.1.5.1. Substations

A total of six electrical substations are required for the DART+ South West Project. The substations will comprise a secured, fenced compound surrounding a building which will house all the necessary electrical switching and feeding equipment. Further details on the substations are contained in Chapter 4 Project Description. Table 14.43 presents a list of the likely plant/equipment to be used during the construction of substations.

Table 14.43: Typical Construction Plant for Construction of Substations

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
Site Preparation	Tracked excavator	C.2.7	97.6
	Road lorry (full)*	C.6.21	108.6
	Dozer	C.2.13	106.5
Preparation of Hardstanding's and Paving Areas	Tracked excavator	C.2.19	105.5
	Dump truck (tipping fill)	C.2.30	107.1
	Dozer	C.5.12	104.7
	Vibratory roller*	C.5.21	108.4
	Grader *	C.6.31	114.5
Concrete Pours	Concrete mixer truck (discharging) & concrete	C.4.28	102.8
	Poker vibrator	C4.34	96.7
	Road lorry (full)*	C.6.21	108.6
General Works	Wheeled mobile crane	C.4.43	97.8
	Telescopic handler	C.4.54	106.5
	Angle grinder (grinding steel)	C.4.93	108.7
	Road lorry (full)*	C.6.21	108.6

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
	Diesel generator	C.4.78	93.5
	Lifting platform	C.4.57	95.2
	Mini tracked excavator	C.4.67	101.8
Surface Paving	Road lorry (full)*	C.6.21	108.6
	Grader *	C.6.31	114.5
	Tracked excavator	C.5.35	102.7
	Road roller*	C.5.19	107.7
	Asphalt paver (+ tipper lorry)*	C.5.32	111.8
	Vibratory roller (not vibrating)*	C.5.23	110.9
	Road sweeper	C.4.90	103.9
* - Drive-by maximum sound level			

The predicted noise levels at various distances from substation activities is shown in Table 14.44.

Table 14.44: Substation Works - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Site Prep	68	63	59	57	55
Hardstanding Areas	76	71	67	65	63
Concrete Pours	64	60	57	56	55
General Works	69	65	62	60	59
Surface Paving	75	70	67	65	64

All substation locations are at least 25m away from nearby noise sensitive locations with the majority of the substations at least 50m away from nearby noise sensitive locations. The predicted noise at locations greater than 25m from the proposed substations does not exceed the 70 dB L_{Aeq}. Where line of sight is blocked, the noise impact will reduce. The activities with the greatest potential to generate noise are the hardstanding area works and surface paving. The grader is the loudest item of plant and although no specific mitigation measures are required to mitigate the noise from these activities, general mitigation measures to mitigate construction impacts will be implemented.

14.6.1.5.2. Grid Connection Routes

A total of six electrical substations are required for the DART+ South West Project. Each substation will be supplied from two independent 38kV circuits. The works will involve laying underground cables (UGC) 38kV electricity connection in the existing road and across greenfield sites. For the proposed Adamstown and Park West substations, a horizontal directional drill will be required to cross below the railway (UTX) to complete the route into the proposed substation.

ESB Networks will progress a separate planning application for electricity supply connections to accommodate the electrification of the proposed DART+ South West Project. Desk studies completed by the DART+ South West Design Team have identified the potential preferred routes of the proposed 38kV underground cable connections and these routes have been considered as part of the noise assessment. The proposed routes are described in Chapter 5 Construction Strategy of this EIAR. Table 14.45 presents a list of the likely plant/equipment to be used during installation of the underground cables.

Table 14.45: Typical Construction Plant for Installation of Underground Cabling

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
Installation of Underground Cabling	Road sweeper	C.4.90	103.9
	Mini excavator with hydraulic breaker	C.5.2	110.5
	Vibratory roller	C.5.27	94.6
	Wheeled excavator	C.5.34	98
	Hand-held circular saw (petrol)	C.5.36	114.6
	Dump truck (tipping fill)	C.2.30	107.1
	Vibratory plate (petrol)	C.2.41	108.1
	Directional drilling	C.3.5	110.7

The underground cabling works have potential to generate noise. However, given the linear nature of this activity, the worst of the impacts will occur for brief periods with the magnitude of the impact dependent on the distance between the noise sensitive location and the construction activity. Given the duration of this activity, the significance of effect is assessed to be slight to moderate for the nearest noise sensitive locations.

14.6.1.5.3. Construction and Installation of OHLE Infrastructure

The existing Project route corridor is not currently electrified and OHLE infrastructure will need to be installed. The OHLE arrangement will vary at different sections along the route depending on the track configuration, clearance to structures and local site conditions. Typical spacing between OHLE support structures will be between 40m and 50m, with a maximum spacing of 65m. Further details on OHLE arrangements including the arrangements at Heuston Station can be found in Chapter 4 Project Description.

OHLE foundations will be a critical and key element for the electrification works to be undertaken under the DART+ Programme. It is likely concrete bored pile foundations will be required. Foundations and mast will generally be completed once all the other Permanent way civils components have been constructed up to ballast level. The foundation and poles will be installed prior to bringing a new section of track into operation. OHLE wiring will be done line by line with daytime possession of a single line or in night-time possession with wiring train(s).

In sections where piled foundations are required, the piles will be constructed using road-rail vehicles. Once the piles have been installed, then masts and overhead wires are installed. Table 14.46 presents a list of the likely plant/equipment to be used during construction and installation of OHLE infrastructure.

Table 14.46: Typical Construction Plant for Construction and Installation of OHLE Infrastructure

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
Concrete Bored Pile Foundation	Mini Piling Rig	C.3.17	104.2
	Excavator	C.2.19	105.5
	Dumper*	C.4.4	103.5
	Truck mounted concrete pump and boom arm	C.4.30	107.5
	Poker vibrator	C.4.34	96.7

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
Installation of support structures including masts and cantilevers	Truck mounted Crane	C.4.53	104.9
	Angle grinder (grinding steel)	C.4.93	108.7
	Diesel generator	C.4.78	93.5
	Lifting platform	C.4.57	95.2
	Mini tracked excavator	C.4.67	101.8
	Welding-equipment	C3.31	100.9

* - Drive-by maximum sound level

The predicted noise levels at various distances from OHLE works are shown in Table 14.47. It is expected that the piling rig will be operating for a 30 – 40 minute duration at each location with 5 to 6 piles bored (distance of 200 – 300m) during a working day.

The installation of OHLE infrastructure will occur at a later stage. There is potential for elevated noise levels during the use of plant such as an angle grinder. However, the use of such plant is expected to be limited and in general the noise from the installation of support structures is expected to be lower than the predicted levels.

Table 14.47: OHLE Works - Predicted Noise Levels

Activity	Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
		10m	25m	50m	75m	100m
OHLE Works	Concrete Pile Foundation	77	68	62	58	55
	Infrastructure	78	69	63	59	56

Given the duration of this activity the significance of effect is assessed to be slight to moderate for the nearest noise sensitive locations depending on whether there is direct line of sight between the activity and the noise sensitive location. Mitigation measures are discussed in Section 14.7.1.

14.6.1.5.4. Signals and Related Infrastructure

New physical signalling and low voltage infrastructure comprising of a network of signalling and LV elements including localised control cabinets and cabins at several locations. Two signal gantries are proposed in Zone C and the installation of these have the potential to generate high levels of noise albeit for a short duration. Further details can be found in Chapters 4 and 5. Table 14.48 presents a list of the likely plant/equipment to be used during construction and installation of signal gantries.

Table 14.48: Typical Construction Plant for Construction and Installation of Signal Gantries

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
Concrete Bored Pile Foundation	Mini Piling Rig	C.3.17	104.2
	Excavator	C.2.19	105.5
	Dumper*	C.4.4	103.5
	Truck mounted concrete pump and boom arm	C.4.30	107.5
	Poker vibrator	C.4.34	96.7
	Truck mounted Crane	C.4.53	104.9

Activity	Plant	BS5228 Ref	Sound Power Level dB(A)
Installation of support structures including masts and cantilevers	Angle grinder (grinding steel)	C.4.93	108.7
	Diesel generator	C.4.78	93.5
	Lifting platform	C.4.57	95.2
	Mini tracked excavator	C.4.67	101.8
	Welding-equipment	C3.31	100.9

* - Drive-by maximum sound level

Table 14.49 presents the predicted noise levels associated with signal gantry works at various set back distances.

Table 14.49: Signal Gantry Works - Predicted Noise Levels

Activity	Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
		15m	25m	50m	75m	100m
Signal Gantry Works	Concrete Pile Foundation	71	66	60	56	53
	Installation of Gantries	72	67	61	58	56

No works are proposed within 10m with the nearest sensitive location approximately 15m away. The predicted noise levels for concrete bored piled foundation assuming not all plant is operating simultaneously is expected to be below 70 dB L_{Aeq} and noise impacts are not deemed to be significant. The installation of gantries assuming not all plant is operating simultaneously is expected to be below the 70 dB L_{Aeq} and the significance of effect is assessed to be not significant. Nonetheless, measures to mitigate the noise impact are discussed in Section 14.7.1.

14.6.1.6. Roads

Where bridge reconstructions are necessary as part of the Project, associated roadworks will be necessary (including footpaths or cycle track reinstatement or enhancements). The proposed road reconstructions are short in length as their purpose is only to facilitate bridge reconstruction to accommodate electrification of the railway. The sections of road on the DART+ South West Project that require reconstruction as a result of bridge reconstruction measure between 50m and 250m in length. A summary of the road reconstruction works is provided in Chapter 4 Project Description.

The road works comprise of removal of existing surface, profiling and shaping of road and construction of the road pavement. Table 14.50 presents the likely plant associated with this activity. This phase of works is expected to last several weeks at any location, but it will vary in activity level.

Table 14.50: Plant for Road Works

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Road Planner	C.5.7	Road Planning	109.7
Wheeled excavator	C.5.11	Removing broken road surface	100.7
Road lorry (full)*	C.6.21	Distribution of Material	108.6
Grader *	C.6.31	Levelling road	114.5
Tracked excavator	C.5.35	Trenching	102.7
Road roller*	C.5.19	Rolling and Compaction	107.7
Asphalt paver (+ tipper lorry)*	C.5.32	Paving	111.8

Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Vibratory roller (not vibrating)*	C.5.23	Rolling and Compaction	110.9
Road sweeper	C.4.90	Sweeping and dust suppression	103.9

* - Drive-by maximum sound level

Table 14.51: Road Works - Predicted Noise Levels

Activity	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Road Works	77	72	70	68	65

There is potential for noise levels to be above 70 dB L_{Aeq} when activity is occurring simultaneously within 25 m of a noise sensitive location. However, not all plant will operate simultaneously, and the actual noise levels are expected to be lower than the predicted noise level. Where line of sight is blocked, the noise impact will be further reduced.

The locations closest to the road works with the greatest impact experience high levels of noise from passing traffic. During these works, there will be no passing traffic and the noise impact is not expected to be over and above the existing noise levels experienced at these locations. Nonetheless the character of the noise will be different and mitigation measures will be implemented to minimise the impact, and these are discussed in Section 14.7.1.

14.6.1.7. Heuston West Station

The new Heuston West Station will be located west of the existing Heuston Station. It is proposed that the station construction works will be undertaken during a wider shutdown of the Phoenix Park Tunnel Branch Line and Phoenix Park Tunnel (PPT) (approximately 6 months) to facilitate the necessary works on the PPT and the other works along the branch line. The station works will be coordinated with the alterations to the track layout and the attenuation tank which are to be installed in the area. The construction activity associated with the installation of attenuation tanks has been assessed in Section 14.6.1.4.2 and the track alignment works is assessed in Section 14.6.1.4.1. Demolition and site enabling works are assessed in Section 14.6.1.1.2, retaining walls are assessed in Section 14.6.1.3.2 and earthworks in Section 14.6.1.2.

The tasks and plant will vary depending on the day and construction activities will include but not be limited to plant items in Table 14.52 which presents the likely plant associated with the station construction phases, including the station pedestrian and cycle bridge.

Table 14.52: Heuston West Station Construction Works

Task	Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Preparation of Hardstanding Areas	Road Lorry(full)*	C.6.21	Distribution of material	108.6
	Dump truck (tipping fill)	C2.30	Tipping Fill	107.1
	Tracked excavator	C.2.19	Ground Excavation/earthworks	105.5
	Dozer	C.5.12	Spreading chipping/fill	104.7
	Vibratory roller	C.5.27	Rolling and Compaction	94.6

Task	Plant	BS 5228 Ref	Description	Sound Power Level dB(A)
Substructure	Tracked excavator	C.5.35	Trenching/Excavation/Earthworks	102.7
	Road lorry (full)*	C.6.21	Distribution of Material	108.6
	Crawler mounted rig	C.3.22	Continuous flight auger piling – cast in situ	107.8
	Lorry with lifting boom	C.4.53	Lifting material	104.9
	Wheeled mobile crane	C.5.37	Lifting	103.7
	Truck mounted concrete pump + boom arm	C.4.30	Pumping concrete	107.5
	Hand-held pneumatic breaker	C.1.6	Breaking concrete	111.5
	Hand-held circular saw (petrol-cutting concrete)	C.4.72	Cutting Concrete	107.2
Superstructure (Bridge Construction)	Lorry with lifting boom	C.4.53	Lifting material	104.9
	Wheeled mobile crane (80T)	C.4.39	Lifting	104.7
	Wheeled mobile Telescopic crane (400T)	C.4.38	Lifting	106.2
	Truck mounted concrete pump + boom arm	C.4.30	Pumping Concrete	107.5
	Hand-held pneumatic breaker	C.1.6	Breaking concrete	111.5
	Hand-held circular saw (petrol-cutting concrete)	C.4.72	Cutting concrete	107.2
	Poker vibrator	C.4.34	Vibrate concrete	96.7
	Road lorry (full)*	C.6.21	Delivery of material	108.6
Platform Foundations	Excavator	C.2.19	Ground Excavation/earthworks	105.5
	Dumper*	C.4.4	Distribution of materials	103.5
	Truck mounted concrete pump and boom arm	C.4.30	Pumping concrete	107.5
	Poker vibrator	C.4.34	Vibrate concrete	96.7
* - Drive-by maximum sound level				

The predicted noise levels at various distances from construction activities is shown in Table 14.53.

Table 14.53: Heuston West Station - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Hardstandings	-	69	62	58	55
Substructure	-	75	68	63	60

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Superstructure	-	72	66	63	60
Platforms	70	64	60	58	56

The predicted noise levels show that for some activities there is potential for noise levels in excess of 70dB L_{Aeq} when activities are occurring over 25m of noise sensitive locations. The activity with the greatest potential is substructure works where piling is required. The distance between noise sensitive locations and construction activities will vary. Overall, the magnitude of impact at the nearest noise sensitive locations is assessed to be medium and the significance of effect is assessed to be moderate. However, at some of the nearest noise sensitive locations, there is potential for temporary significant effects when activities are within 25m. Measures to mitigate the noise impact are discussed in Section 14.7.1.

14.6.1.8. Night-time Construction Works

Where possible works will be undertaken in safe zones during daytime periods. In certain circumstances full possession of the railway (i.e. no trains running) will be required and these will take place during weekend and night-time possessions.

Preparatory Works

There are strict safety restrictions related to working on or adjacent to a live railway line. This will include barriers between the live tracks and the working area to provide safe zones of work. Preparatory works create working platforms and safe zones of work and these works are undertaken during track closures, typically during weekends or night-time periods.

There is also a requirement for preparation of piling platforms on the north side of the tracks from Chainage 12+000 – 12+700 during night-time periods. Details on likely plant items and predicted noise levels from this activity are presented in Section 14.6.1.3.2. Predicted noise levels associated with the Piling Platform activity are presented in Table 14.54.

Table 14.54: Pilling Platform Construction - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Piling Platform	73	67	62	60	58

The baseline noise levels at these locations[4] are greater than the Category C threshold value in BS5228. A potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3dB due to site noise. The nearest noise sensitive locations are generally 10 – 25m away from the construction activity. There is potential for temporary significant to profound effects at the nearest noise sensitive receptors given that the night-time works associated with this activity are programmed to occur for 20 nights. The distance to the construction activity for a given noise sensitive location will vary during the period but overall, at least a significant effect is likely. Mitigation measures are discussed in Section 14.6.1.2.

[4] 60 and 57 dB $L_{Aeq,8hr}$ at monitoring locations NML 14 and NML 15, respectively

Le Fanu Bridge

The abutment walls will be constructed in safe zones on either side of the existing bridge; with the northern side being constructed during the day and the southern side requiring night works for up to two weeks. Beams, slab and parapets will then be placed during night-time possessions.

Details on likely plant items and predicted noise levels from this activity are presented in Section 14.6.1.3.2. Predicted noise levels associated with the piling are presented in Table 14.55.

Table 14.55: Piling - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Piling	82	74	68	64	62

The baseline noise levels at this location (NML 15)[4] are greater than the Category C threshold value in BS5228. A potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. The nearest noise sensitive location is over 25 m away from the construction activity. There is potential for temporary significant to profound effects at the nearest noise sensitive receptors given that the night-time works associated with this activity are programmed to occur for a period of 10 nights in addition to night-time works for preparing the piling platform for the secant piled walls. Mitigation measures are discussed in Section 14.6.1.2.

There will also be a requirement to install beams during night-time. This is expected to occur for a period of 3 - 4 nights. The main source of noise will be from cranes with predicted noise levels of 60 dB L_{Aeq} at the nearest noise sensitive location. There is potential for temporary moderate to significant effects from this activity. Mitigation measures are discussed in Section 14.6.1.2.

Kylemore Bridge

The following activities will be undertaken during night-time periods and have potential to generate noise over and above those measured during the baseline noise survey:

- Erect temporary road and footbridges;
- Pile new abutments behind existing abutments; and
- Demolition of bridges (Weekend possession may incl. night works).

Details on likely plant items and predicted noise levels from these activities are presented in Section 14.6.1.3.1 and 14.6.1.3.2. The baseline noise levels at this location (NML 14)[4] are greater than the Category C threshold value in BS5228. A potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.

The main source of noise during night-time periods associated with erecting of the temporary road and footbridges will be from cranes with predicted noise levels of 70 dB L_{Aeq} at the nearest noise sensitive location. This activity is expected to occur for a period of 2 nights. The activity with the greatest potential to cause disturbance is the pilling of new abutment walls which is programmed for a period of 20 nights. There is potential for temporary significant to profound effects at the nearest noise sensitive receptors given that noise level and duration of the construction activities.

Demolition of the existing bridge is likely to occur during weekend possession. However, this may include night-time works to ensure this phase of works is completed during the wider weekend

possession. Should the night-time works occur, the duration of the significant to profound effects will be extended. Mitigation measures are discussed in Section 14.6.1.2.

Khyber Pass Footbridge

It is proposed to replace the existing bridge with a prestressed beam and slab bridge including new piers and ramps/stairs. All works can take place in safe zones adjacent to the works until such time as the main bridge span is lifted into place. This main span lift will require night-time possession and it will occur over one night. The main source of noise during night-time periods associated with this activity will be from cranes with predicted noise levels of 60 dB L_{Aeq} at the nearest noise sensitive location. The Baseline noise level (NML 12) is 55 dB $L_{Aeq,8hr}$ at this location which is greater than the Category C threshold value in BS5228. A potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. Given the duration of the works is one night, the significance of effect is assessed to be moderate.

Sarsfield Road Under-Bridge

It is envisaged that Sarsfield Road will remain open for most operations with some night-time closures required to remove and place decks. Most works outside that of the bridge superstructure works can be undertaken within safe zones to avoid working at night-time under possession.

The main source of noise during night-time periods associated with this activity will be from cranes with predicted noise levels less than 60 dB L_{Aeq} at the nearest noise sensitive location. The Baseline noise level (NML 11) is 60 dB $L_{Aeq,8hr}$ at this location which is greater than the Category C threshold value in BS5228. A potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. Two periods of three nights are likely to be required to undertake the works. The significance of effect is assessed to be moderate. Mitigation measures are discussed in Section 14.6.1.2.

Memorial Road Bridge

Boring the piles on the south side will be done under night-time possession, but piles on the north side are far enough away from the live carriageway to enable daytime safe zone working. Details on likely plant items and predicted noise levels from this activity are presented in Section 14.6.1.3.2. Predicted noise levels associated with the piling are presented in Table 14.55.

The baseline noise levels at this location[5] are greater than the Category C threshold value in BS5228. A potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. The nearest noise sensitive dwelling is approximately 50 m away from the construction activity. There is potential for temporary significant to very significant effects at the nearest noise sensitive dwellings given that the night-time works associated with this activity are programmed to occur for a period of 30 nights. Mitigation measures are discussed in Section 14.6.1.2.

Track Works

During the construction phase there will be a requirement to undertake track works during night-time periods. The works include:

[5] 59 dB $L_{Aeq,8hr}$ at monitoring locations NML 8 and NML 11, and 60 dB $L_{Aeq,8hr}$ at location NML 10

- Tie in works will require overnight work or blockades:
    - Ch 9+240 (3 installations);
    - Ch 10+800 (2 installations);
    - Ch 12+000 (2 installations);
    - Ch 13+250 (2 installations); and
    - Heuston Yard (multiple locations).
- Turnouts installation and removal: overnight work:
    - Ch 10+340 to 10+440.

Details on likely plant items and predicted noise levels from this activity are presented in Section 14.6.1.4.1. Not all plant items will be required during the night-time works and the predicted noise levels at various distances from rail cutting, removal and installation are shown in Table 14.56.

Table 14.56: Rail Cutting, Removal and Installation - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Rail Cutting and Removal	75	69	65	63	61
Rail Installation	75	69	65	62	60

The baseline noise levels at these locations vary between 55 – 60 dB $L_{Aeq,8hr}$ and are greater or equal to the Category C threshold value in BS5228. A potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. The nearest noise sensitive dwellings are typically greater than 25 m away from the construction activity. The exception is at Ch 9+240 and Ch 10+340 to 10+440 where there are a limited number of dwellings between 10 – 25 m away from the construction activity. There is potential for elevated noise levels. However, the works are likely to occur over one night for each installation. There is potential for brief moderate to significant effects at the nearest noise sensitive dwellings. Mitigation measures are discussed in Section 14.6.1.2.

Phoenix Park Tunnel

Night-time works are proposed to anchor the existing tunnel structure. The plant required will include a small excavator and a drilling and grouting rig. Works will take place near the entrance to the Phoenix Park Tunnel (Conyngham Road end). Predicted noise levels associated with the installation of the wall anchors are presented in Table 14.57.

Table 14.57: Wall Anchors - Predicted Noise Levels

Description	Predicted Noise Level, L_{Aeq} (dB) at various distances (m)				
	10m	25m	50m	75m	100m
Wall Anchors	82	74	68	65	62

The baseline noise level at this location is 55 dB $L_{Aeq,8hr}$ and is equal to the Category C threshold value in BS5228. A potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. The nearest noise sensitive locations overlook the tunnel entrance with activity programmed for 15 nights. There is potential for significant to profound effects from this activity. Mitigation measures are discussed in Section 14.6.1.2.

Testing and Commissioning of the System

- OHLE - adjusting contact wire heights and staggers – This activity is not expected to have any significant impacts above those for normal maintenance on the existing railway;
- Signalling – Some signalling testing during night-time periods. Same noise and vibration levels as during the day when trains are running; and
- Rolling stock (RS) dynamic tests – some tests performed during night-time periods, and they will have the same impact of trains running outside of normal hours.

14.6.1.9. Construction Traffic

As noted previously in Section 14.6.1.1.2, several temporary construction compounds will be provided along the length of the line, local to the works sites for shorter period. Each of these locations will generate vehicular trips which will contribute to road traffic on the local road network. The external and internal haul routes proposed to facilitate these construction vehicles are also illustrated in Chapter 5 Construction Strategy and Chapter 6 Traffic and Transport of this EIAR.

The increase in AADT generated by construction vehicles on external haul routes servicing works compounds or access/egress points are noted in Chapter 6 Traffic and Transportation. The largest contribution of construction traffic to the peak hour volumes as opposed to AADT will likely be construction personnel arriving and leaving the Main Construction Compound sites in the morning and evening. Typically, the bulk of construction personnel on large infrastructure projects arrive before the morning peak and leave in phases during the course of the afternoon, and past the evening peak. Construction material deliveries will be restricted to between 9am and 3pm in Zones B, C and D; however, this restriction is not considered a requirement in Zone A.

The increase in AADT generated by construction vehicles on external haul routes servicing works compounds is less than 10% for most roads adjacent to the site compounds. At some locations the change in increase in AADT is greater than 10%. The predicted change in noise from construction traffic was calculated using Calculation of Road Traffic Noise (CRTN), Department of Transport Welsh Office, HMSO 1988. When the additional traffic flow from the construction activity is added to the existing traffic flow, there is a negligible increase in predicted traffic noise levels, and this is not significant in EIA terms.

In addition to the increase in AADT generated by construction vehicles on external haul routes servicing works compounds or access/egress points, temporary traffic management diversions identified to facilitate temporary bridge closures or junction modifications will also change the traffic flows on the road network in proximity. The main temporary bridge closures resulting in traffic management diversion with the potential for the greatest change in noise levels are:

- Le Fanu Road Bridge Closure (OBC7);
- Kylemore Road Bridge Closure (OBC5A);
- Memorial Road Bridge Closure (OBC3); and
- South Circular Road Interchange.

The closure of Le Fanu Road Bridge, Kylemore Road Bridge and Memorial Road Bridge is anticipated to result in significant congestion on the immediate road network to the bridges. Table 14.58 presents the change in traffic noise levels and AADT on the road network associated with the Le Fanu Road Bridge closure.

Table 14.59 presents the change in traffic noise levels and AADT on the road network associated with the Kylemore Road Bridge closure. Table 14.62 presents the change in traffic noise levels and AADT on the road network associated with the Memorial Road Bridge closure.

Table 14.58: Change in Traffic Noise Levels associated with Le Fanu Road Bridge (OBC7) Closure

Link Arm ID	Road Name	Existing		Le Fanu Bridge Closure		AADT % Diff.	Change in Noise Level	Significance Rating
		AADT	HGV %	AADT	HGV %			
1	Le Fanu Road (N)	9,130	2.1	7,814	2.1	-14.4	-0.7	Not Significant (positive)
2	Ballyfermot (W)	14,906	8.8	14,708	8.8	-1.3	0.0	Neutral
3	Ballyfermot (E)	13,464	11.6	14,578	10.8	8.3	+0.2	Imperceptible
4	Kylemore Road (N)	11,386	6.5	12,307	6.1	8.1	+0.2	Imperceptible
5	Le Fanu Road (S)	7,564	2.5	3,616	2.5	-52.2	-3.2	Moderate (positive)
6	Kylemore Road (S)	17,831	8.3	22,664	8.0	27.1	+1.0	Slight
7	Kylemore Ave	4,916	3.5	8,062	3.4	64.0	+2.2	Moderate
8	Le Fanu Road (bridge)	9,164	2.7	244	2.7	-97.3	-15.7	Profound (positive)
9	Kylemore Road (SS)	18,136	8.7	27,633	8.4	52.4	+1.8	Slight
10	Landen Road	4,817	11.1	4,817	11.1	0.0	0.0	Neutral
11	Kylemore Road (Bridge)	17,813	7.7	27,502	7.5	54.4	+1.8	Slight
12	Kylemore Park Road N	7,754	12.8	13,715	11.9	76.9	+2.3	Moderate
13	L1014	13,357	9.5	12,947	9.5	-3.1	-0.2	Imperceptible (positive)
14	Kylemore Road (SSS)	14,767	7.5	15,754	7.1	6.7	+0.2	Imperceptible

Table 14.59: Change in Traffic Noise Levels associated with Kylemore Road Bridge (OBC5A) Closure

Link Arm ID	Road Name	Existing		Kylemore Road Bridge Closure		AADT % Diff.	Change in Noise Level	Significance Rating
		AADT	HGV %	AADT	HGV %			
1	Le Fanu Road (N)	9130	2.1	8973	2.1	-1.7	-0.1	Imperceptible (positive)
2	Ballyfermot (W)	14906	8.8	14860	8.8%	-0.3	+0.1	Imperceptible
3	Ballyfermot (E)	13464	11.6	15207	11.3%	12.9	+0.4	Not Significant
4	Kylemore Road (N)	11386	6.5	11386	6.5%	0.0	0.0	Neutral
5	Le Fanu Road (S)	7564	2.5	11297	3.1%	49.4	+1.8	Slight
6	Kylemore Road (S)	17831	8.3	13896	8.3	-22.1	-1.1	Slight
7	Kylemore Ave	4916	3.5	6977	4.2	41.9	+1.7	Slight
8	Le Fanu Road (bridge)	9164	2.7	16906	3.1	84.5	+2.9	Moderate
9	Kylemore Road (SS)	18136	8.7	12889	8.7	-28.9	-1.5	Slight (positive)
10	Landen Road	4817	11.1	4817	11.1	0.0	0.0	Neutral
11	Kylemore Road (Bridge)	17813	7.7	9568	7.7	-46.3	-2.7	Moderate (positive)
12	Kylemore Park Road (N)	7754	12.8	12775	12.4	64.7	+2.1	Moderate
13	Le Fanu/Killeen Road (L1014)	13357	9.5	14906	9.3	11.6	+0.4	Not Significant
14	Kylemore Road (SSS)	14767	7.5	15059	7.5	2.0	+0.1	Imperceptible

Table 14.60: Change in Traffic Noise Levels associated with Memorial Road Bridge (OBC3) Closure

Link Arm ID	Road Name	Existing		Memorial Road Bridge Closure		AADT % Diff.	Change in Noise Level	Significance Rating
		AADT	HGV %	AADT	HGV %			
15	Sarsfield Road (Bridge)	5765	10.6	5765	10.6	0.0	0.0	Neutral
16	R839 (N)	14205	6.6	9630	6.6	-32.2	-1.7	Slight
17	R839 (S)	14290	8.8	14290	8.8	0.0	0.0	Neutral
18	R810 (W)	14065	8.9	14879	7.9	5.8	-0.1	Imperceptible
19	R111 (N)	15080	3.6	20734	4.2	37.5	1.6	Slight
20	Ballyfermot (EE)	14277	10.4	14277	10.4	0.0	0.0	Neutral
21	Con Colbert Rd	9005	10.3	9005	10.3	0.0	0.0	Neutral
22	Inchicore Road (W)	8688	6.2	4113	6.2	-52.7	-3.3	Moderate (positive)
23	Inchicore Road (E)	3716	4.0	3716	4.0	0.0	0.0	Neutral
24	Memorial Road	6993	6.0	0	6.0	-100.0	-66.7	Profound (positive)
25	Chapelizod Bypass (W)	27988	13.9	27988	13.9	0.0	0.0	Neutral
26	Chapelizod Bypass (E)	25815	12.9	28951	11.6	12.1	0.2	Imperceptible
27	South Circular (S Bridge)	17315	4.2	22969	4.6	32.7	1.3	Slight
28	South Circular (N Bridge)	17410	6.0	19928	6.0	14.5	0.6	Not Significant
29	Conyngham Road (E)	15205	8.2	15205	8.2	0.0	0.0	Neutral
30	Conyngham Road (W)	10615	7.1	10615	7.1	0.0	0.0	Neutral
31	R148 (E)	23275	18.2	23275	18.2	0.0	0.0	Neutral
32	Kilmainham Lane	2155	1.4	2155	1.4	0.0	0.0	Neutral
33	R810 (E)	9201	14.5	6921	14.5	-24.8	-1.2	Slight (positive)
34	R111 (S)	12645	5.1	14926	5.4	18.0	0.8	Slight
35	Raheen Park	6300	2.8	6300	2.8	0.0	0.0	Neutral

The closure of the bridges will result in a redistribution of the traffic on the local road network. However, no significant effects are predicted as result of the bridge closures. The greatest impact from the Le Fanu Road Bridge closure will be on Kylemore Park Road N where a moderate effect is predicted. The closure of the Kylemore Road Bridge will also result in a moderate effect on the Kylemore Park Road N. Slight to moderate effects are predicted on Le Fanu Road. The greatest impact from the Memorial Road Bridge closure will be on R111 (N) and South Circular (S Bridge) where a slight effect is predicted.

The temporary junction modifications at the South Circular Road interchange (R111 and R148) are predicted to remain unchanged as it is not an offline diversion. However, the temporary junction modifications will result in delays. From a noise perspective, there is no change in traffic volumes and the changes in speeds at the junction are likely to range from slight (positive) to slight (negative) depending on the level on congestion.

14.6.2. Potential Operational Noise Impacts

The Do Something scenario for the proposed DART+ South West Project will result in electrification of the northern tracks. The DART+ South West Project will separate Intercity and fast regional services from the future DART service. This allows for the faster Intercity and regional services to operate efficiently along with the future DART services. The future DART service will operate on the electrified lines (northern tracks), while the Intercity and fast regional services will operate on the fast non-electrified lines. Along with an increase to service levels within the electrified DART+ area, there will also be service enhancements to the Intercity and Outer Commuter service levels with the proposed Project in place.

Peak hour passenger capacity will increase as set out in Chapter 4 Project Description. The number and length (number of carriages) of the trains will increase along with the speed of the service to achieve this.

Iarnród Éireann will incrementally introduce new services and enhanced timetables in response to growing demand. As such, the proposed level of service for the Do Something scenario with the DART+ South West Project in effect will be delivered over a period of time and will not come into effect in one timetable change.

Operational noise levels are calculated as L_{Aeq} which is the A weighted equivalent sound energy over a chosen time period. For this project a 16 hour day period and an 8 hour night period are used for consistency with other major rail projects such as Crossrail, the Jubilee Line extension, DART Underground and MetroLink. This metric includes both the sound level and the duration of the sound in order to account for the intermittent nature of rail noise.

The L_{Aeq} value is influenced by:

- The type of trains;
- The number of trains;
- The number of carriages on each train;
- The speed of the train; and
- The assumptions made regarding the rail track.

Several assumptions are built into the modelling to present a worst-case scenario. It is important to test the proposed Project in this way due to the proximity to extensive residential properties and the proposed level of service.

14.6.2.1. Operational Railway Noise

Predictive noise modelling is carried out using propriety acoustic modelling software. The noise modelling methodology applies the Dutch (RMR) methodology for the assessment of railway noise. This is consistent with the approach followed by Iarnród Éireann as the designated noise mapping body for heavy rail for compliance with the requirements of strategic noise mapping under the Environmental Noise Directive (END).

There will be an increase in train capacity along the route, with the introduction of electrified rolling stock for the DART service and service enhancements on existing services. The electrification of the line as part of the DART+ South West Project will result in an increase in train capacity by utilising new DART trains, operating at increased service frequency. Intercity rail traffic will be carried on the two southern most lines with clear access to Heuston. This increase in rail traffic is anticipated to result in a change in rail noise. DART traffic will increase significantly in the section of rail line from Islandbridge to Glasnevin (Zone D) where there are currently no significant rail movements. The assessment focuses on the potential noise impacts associated with modified service frequency.

While electrification of the service may result in a noise reduction when comparing a modern EMU to a current DMU, the noise assessment must consider the noise level measured on an equivalent energy level. In this regard the number of carriages/axles on a train along with the frequency of service is a key determining factor in the assessment.

14.6.2.1.1. Models / Tools Used in Assessment

The assessment on noise has used Softnoise Predictor LimA, Version 2021.1, noise modelling software to calculate the predicted noise levels at selected sensitive locations.

Operational railway noise has been modelled using the Netherlands national computation method published ‘Reken- en Meetvoorschrift Railverkeerslawaai '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996, Calculation and Measurement Regulations Rail traffic noise (RMR); The Minister of Housing: Spatial Planning and the Environment. This method has been used for the END noise modelling and other railway noise projects in Ireland.

A three-dimensional model of the Noise and Vibration Study Area has been developed from ground contours. Buildings which provide screening between sources and receptors are included as topographical features.

14.6.2.1.2. Noise Model Inputs

The noise model was prepared using the following data:

- Rail alignments based on the latest design, lidar survey and ordnance Survey mapping;
- Topographical data was informed by site specific survey data;
- Ordnance Survey mapping and site-specific survey data was used for identifying building footprints, existing rail lines including centrelines and extent of the rail corridor;

- 2021 Geodirectory data was used to identify noise sensitive receptor locations. This was supplemented with a review of aerial imagery and site visits to identify the receptor height (i.e. single storey, two storey or other);
- Train numbers, train type, type of track support and speeds used in the noise model were collated from data provided by Iarnród Éireann and shown in Chapter 4 (Table 4.22 – Future Do Minimum Level of Service and Table 4.23 – Future Do Something Level of Service);
- The following RMR Rail Categories were provided by Iarnród Éireann:
    - Category 3 existing Intercity Cork route (SGM-II/III, 2 units);
    - Category 4 for Freight (cargo, 5 units);
    - Category 6 for DMU (existing Intercity (except Cork route) and Commuter) (DH, 1 unit);
    - Category 8 for EMU (DART) (ICM-IV, 4 units);
    - Support Correction: Concrete sleepers in ballast;
    - Track Correction: Joined rails; and
    - Operational Speed: in order to model worst-case conditions the maximum operational speed of the track was used with acceleration and deceleration at stations as appropriate.

Noise predictions were undertaken for multiple receptor locations along the corridor. At some of these locations, predictions were undertaken adjacent to multiple façades and elevations (depending on the number of storeys) as the most exposed façade is not obvious.

14.6.2.1.3. Operational Rail Noise Validation

The purpose of validating the noise model is to confirm the noise modelling software is correctly interpreting the input data.

The model validation process is only possible at locations where rail noise is the dominant noise source. At locations where other noise sources such as road traffic or other urban noise source are also significant contributors, it is not expected that the rail noise model will calculate a similar noise level to the baseline measurement. To validate the operational rail noise model, the baseline noise survey at three locations was compared with the predicted results obtained using rail traffic data that was representative of the conditions during the period when the survey was undertaken.

Table 14.61 presents the predicted noise levels against the measured noise levels. In all instances, the predicted and measured noise levels are within 2.6 dB. There is good agreement between the noise model and measurements, and it is considered that the noise modelling software is correctly interpreting the input data.

Table 14.61: Measured vs Modelled Noise Level

Location ID	Location Description	Measured $L_{Aeq,16hr}$	Predicted $L_{Aeq,16hr}$	Difference
NML 1	Monitor Located in rear garden of residential property on Claremont lawns off Finglas Road.	54.3	53.4	0.9
NML 13	Located in rear garden of a residential property along Quarry Road.	61.5	60.7	0.8
NML 15	Located in rear garden of a residential property on Clover Hill Road.	62.9	60.3	2.6

14.6.2.1.4. Operational Noise Modelling Results

The following scenarios were modelled:

- Baseline;
- Do Minimum (DM);
- Do Something (DS); and
- Do Something with Mitigation.

Free-field noise levels were predicted at multiple receptors. For some receptors several locations around the building have been modelled given their proximity to the proposed Project. All receptors were modelled at heights of 1.5 and 4.0 m above ground level corresponding to ground floor and first floor levels, respectively. There are also several multi-storey residences, apartment blocks and commercial properties and these are modelled at higher floor levels as well. In some instance, some receptors were single storey and only results at ground floor height were considered for those locations. For all other locations the highest predicted noise level from each case (i.e. 1.5 m and 4 m height receiver point) has been presented.

The number of receptors with noise levels greater than 55 dB $L_{Aeq,16hr}$ daytime and 45 dB $L_{Aeq,8hr}$ night-time within the study area for both the Do Minimum and Do Something scenarios is presented in Table 14.62. It is observed that the proposed Project results in an overall positive noise impact between Phoenix Park Tunnel and Glasnevin as the number of receptors with predicted noise levels greater than the noise criteria reduces as the DMUs currently travelling along this section will be replaced with EMUs. However, between Hazelhatch and Heuston Station, the proposed Project will have a negative noise impact as there will be an increase the number of commuter trains and the average number of carriages per train is higher in order to deliver the increased passenger capacity.

It is important to note, although there will be an increase in the L_{Aeq} noise levels over a 16 hour daytime period and 8 hour night-time period at some noise sensitive locations, the introduction of EMUs will not increase the peak noise level experienced at noise sensitive locations when each train passes by.

Table 14.62: Predicted Noise Levels Greater than 55 dB $L_{Aeq,16hr}$ Daytime and 45 $L_{Aeq,8hr}$ Night-time

Receptor Description	$L_{Aeq,16hr}$ Daytime			$L_{Aeq,8hr}$ Night-time		
	Do Minimum	Do Something	Change	Do Minimum	Do Something	Change
All Receptor Types	729	863	134	1332	1506	174
Residential	675	807	132	1252	1423	171
Educational and Childcare Facilities	3	4	1	4	4	0
Hotels and Accommodation	0	0	0	1	1	0
Healthcare	0	0	0	0	0	0
Activities of Religious Organisations	0	0	0	0	0	0
Other	51	52	1	75	78	3

Given the large number of receptor locations modelled, a representative sample of noise sensitive locations along the rail corridor are presented in Table 14.63. Where increases in noise levels as a result of the proposed Project have been identified, noise sensitive locations have been assessed against the noise mitigation criteria outlined in Section 14.3.3.5. The outcome of the mitigation assessment is summarised in Table 14.63. Several locations along the length of the proposed Project have been identified as meeting the criteria for mitigation.

There are two additional locations that meet two of the criteria for mitigation (R44 and R59) and the proposed Project will result in a significant increase in noise levels at these locations. At location R44 the sound insulation performance of some of the dwellings (caravans) are of a lower performance than a conventionally constructed dwelling, the noise break-in will be higher and to protect the internal areas it is proposed that mitigation measures are implemented at this location. Location R59 is adjacent to an existing maintenance yard, and the cumulative noise from activities at the maintenance yard and rail operations at this location is sufficient to result in this location qualifying for mitigation. Further details on operational noise mitigation are presented in Section 14.7.3.

Table 14.63: Predicted Operational Rail Noise

Location ID	Description	Daytime - $L_{Aeq,16hr}$			Night-time $L_{Aeq,8hr}$			Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Base	DM	DS	Base	DM	DS	(a)	(b)	(c)	
R1	Claremont Lawns	54.3	47.4	45.9	45.7	41.8	40.4	No	No	No	No
R2	Claremont Crescent	56.8	57.1	56.9	51.2	51.5	51.3	Yes	No	No	No
R3	Royal Canal Way	58.9	58.9	58.9	53.4	53.4	53.3	Yes	No	No	No
R4	St Attracta Road	52.9	36.7	34.8	45.5	31	29.4	No	No	No	No
R5	Faussagh Ave and Barrow Road	52.9	56.2	52.4	45.5	50.5	47.1	Yes	No	Yes	No
R6	Hamilton Gardens	52.9	54.6	51.6	45.5	49	46.2	Yes	No	Yes	No
R7	Homestead Court	56.7	59.7	56.9	48.5	54	51.5	Yes	No	Yes	No
R8	Marlborough Road	51.6	55.3	52.5	44.1	49.6	47.1	Yes	No	Yes	No
R9	McKee Barracks	51.6	54.2	51.4	43.4	48.6	46	Yes	No	Yes	No
R10	Park Lodge Apartments	56.3	53.7	50.6	45.8	48	45.2	Yes	No	Yes	No
R11	Bridgewater Quay	63.7	59.2	56.7	53.9	53.6	51.3	Yes	No	No	No
R12	Riverpark Apartments	63.7	57	54.7	53.9	51.3	49.3	Yes	No	No	No
R13	Cavalry House	58.6	54	52.9	52	48.5	47.7	Yes	No	No	No
R14	Clancy Quay (Brewery)	58.6	57.3	56.6	52	51.9	51.5	Yes	No	Yes	No
R15	Clancy Quay (Cooke Hall)	64	59.2	60.9	59.1	54	55.7	Yes	Yes	Yes	Yes
R15a	Clancy Quay (Cooke Hall)	58.6	57.9	59.5	52	52.7	54.3	Yes	Yes	Yes	Yes
R16	St John of God School, Islandbridge	50	35.5	37.8	43	30.4	32.7	No	Yes	No	No
R17	Kilmainham Square (3rd floor)	64	63.3	65.4	59.1	58.1	60.3	Yes	Yes	Yes	Yes
R17a	Kilmainham Square (9th floor)	69.8	61.1	62.3	65.4	55.9	57.2	Yes	Yes	No	No
R18	Dwellings along Inchicore Road	64	61.7	61.7	59.1	56.7	56.7	Yes	No	Yes	No
R19	Dwellings of Sarsfield Road	63.8	61.1	62	60	56.1	57	Yes	No	Yes	No

Location ID	Description	Daytime - $L_{Aeq,16hr}$			Night-time $L_{Aeq,8hr}$			Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Base	DM	DS	Base	DM	DS	(a)	(b)	(c)	
R20	Seven Oaks Apartments (4th Floor)	60.6	58.9	63.7	55.5	53.5	58.6	Yes	Yes	Yes	Yes
R20a	Seven Oaks Apartments (6th Floor)	60.6	60.6	63.2	55.5	55.4	58.1	Yes	Yes	Yes	Yes
R21	16 - 72 Landen Road	61.5	59.5	60.7	55.2	54.3	55.6	Yes	Yes	Yes	Yes
R22	139 – 179 Landen Road	60.6	61.1	61	55.5	56	55.9	Yes	No	Yes	No
R23	183 – 315 Landen Road	60.6	63.3	62.8	55.5	58.2	57.7	Yes	No	Yes	No
R24	317 – 453 Landen Road	61.5	54	54.6	55.2	48.7	49.5	Yes	No	No	No
R25	317 – 453 Landen Road	61.5	55.6	56.3	55.2	50.4	51.2	Yes	No	Yes	No
R26	317 – 453 Landen Road	61.5	60.2	61.3	55.2	55.1	56.2	Yes	Yes	Yes	Yes
R27	317 – 453 Landen Road	61.5	57.6	59.8	55.2	52.5	54.7	Yes	Yes	Yes	Yes
R28	Kylemore Drive	61.5	58.4	54.4	55.2	53.2	49.3	Yes	No	No	No
R29	Le Fanu Drive	62.9	66.4	66.3	58.2	61.4	61.3	Yes	No	Yes	No
R30	33 - 123 Cloverhill Road	61.5	61.1	63.2	55.2	56	58	Yes	Yes	Yes	Yes
R31	1 – 27 Cherry Orchard Ave	61.5	60.2	62.9	55.2	55	57.7	Yes	Yes	Yes	Yes
R32	1 – 27 Cherry Orchard Ave	61.5	61.3	64.4	55.2	56	59.2	Yes	Yes	Yes	Yes
R33	28 - 60 Cherry Orchard Ave	61.5	61.3	64.1	55.2	55.9	59	Yes	Yes	Yes	Yes
R34	44-47 Cherry Orchard Parade	61.5	62.2	63.9	55.2	57	58.8	Yes	Yes	Yes	Yes
R35	45-51 Cherry Orchard Crescent	61.5	55.9	57.7	55.2	50.7	52.6	Yes	Yes	Yes	Yes
R36	New Development - Park West Road/Avenue	67.4	63	63.7	57.8	58.5	58.8	Yes	No	Yes	No
R36a	New Development - Park West Road/Avenue	67.4	65.5	68.1	57.8	60.5	63.1	Yes	Yes	Yes	Yes
R36b	New Development - Park West Road/Avenue	67.4	64.6	64.8	57.8	59.9	60	Yes	No	Yes	No
R36c	New Development - Park West Road/Avenue	67.4	66.6	68.6	57.8	61.5	63.5	Yes	Yes	Yes	Yes
R37	Cherry Orchard Court	65.7	69.4	70.2	62.1	64.7	65.2	Yes	No	Yes	No

Location ID	Description	Daytime - $L_{Aeq,16hr}$			Night-time $L_{Aeq,8hr}$			Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Base	DM	DS	Base	DM	DS	(a)	(b)	(c)	
R38	45-48 Barnville Park	67.4	62.8	67.1	55.8	57.5	62	Yes	Yes	Yes	Yes
R39	Park West Ave (Hotel)	61.5	53	52.7	55.2	48.4	47.6	Yes	No	No	No
R40	Park West Ave	61.5	48.8	51.8	55.2	43.9	46.7	Yes	Yes	No	No
R41	Cooleven Close	64.3	66.1	67	60	61.1	61.9	Yes	No	Yes	No
R42	Cappagh Ln (East)	52.2	56	57.5	47.2	50.9	52.4	Yes	Yes	Yes	Yes
R43	Cappagh Ln (West)	55.7	56.4	57.9	51.4	51.5	52.9	Yes	Yes	Yes	Yes
R44	Lynch's Park 15-20	61.5	65.2	65.9	57.1	60.2	60.9	Yes	No	Yes	No
R45	Kishoge Road	58	59.8	60.9	53.3	54.7	55.8	Yes	Yes	Yes	Yes
R46	55 - 75 Tullyhall Drive	66.2	65.1	65.7	58	60.2	60.7	Yes	No	Yes	No
R47	Hansted Place	66.2	66.1	66.8	58	61.2	61.7	Yes	No	Yes	No
R48	Adamstown Community College	66.2	66.7	67.6	58.9	61.8	62.6	Yes	No	Yes	No
R49	Adamstown Ave/ Adamstown Park	66.2	54.3	56.5	58	49.3	51.3	Yes	Yes	No	No
R50	Tubber Lane Road (North of Hillcrest Bridge)	51.2	54.4	55.8	48.4	49.3	50.7	Yes	Yes	Yes	Yes
R51	Tubber Lane Road (South of Hillcrest Bridge)	54.7	57.9	59.1	52	52.9	54	Yes	Yes	Yes	Yes
R51a	Tubber Lane Road (South of Hillcrest Bridge)	58.3	61.7	62.1	55.7	56.7	57	Yes	No	Yes	No
R52	Loughlinstown Road	54.7	57.3	58.6	51.3	52.2	53.5	Yes	Yes	Yes	Yes
R53	Intersection of Railway Cottages and Hazelhatch Road	66.2	69.9	71.6	60.8	64.8	66.5	Yes	Yes	Yes	Yes
R54	Old Station Road	55.1	58.8	59.9	50	53.7	54.9	Yes	Yes	Yes	Yes
R55	27 - 30 Railway Cottages	70.9	73.5	75.6	66.7	68.2	70.5	Yes	Yes	Yes	Yes
R56	27 - 30 Railway Cottages	70.3	73.7	75.8	62.6	68.3	70.6	Yes	Yes	Yes	Yes
R57	Railway Cottages (Opposite Hazelhatch Car Park)	60.1	57	58.2	54.2	52	53.2	Yes	Yes	Yes	Yes
R58	Off Hazelhatch Road	54.7	56.4	57.3	51.3	51.7	52.7	Yes	Yes	Yes	Yes

Location ID	Description	Daytime - $L_{Aeq,16hr}$			Night-time $L_{Aeq,8hr}$			Condition for Noise Mitigation Satisfied?			Mitigation Required?
		Base	DM	DS	Base	DM	DS	(a)	(b)	(c)	
R59	Lord's Road	51.7	55.3	56.2	47.2	50.4	51.1	Yes	No	Yes	No

14.6.2.2. Fixed Plant Noise

In addition to noise from rail operations, there are several items of fixed plant required as part of the proposed Project including HV Power and substations, signalling systems, telecommunication systems, other technical buildings and cabinets and pumping stations.

It is proposed to upgrade the existing signalling system as well as replacing some of the legacy signalling system. This will include the provision of Signalling Equipment Buildings/Rooms (SEB/SER), Low Voltage Rooms (LVRs) and Relocatable Equipment Buildings (REB) where required. The proposed signalling system will incorporate similar components to those already in use on the existing line.

Telecommunications systems require space at certain locations in order to house the equipment needed. Among those, Telecom Equipment Rooms (TER) are the most significant. TER's are installed at all stations to support station services. TER's will typically be located within stations on CIÉ owned land. New TERs are proposed at Adamstown station and Park West & Cherry Orchard station and Heuston West Station.

A range of technical equipment cabins are required to support the signalling, electrical and telecommunication infrastructure. Two new Auxiliary Supply Points are being provided for Low-Voltage power. The noise emissions from these plant items are low and will not be audible at nearby noise sensitive locations.

A new pumping chamber installation at Inchicore Works is proposed downstream of the attenuation tank to pump surface water flows up to the discharge level and into the existing SW sewer. The proposed pumping chamber includes 2.2 kW submersible pumps with a maximum pump flow of 10.8 l/s. Using SourceDB+ database (which is a noise source database which forms part of the noise modelling software), a 2.2 kW centrifugal pump has a sound power level of 77.4 dB(A). However, as the pumps are submersed, the noise emissions will be reduced significantly, and the pump will not be audible at the nearest noise sensitive location.

A total of 6 traction electrical substations are necessary along the project extents. The traction power substations will be located in the following locations:

- Hazelhatch;
- Adamstown;
- Kishoge;
- Park West;
- Kylemore (Inchicore Depot); and
- Islandbridge/Heuston.

The substations will be located adjacent to the railway line in the form of a fenced compound surrounding a building which will house all the necessary electrical switching and feeding equipment. The substation buildings will contain several rooms of which the transformer rooms with two 3.3MVA transformer/rectifier units are the most significant sources of noise. Equipment other than the transformers (switchgear etc.) housed within the substation buildings has been assessed to have negligible contribution to noise emissions from the substations, and therefore noise emissions of the electrical transformers have been examined in more detail.

An indicative sound power level of 62.4dB L_{wA} for a typical modern 10MVA 38kV transformer has been used. The example transformer has 3 times the power handling capacity of the 3.3MVA transformers to be installed in the traction substations and therefore the indicative sound power level is considered to be a conservative over-estimate.

The frequency characteristics of a transformer was sourced from RPS file measurements (on-site measurements at 110 kV Transformer). The A-weighted octave band sound power levels and overall sound power level for the transformer are presented in Table 14.64.

Table 14.64 Transformer - Octave Band Sound Power Levels - LwA dB(A)

Frequency	A-weighted Octave Band Lw (dB) for Centre Frequency (Hz)							LwA
	63	125	250	500	1000	2000	4000	
Sound Power Level, dB(A)	35	58	59	54	40	35	30	**62.4**

As noted above, the transformers will be housed within the substation building. Specifications of the substation build-up have been taken from A3D.205071-16A Rev C – Architectural Drawings for MV Substation Buildings and ESB Construction Standards for MV Substation Buildings. Key details of construction are as follows:

- Internal leaf of walls 215mm concrete block on flat construction, external walls minimum 415mm thickness;
- Poured concrete floor and roof slab;
- Standard size door opening 2485mm x 2485mm:
    - Doors are hot-dip galvanised with vertical louvres for ventilation.

Given the thickness of masonry specified, noise break-out through the substation walls and roof will be negligible. The ventilation louvres in the doors (4m^2 of ventilation louvres have been assumed for the doors) are a noise transmission path with minimal transmission loss. Noise breakout through the door louvres was predicted using:

- Indicative sound power level for a transformer with similar kVA rating;
- Calculation of reverberant noise level within the transformer room; and
- Indoor to outdoor noise calculation using transmission loss for standard louvres.

As the substations will be a new source, the noise levels at the nearest dwellings from the plant items were predicted using a using a three-dimensional model using Predictor LimA, Version 2021.1 noise modelling software. The method for calculating outdoor noise attenuation used by the Predictor LimA software is based on the international standards ISO 9613-2:1996 – Attenuation of sound during propagation outdoors - Part 2: General method of calculation. Table 14.65 provides a summary of the operational noise model inputs.

Table 14.65 Summary of Operational Noise Model Inputs

Item	Input
Noise Source	Indicative sound power level from electrical substation planning report.
Noise Receptor	Receptor locations (Nearest NSLs to substations)

Item	Input
	Receiver Heights of 1.5 m and 4 m except for multistorey dwellings and apartments blocks where additional heights were assessed.
Model Parameters	Relative Humidity 70% (ISO 9613).
	Temperature 10°C (ISO 9613).
	Ground absorption 0 for acoustically hard surfaces and 0.5 for all other acoustically soft surfaces.
	Survey Data provided by Murphy Geospatial.
	ISO 9613-2 downwind propagation noise model.

The predicted noise levels at the nearest noises sensitive locations to the proposed substations are presented in Table 14.66.

Table 14.66: Substation – Predicted Operational Noise Levels, dB(A)

Substation Location	Predicted Noise Level, dB(A)	Background Noise Level, dB(A)
Hazelhatch	23	30
Adamstown	<0	20
Kishoge	16	38
Park West	18	42
Kylemore	11	41
Islandbridge/Heuston	25	40

The highest predicted substation noise level at a noise sensitive location is 25dB L_{Aeq}. This level is at substantially below the ambient and background noise levels measured during the surveys and it is therefore highly unlikely that substation noise will be perceptible at any of the nearby dwellings. The very low predicted noise levels indicate that, despite the highly tonal nature of electrical transformer noise, tonal noise at nearby sensitive locations is highly unlikely to be an issue. Given the very low predicted levels, the magnitude of impact is assessed to be negligible, and the significance of effect is assessed to be not significant.

14.6.2.3. Road Traffic Noise

In terms of road traffic changes during the operation phase, there are no station car parks, level crossings, depots or other infrastructure that will significantly alter the traffic patterns and natural growth on the road network. As such, no detailed analysis has been undertaken given the absence of any potential for significant effect on the noise and vibration environment.

14.6.2.4. Noise from Public Address Systems

The proposed Heuston West Station will be provided with PA systems for critical technical and safety messages. There is no specific legislation or guidance for assessing the noise from PA systems. London Underground guidance document G-148 Manual of Good Practice - Public Address Systems - Noise Management cites the use of British Standard BS 4142 as a method of assessment. However, this manual predates the current version of BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sounds which states that the standard is not intended to be applied to the rating and assessment of sound from public address systems for speech.

Nonetheless, there is a potential for the PA systems to generate a brief negative impact at nearby sensitive locations during announcements. Given the absence of appropriate legislation or guidance for assessing the noise from PA systems, the noise impacts at nearby noise sensitive locations will be controlled through the careful consideration of the PA system design. The primary method of ensuring that noise impacts are controlled is to limit the volume level used in accordance with the existing ambient noise level. This will ensure the system is operating only at the volume level required to ensure audibility on the platform. Iarnród Éireann have a standard procedure for the design of station services which includes a procedure for the design of PA systems and further details are outlined in Section 14.7.3 which outlines recommended mitigation measures to be implemented during detailed design.

14.6.2.5. Maintenance Activities

During the operation of DART+ South West Project there will be several ongoing maintenance activities associated with the operation of the rail network (including OHLE) to ensure the safe and efficient operation. To maintain the service provision, maintenance activities are carried out at night. Some of the activities have the potential to generate noise with a risk of noise disturbance during the activity. Following discussion with Iarnród Éireann it is understood that the frequency of common maintenance is generally as follows:

- Alignment and levelling of tracks – only occurs when inspections identify a track defect;
- Track Tamping – depending on the maintenance requirement, will occur once a year to once every three years;
- Ballast track reprofiling – every two years;
- Rail and manhole cleaning – once every four months done by personnel walking the track;
- Switches cleaning – once a week; and
- Track geometry inspection – once a year.

As outlined in Section 14.5, in the Do Minimum scenario the frequency of maintenance activities will be significantly higher than in the Do Something scenario. There is however a risk of brief and short term negative significant noise impacts at sensitive locations near the railway line during essential maintenance works. Section 14.7.3 outlines recommended mitigation measures to be implemented during maintenance works.

14.6.3. Vibration

Potential vibration impacts will arise during both the construction and operational phases. Prediction of vibration propagation is a complex task and requires detailed geotechnical information which is limited at this stage. Reliable estimates have been made using available data, which indicates that levels will be on the lower end of the impact scale during construction and particularly during operation. To ensure vibration levels during construction are controlled and remain at low impact levels, a monitoring programme will be in place. The potential magnitudes of construction vibration impacts are determined through review of published data for varying construction activities with the potential for generation of vibration beyond the works boundary and empirical calculations based on this data. Baseline vibration measurements were carried out and are reported in Section 14.4.2.

14.6.4. Potential Vibration Impacts During Construction

Vibration during construction arise from a variety of sources including pile installation, earthmoving equipment including dozers, excavators, and trucks. A review of construction vibration by Wiss (1981)[6] provided typical vibration data on several construction sources which are reproduced in Figure 14-3.

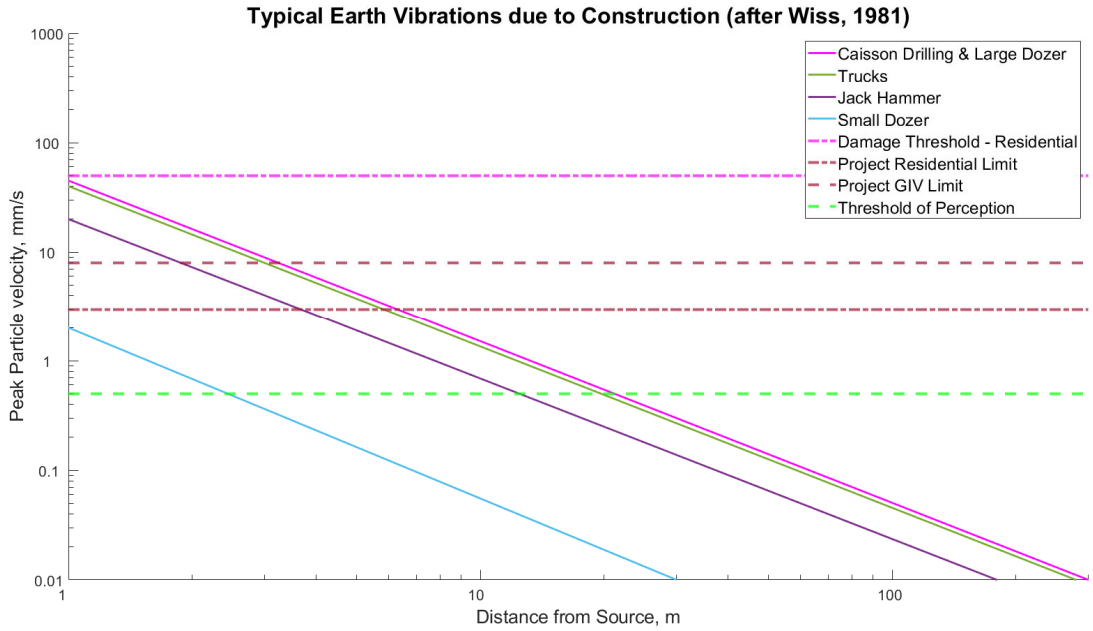

Figure 14-3 Typical Earth Vibrations due to Construction

Activities during the construction phase that will cause vibration include caisson drilling for 1 metre diameter piles and drilling for ground anchors and soil nails at different locations along the alignment. The majority of the closest residences to these activities are located along Cloverhill Road, Cherry Orchard Avenue, Kylemore Drive and Landen Road. The majority of the residences are greater than 15 metres from proposed caisson pile activity. They are below the damage threshold but vibrations from caisson drilling may be perceptible at some residences.

14.6.4.1. Methodology of the Vibration Assessment

The data in Figure 14-3 includes caisson drilling which is a significant activity on the proposed Project. This data indicates that vibration up to 1 mm/s can occur at distances up to 21 metres from the source. While this is a typical situation providing general guidance, some site-specific data was collated from a literature review.

Chapter 9 Land & Soils of this EIAR states that subsoils within the Adamstown area generally consist of Made Ground (of approx. 1m thickness), overlying tills derived from Limestone (stiff to very stiff sandy gravelly clay of approx. 4m thickness). Bedrock geology is classified as the Lucan Formation, a medium to strong black-grey limestone, with depth to bedrock of approx. 4-5m below ground level. This formation extends east to Dublin Bay through the study area.

[6] Wiss (1981), Construction Vibrations: State of the Art, Journal of the Geotechnical Engineering Division, ASCE, Vol. 107, Issue 2

Published data on the Dublin Port Tunnel[7] drilling operation (drill diameter 10 m) is plotted in Figure 14-4 along with vibration levels for caisson piling and ground anchor drilling on the proposed Project. Baseline PPV measurements taken from train passings at Adamstown are also shown on the plot.

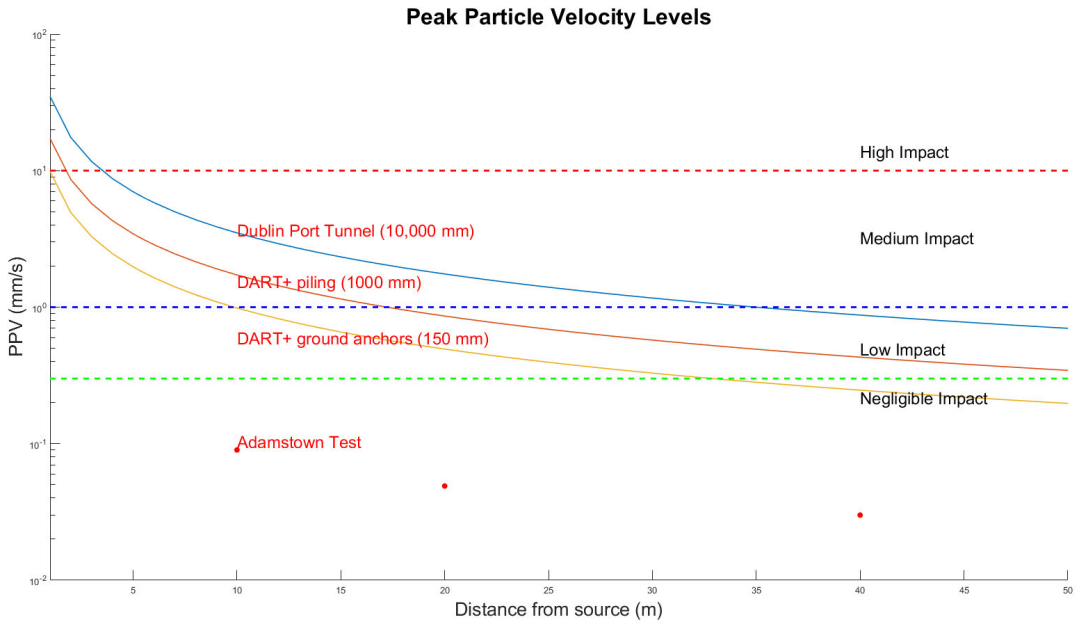

Figure 14-4 Potential Vibration Impacts at Residences during Construction

The baseline vibration test results at Adamstown match the attenuation characteristics of the geology quite well and clearly indicate the significantly lower level of vibration arising from train passings.

14.6.4.2. Predicted Vibration Levels

The worst-case scenario arises at Le Fanu Drive where residences are close to the piled wall and it is proposed to install ground anchors underneath these residences to provide support for the wall. The ground anchor will require drilling underneath these residences. At times a caisson piling rig will operate close to the residence drilling a 1 metre hole and a smaller drilling rig will drill a 150 mm hole under the residences. It is estimated that two caisson piling rigs can install three piles per day and the ground anchor rig can install three anchors per day. The duration of these events at any specific location will be temporary.

The worst-case vibration levels at Le Fanu Drive are therefore 2.15 mm/s for caisson piling and 2.17 mm/s for ground anchoring. The magnitude of impact is medium, and the significance of effect is assessed to be moderate for residential locations.

To put these vibration levels in context some examples of PPV levels in a modern masonry dwelling house are presented in New (1986)[8]. The levels are reproduced in Table 14.67.

[7] Orr, T.L.L. and Rahman, M.E. (2008), 'Prediction of ground induced vibrations due to tunnelling', Proceedings of 4th Symposium on Bridge and Infrastructure Research in Ireland, National University of Ireland, Galway, 453-460
[8] New (1986), Ground Vibration caused by civil engineering works, Traffic Research Laboratory Report 53, UK

Table 14.67: Typical Vibration Levels in a Modern Residence

Vibration Source	Resultant PPV (mm/s)
Normal footfalls	0.05 - 0.5
Foot stamping	0.3 – 3.0
Door slams	11 - 17
Percussive drilling	10 - 20

While the predicted vibration levels are in the moderate significance range at the closest residences, BS 5228-2 indicates that these levels will cause complaints in residential environments but can be tolerated if prior warning and explanation is given to residents.

14.6.5. Potential Vibration Impacts during Operation

The cumulative VDV levels for intermittent events, such as trains passing, are determined by peak levels whereas cyclical vibration is closer to root mean square (average) levels. In order to determine the likely long term VDV level due to trains passing the peak level can be extrapolated for multiple events and compared with the guideline level.

The nearest residential property to the track is in the order of 3.5 metres from the nearest track. Vibration impacts from operating trains were measured at Adamstown and presented in Table 14.22. Using the data from the nearest sensor to the track (10 metres) the peak instantaneous VDV measurement resulted from a high-speed Intercity train passing. The level recorded was 0.0315 $m/s^{1.75}$ which was exceptionally high in comparison to all other train passby events. The next highest peak was 0.0127 $m/s^{1.75}$.

Using the highest peak value, it is possible to calculate the cumulative VDV at residences located 10 metres from the nearest track. Using the site-specific vibration attenuation coefficient shown in Figure 14-4, the cumulative VDV for residences at Hazelhatch located 3.5 metres from the tracks was also calculated. The results are shown in Table 14.68 along with the significance rating from Table 14.18.

Table 14.68: Operational Vibration – Significance of Impact

BS 6472-1 Rating	In absence of appreciable Existing Level of Vibration		Impact Classification	Significance Rating
	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)		
VDV level at which adverse comment is not expected	**≤ 0.2**	**≤ 0.1**		
Calculated VDV at properties 10m from nearest track	0.13	0.08	Negligible	Not Significant
Calculated VDV at properties near Hazelhatch 3.5 m from nearest track	0.19	0.13	Low	Slight

There will therefore be no significant vibration arising from the proposed Project during the operational phase.

14.7. Mitigation Measures

14.7.1. Construction Phase - Noise

A range of mitigation measures will be implemented during construction works to mitigate the noise impacts where possible. Activity specific mitigation measures are outlined later in this section. A list of general mitigation measures to be applied site wide are outlined below.

General Mitigation

- Construction shall be phased in accordance with the phasing of works outlined in Chapter 5 Construction Strategy of the EIAR to minimise the duration of activities in each area. Due to the complex nature of the works detailed schedules, noise control measures and monitoring proposals shall, as a minimum, include the measures set out in this assessment and be documented in the CEMP;
- Works will be carried out using Best Practicable Means (BPM) to minimise noise and vibration, such measures shall include:
    - Limiting the hours of construction and construction noise limits to those set out in Table 14.3, except in exceptional circumstances during night-time or weekend possessions as outlined in Chapters 4 and 5 of this EIAR;
    - Work practices, equipment noise control and screening shall be in compliance with BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise, and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (together referred to as B.S. 5228). Typical work practices include:
        - Scheduling of noisy works to the normal working hours;
        - Adopting quiet working methods, using plant with lower noise emission levels;
        - Adopting working methods that minimise vibration generation particularly with regard to demolition activities and piling;
        - Plant such as pumps and generators used on or near sensitive locations will be contained within an acoustic enclosure and comply with the noise levels in Table 9 4 and Table 9 5 of BS 5228;
        - Plant and machinery used on-site will comply with the EC (Construction Plant and Equipment) Permissible, Noise Levels Regulations, 1988 (S.I. No. 320 of 1988);
        - All noise producing equipment will comply with S.I. No 632 of 2001 European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001;
        - Measures outlined in “Environmental Good Practice Site Guide” 2005 compiled by CIRIA and the UK Environmental Agency and the “London Good Practice Guide: Noise & Vibration Control for Demolition and Construction” 2016. These guidelines provide useful and practical information regarding the control of noise emissions at construction sites;
        - Ensuring that all plant is properly maintained, (mechanisms properly lubricated, faulty silencers replaced, worn bearings replaced, cutting tools sharpened etc.);

- Closing acoustic covers to engines when in use or idling;
- Use of electrically powered equipment in preference to internal combustion powered equipment;
- Use of hydraulic equipment in preference to pneumatic equipment;
- Use of wheeled plant in preference to tracked plant;
- Locating plant as far away from noise and vibration sensitive receptors as practicable;
- Installation of site hoardings or perimeter noise barriers;
- Use of temporary acoustic enclosures or screens around specific noisy static plant;
- Use of large fully enclosed acoustic buildings to surround activities and/or worksites;
- Avoiding the unnecessary revving of engines and switch off equipment when not in use;
- Starting-up plant and vehicles sequentially rather than at the same time;
- Keeping internal haul routes well maintained to minimise impulsive noise and vibration from vehicles running over discontinuities in the running surfaces;
- Fitting rubber linings to chutes, hoppers and dumper vehicles to reduce impact noise from material transfer;
- Minimising drop heights of materials;
- Carrying out regular inspections of mitigation measures (BPM audits) to ensure compliance with noise and vibration commitments;
- Providing regular briefings for all site-based personnel so that noise and vibration issues (including the requirement to employ BPM at all locations at all times) are understood and that generic and site-specific mitigation measures are explained and adhered to;
- Ensuring that unloading is carried out within the work site rather than on adjacent roads or laybys;
- Phasing of materials deliveries to be controlled on a 'just in time' basis to minimise noise and congestion on roads around the site;
- A formal stakeholder engagement process shall be put in place for the duration of the construction phase, including the provision of information to local residents about noise and vibration monitoring results, works likely to cause significant noise or vibration and/or works planned to take place outside of core working hours;
- Channels of communication between the Contractor, the relevant Planning Section (Planning Authority) and residents will be established at project commencement; and
- Records of any noise complaints relating to the construction operations will be investigated as soon as possible and reported to the Planning Authority.

- Where the use of noise barriers is specified to reduce the noise level from construction works, their use will be temporary and they will be removed following the completion of the works;

- Where works need to be completed outside normal working hours or where proposed works indicate that the noise or vibration levels set out in Section 14.3.3.2 (Construction Nosie Criteria) or Section 14.3.3.4 (Construction Vibration Criteria) may be exceeded, permission for these works must be sought from the Planning Authority in advance of any works taking place. The application for such works will require a detailed noise control plan and follow up report to be prepared. This plan will include (i) a justification for the works being carried out in the manner proposed, (ii) an assessment indicating what alternatives have been considered, (iii) a statement of the noise control measures from B.S. 5228 to be adopted and how Best Practicable Means will be used to control noise, (iv) an activity specific noise monitoring programme including contact details for persons with the authority to cease working if required by the Planning Authority. Each follow up report will include details of any complaints received and the action taken to address such complaints;
- A noise and vibration monitoring programme will be implemented for the duration of the construction phase. Monitoring will assess compliance of the construction works with the noise limits set out in Table 14.3 and Table 14.6; and
- Full details of the Contractor's provision for noise and vibration monitoring and procedures including provisions for publication of monitoring results will be submitted to and approved by the Planning Authority prior to commencement of work. The Planning Authority shall have discretion to vary the monitoring requirements and publication of results during the course of construction.

Site Clearance

There is potential for elevated noise levels greater than 70 dB L_{Aeq} at noise sensitive locations within 33m of the proposed works where there is direct line of sight with the noise sensitive locations. The site clearance works will be the first activity to be undertaken and the installation of noise barriers along boundaries to mitigate the noise impact is likely to be premature as areas where the noise barriers are proposed are likely to require vegetation clearance before noise barriers are installed. To mitigate the noise impact, it is recommended to minimise the plant items operating simultaneously when clearance activities are within 33m of a noise sensitive location. The plant items with the potential for greatest impact are the chainsaw, mulcher and stump grinder and it is recommended that these activities do not occur simultaneously within 33m of noise sensitive locations. Where these activities are occurring for an extended duration within 20m of a receptor and there is direct line of sight, temporary barriers or enclosures should be considered where practicable.

Ground Investigation

Ground Investigation works are proposed on-track and off-track. Off-track works are not expected to exceed 70 dB L_{Aeq}. Where ground investigation works are on-track, this is undertaken at night-time when trains are not operating and the use of a vacuum excavator is required. The use of a vacuum excavator results in an increase in noise levels with exceedances in a noise limit of 70 dB L_{Aeq} at distances up to 42m away from the activity where there is direct line of sight with the noise sensitive location. To mitigate the noise from the vacuum excavator the following mitigation measures are proposed:

- Fit a muffler to the upper air vent, the point at which the air flow exits the vacuum extractor vehicle to the atmosphere;
- Where practicable, use a plastic intake hose/nozzle. The selection of the nozzle is dependent on ground conditions and depth of excavation required. Where ground conditions are suitable a plastic nozzle should be used;
- Investigate the feasibility of installing a vertical screen fitted to the side of the vehicle to reduce the propagation of noise from the fans via the louvered fan vents. The feasibility of this design needs to consider the safe operation of the vacuum excavator, ventilation requirements for air flow and vertical and horizontal clearances for safe access along the railway line particularly through bridges and tunnels; and
- The relevant local authorities will also be informed and notified of night-time GI works. The local authority will be kept informed of the progression of the night-time GI works and of any concerns or complaints raised by the local community.

Site Compounds

There is potential for noise levels greater than 70 dB L_{Aeq} when activities occur less than 14m from noise sensitive locations. At this stage of the project installation of noise barriers along site compound boundary to mitigate the noise impact is likely to be premature as areas where the noise barriers are proposed are likely to require site clearance before noise barriers are installed. Noise barriers should be installed as soon as practicably possible. To mitigate the noise impact, it is recommended to minimise the plant operating simultaneously especially when activities are within 14m of a noise sensitive location.

Crushing and Screening

The proposed location for crushing and screening is over 100m from the nearest residential dwelling. The predicted noise level at the nearest dwelling is less than 70 dB L_{Aeq} and is not significant. It is proposed that noise barriers are installed adjacent to the crushing and screening plant where practicable. The location of the plant within the site compound should be such, that it maximises the distance to noise sensitive locations.

Demolitions

The predicted construction noise level from demolition activities is expected to be below 70 dB L_{Aeq} at the nearest noise sensitive locations when hydraulic breaker is not operating. The predicted noise levels are of the order of 10 dB higher when the hydraulic breaker is not operating. However, the hydraulic breaker will be required for brief periods. To mitigate the noise impact from the rock breaker, the following measures should be considered:

- Fit suitably designed muffler or sound reduction equipment to reduce noise without impairing machine efficiency; and
- Use dampened bit to eliminate ringing.

Where works are occurring over an extended period, the use of temporary noise barriers/screens or enclosure should be implemented where practicable.

Earthworks

There is potential for elevated noise levels above 70 dB L_{Aeq} at noise sensitive locations within 18m and 30m of the proposed works when there is line of sight and partial line of sight respectively. Noise barriers are proposed along the boundary adjacent to nearby noise sensitive locations. Where line of sight is blocked, it is expected that construction noise impact will not be significant. Where line of sight between the construction plant and noise sensitive locations cannot be blocked, it is recommended that simultaneous use of plant in close proximity to the noise sensitive location be limited.

Bridges

There is potential for elevated noise levels above 70 dB L_{Aeq} at locations within 25m of the proposed works. The majority of plant items will result in predicted noise levels below the noise limit. However, rock breaking results in an increase in noise level although this activity will occur sporadically. To mitigate the noise impact from the rock breaker, the following measures should be considered:

- Fit suitably designed muffler or sound reduction equipment to reduce noise without impairing machine efficiency; and
- Use dampened bit to eliminate ringing.

Where works are occurring over an extended period, the use of temporary noise barriers/screens or enclosure should be implemented where practicable.

Retaining Walls

Where activities occur within 10m of the noise sensitive receptors, predicted noise levels can reach up to 80 dB and higher for secant piling, trench wall works and soil nailing/wall anchoring. The noise levels at the nearest receptors are likely to have a temporary significant to profound impact.

Installation of noise barriers along the boundary provided they block direct line of sight as well as minimising the simultaneous use of plant will reduce the noise impact. However, in some instances plant will be so close that an individual item plant could result in a very significant or profound significance of effect and/or it may not be practical to install a noise barrier as the boundary wall is being replaced with a piled wall. Where possible the driving system should be enclosed in an acoustic shroud. However, given the proximity to some noise sensitive locations, the measures proposed may not be sufficient to fully mitigate the noise impact. Where this occurs, and where all reasonable measure have been taken to reduce noise levels through source and pathway control, the thresholds and criteria for temporary accommodation or the reasonable costs thereof, will be assessed and implemented as appropriate where eligibility has been established and in consultation with eligible owners/ occupiers.

It is recommended that in densely populated areas or where mitigation measures are limited for apartment blocks, consideration be given to the use of multiple piling rigs per location as the additional noise impact is minor, however, the works will be completed more quickly, thus reducing the overall impact.

Track Lowering and Alignment

The predicted noise levels show that for some activities there is potential for noise levels in excess of 70 dB L_{Aeq} when activities are within 25m of noise sensitive locations. The plant items with the greatest

potential are the tamping machine with rail cutting and loading of ballast to a lesser extent. The tamping machine is constantly moving so the impact will be brief. Similarly, rail cutting occurs intermittently and the duration of the impact will be brief.

In locations where track widening works are proposed, noise barriers are proposed along the boundary with nearby residents. This will help mitigate the noise from all activities including the track lowering and alignment works. Loading of ballast material has also been identified as one of the activities with potential to cause high noise levels and this will occur over a longer duration compared to tamping and rail cutting. To mitigate the noise impact from the loading of ballast material, it is recommended to minimise the drop height when loading the ballast material and to line the dump with a resilient material.

Attenuation Tanks

For noise sensitive locations in proximity to the two proposed attenuation tanks at Inchicore, predicted noise levels are below the noise limits and no specific mitigation measures are proposed. However, site wide general measures will be applied to reduce the noise impact to its lowest.

For noise sensitive locations in proximity to the proposed attenuation tank at Heuston West Station, there is potential for noise limits to be exceeded when activity occurs within 10m. Works are occurring adjacent to residential dwellings and apartment blocks. It is proposed to install noise barriers adjacent to the residential dwellings and/or the site boundary where applicable. The use of noise barriers will have limited impact for the higher floors of adjacent apartment blocks and it is recommended that noise barriers are installed to protect the lower level floors in combination with reducing the simultaneous use of heavy plant when closer than 10m from noise sensitive locations. These mitigation measures will reduce the overall noise impact as well as the number of noise sensitive locations where noise levels in excess of 70 dB L_{Aeq} are predicted. However, there will be some noise sensitive locations where there will be brief periods where noise levels are above the noise limits.

OHLE Foundations

Where more extensive works are occurring, for example where two tracks are becoming four tracks, noise barriers proposed along the boundary for other construction activities will be in place. When line of sight is obscured, there will be a reduction in the noise emissions.

At locations where electrification is the primary construction activity, for example Zone A, mitigation measures are limited for these works due to the nature of the sites being temporary worksites and the plant involved is difficult to mitigate.

It is recommended that in densely populated areas or where mitigation measures are limited for apartment blocks, consideration be given to the use of multiple piling rigs per location as the additional noise impact is minor, however, the works will be completed more quickly, thus reducing the overall impact.

Installation of Gantries

The installation of the gantries is proposed at locations where noise barriers are proposed along the boundary for other construction activities. Where the line of sight to nearby sensitive receptors is obscured the noise impact will be reduced. In addition to the noise barriers general construction mitigation measures will be implemented where possible.

Roads

The locations closest to the road works with the greatest impact experience high levels of noise from passing traffic. During these works, there will be no passing traffic and the noise impact is not expected to be over and above the existing noise levels experienced at these locations. Nonetheless the character of the noise will be different and best practice measures outlined above should be implemented.

Heuston West Station

The activity with the greatest potential to cause disturbance is substructure works for the new segregated pedestrian / cycle bridge where piling is required. Overall, the significance of effect is assessed to be moderate. However, at some of the nearest noise sensitive locations, there is potential for temporary significant effects when activities are within 25m. Where possible, the driving system (for piling) should be enclosed in an acoustic shroud. It is proposed to install noise barriers adjacent to the dwelling houses and/or the site boundary where applicable. The use of noise barriers will have limited impact for the higher floors of adjacent apartment blocks and it is recommended that noise barriers are installed to protect the lower level floors in combination with reducing the simultaneous use of heavy plant when closer than 10m from noise sensitive locations.

Night-time Works

Where works need to be completed outside normal working hours permission for these works must be sought from the Planning Authority in advance of any works taking place. The application for such works will require a detailed noise control plan and follow up report to be prepared. This plan will include (i) a justification for the works being carried out in the manner proposed, (ii) an assessment indicating what alternatives have been considered, (iii) a statement of the noise control measures from B.S. 5228 to be adopted and how Best Practicable Means will be used to control noise, (iv) an activity specific noise monitoring programme including contact details for persons with the authority to cease working if required by the Planning Authority. Each follow up report will include details of any complaints received and the action taken to address such complaints.

Where possible works will be undertaken in safe zones during daytime periods. In certain circumstances full possession of the railway (i.e no trains running) will be required and these will take place during weekend and night-time possessions. Where night-time works are proposed the following mitigation measures are proposed:

- Inform local residents about works planned to take place outside of core working hours;
- Carry out as much preparatory work in daylight as possible;
- Inspect the work site in daylight if possible and look for the best location to position generators;
- Adopting quiet working methods, using plant with lower noise emission levels;
- Locate plant as far away from noise and vibration sensitive receptors as practicable;
- Plant such as pumps and generators used on or near sensitive locations will be contained within an acoustic enclosure;

- Consider using additional supply cables (if safe) so that the generators can be positioned as far away from sensitive locations;
- Use of electrically powered equipment in preference to internal combustion powered equipment;
- Use of temporary acoustic enclosures or screens around specific noisy static plant;
- Use of large fully enclosed acoustic buildings to surround activities and/or worksites;
- Avoiding the unnecessary revving of engines and switch off equipment when not in use;
- Starting-up plant and vehicles sequentially rather than at the same time;
- Do not leave equipment or vehicle running/idling unnecessarily;
- Providing regular briefings for all site-based personnel so that noise and vibration issues are understood and that generic and site-specific mitigation measures are explained and adhered to;
- Do not shout work instructions when working in residential areas at night unless absolutely necessary;
- Phasing of materials deliveries to be controlled on a 'just in time' basis to minimise noise and congestion on roads around the site;
- Take advantage of natural barriers such as vegetation, walls or embankments that can offer noise screening to adjacent neighbours;
- For piling activity, where possible, the driving system should be enclosed in an acoustic shroud; and
- For anchoring works at the Phoenix Park Tunnel, a temporary noise curtain/barrier should be installed at the tunnel entrance to reduce noise break out.

Eligibility of Temporary Rehousing

Given the proximity of construction activity to some noise sensitive locations, the mitigation measures proposed may not be sufficient to fully mitigate the noise impact. Temporary rehousing will be offered to eligible owners/occupiers where the construction of the proposed Project causes, or is expected to cause, a measured or predicted airborne construction noise level that exceeds either of the following at property lawfully occupied as a permanent dwelling:

- A noise level 10 dB above any of the trigger noise levels presented in Table 14.12 (in Section 14.3.4.3) the corresponding times of day;
- A noise level 10 dB or more above the existing pre-construction ambient noise level for the corresponding times of day; and
- Whichever level is the higher; and for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months.

14.7.2. Construction Phase - Vibration

The worst-case vibration levels at Le Fanu Drive are 2.15 mm/s for caisson piling and 2.17 mm/s for ground anchoring. BS 5228-2 indicates that these levels will cause complaints in residential environments but can be tolerated if prior warning and explanation is given to residents.

A formal stakeholder engagement process will be put in place for the duration of the construction phase, including the provision of information to local residents regarding works likely to cause significant noise or vibration and/or works planned to take place outside of core working hours and also establish a process for handling all enquires including complaints.

14.7.3. Operational Phase - Noise

There is no specific statutory Irish guidance for rail noise mitigation. In order to provide a robust and consistent methodology, reference has been made to the mitigation criteria in the Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1 (2004) as the TII guidelines provide guidance on a structured approach to ameliorate as far as practicable transportation noise. Details on the operational noise mitigation criteria are presented in Section 14.3.3.5.

Several areas along the proposed Project were identified as meeting the criteria for mitigation presented in Section 14.6.2.1. The details of the noise barriers proposed to mitigate the operational noise impact are presented in Table 14.69. Although the term ‘noise barriers’ is used; this may take the form of walls, earthen berms and other landscaping features providing the required acoustic screening and meeting all other technical specifications. The locations of noise mitigation measures are shown in Volume 3A of this EIAR.

Barriers will be specified to achieve a noise reduction class B3 when tested in accordance with EN 16272-2: 2012 Railway Applications - Track - Noise Barriers and Related Devices Acting on Airborne Sound Propagation - Test Method for Determining the Acoustic Performance - Part 2: Intrinsic Characteristics - Airborne Sound Insulation in the Laboratory Under Diffuse Sound Field Conditions. Where absorptive noise barriers are proposed, barriers will be specified to achieve an absorption performance of class A4 in accordance with EN 16272-1:2012 Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation - Test method for determining the acoustic performance - Part 1: Intrinsic characteristics - Sound absorption in the laboratory under diffuse sound field conditions.

Table 14.69: Details of proposed Operational Noise Mitigation Measures

Barrier ID	Chainage	Description	Length (m)	Height (m)
NB 1	Ch 24+507 – 24+856	Absorptive	349	2.0
NB 2	Ch 24+314 – 24+473	Absorptive	164	2.0
NB 3	Ch 24+298 – 24+300	Absorptive	3	2.5
NB 4	Ch 24+124 – 24+292	Absorptive	168	2.5
NB 5	Ch 24+057 – 24+116	Combination Absorptive/Reflective	57	4.0
NB 6	Ch 23+863 – 24+057	Absorptive	211	2.5
NB 7	Ch 24+118 – 24+118	Absorptive	27	3.5
NB 8	Ch 24+020 – 24+118	Absorptive	96	3.5
NB 9	Ch 23+759 – 23+902	Reflective	146	2.5

Barrier ID	Chainage	Description	Length (m)	Height (m)
NB 10	Ch 22+506 – 22+591	Reflective	86	3.5
NB 11	Ch 22+245 – 22+340	Reflective	97	2.4
NB 12	Ch 17+900 – 18+105	Absorptive	205	2.0
NB 13	Ch 17+299 – 17+482	Reflective	182	2.5
NB 14	Ch 15+741 – 15+868	Reflective	128	3.2
NB 15	Ch 15+340 – 15+647	Reflective	316	2.5
NB 16	Ch 13+960 – 14+160	Reflective	201	3.5
NB 17	Ch 13+750 – 14+183	Absorptive	438	3.5
NB 18	Ch 13+555 – 13+960	Absorptive	417	2.25
NB 19	Ch 13+440 – 13+481	Reflective	40	2.4
NB 20	Ch 13+140 – 13+305	Reflective	168	1.5
NB 21	Ch 13+060 – 13+140	Reflective	81	3.5
NB 21a	Ch 13+060 – 13+060	Reflective	1	Varied
NB 22	Ch 12+660 – 13+060	Reflective	405	3.5
NB 23	Ch 12+612 – 12+660	Reflective	48	2.0
NB 24	Ch 12+158 – 12+595	Reflective	437	1.1
NB 25	Ch 11+700 – 12+125	Reflective	425	2.5
NB 26	Ch 11+320 – 11+700	Reflective	379	3.5
NB 27	Ch 11+293 – 11+320	Reflective	27	2.0
NB 28	Ch 11+272 – 11+293	Reflective	21	3.5
NB 29	Ch 10+810 – 11+272	Reflective	463	3.5
NB 30	Ch 9+255 – 9+323	Reflective	68	3.0
NB 30a	Ch 9+090 – 9+237	Reflective	143	3.0

There are several locations (R17, R17a, R20 and R20a) where the installation of noise barriers along the Project boundary is not effective as the properties are high rise buildings and even with noise barriers in place there would be direct line of sight between the noise sensitive locations and passing trains. Resilient rails were considered for these properties. Given that the rails are mounted on concrete sleepers in ballast, the effectiveness of resilient rails as a mitigation measure is limited. Therefore, the significance of effect at locations R17 and R20a was assessed to be long term negative moderate effect with a long term negative significant effect at location R20.

Further investigation at noise sensitive location represented by location R20 and R20a identified that four of the noise sensitive locations (facades overlooking the railway at Seven Oaks Apartment Complex and Floraville from the 2nd to 4th floor) were identified as having a significant effect with a slight or moderate effect at other floors.

For locations where a significant effect is identified, and in absence of an engineering solution to mitigate the noise impact within the Project boundary, noise insulation, or the reasonable costs thereof, will be offered to eligible owners at properties lawfully occupied as a permanent dwelling.

Table 14.70 presents the predicted noise levels at the noise sensitive locations following the implementation of mitigation measures. The significance of effect is also presented.

Table 14.70: Predicted Noise Levels with Mitigation

Receptor ID	Description	Do Something with Mitigation		Significance Rating
		Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	
R1	Claremont Lawns	45.9	40.4	Slight (Positive)

Receptor ID	Description	Do Something with Mitigation		Significance Rating
		Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	
R2	Claremont Crescent	56.9	51.3	Not Significant
R3	Royal Canal Way	58.9	53.3	Not Significant
R4	St Attracta Road	34.8	29.4	Slight (Positive)
R5	Faussagh Ave and Barrow Road	52.4	47.1	Moderate (Positive)
R6	Hamilton Gardens	51.6	46.2	Slight (Positive)
R7	Homestead Court	56.9	51.5	Slight (Positive)
R8	Marlborough Road	52.5	47.1	Slight (Positive)
R9	McKee Barracks	51.4	46	Slight (Positive)
R10	Park Lodge Apartments	50.6	45.2	Moderate (Positive)
R11	Bridgewater Quay	56.7	51.3	Slight (Positive)
R12	Riverpark Apartments	54.7	49.3	Slight (Positive)
R13	Cavalry House	52.9	47.7	Not Significant
R14	Clancy Quay (Brewery - 2 storey)	56.6	51.5	Not Significant
R15	Clancy Quay (Cooke Hall)	60.3	55.1	Slight
R15a	Clancy Quay (Cooke Hall)	50.2	45	Moderate (Positive)
R16	St John of God School, Islandbridge	37.8	32.7	Not Significant
R17	Kilmainham Square (3rd floor)	65.4	60.3	Moderate
R17a	Kilmainham Square (9th floor)	62.3	57.2	Not Significant
R18	Dwellings along Inchicore Road	61.7	56.7	Not Significant
R19	Dwellings of Sarsfield Road	62	57	Slight
R20	Seven Oaks Apartments (4th Floor)	63.7	58.6	Significant
R20a	Seven Oaks Apartments (6th Floor)	63.2	58.1	Moderate
R21	16 - 72 Landen Road	54.9	49.8	Moderate (Positive)
R22	139 – 179 Landen Road	57.2	52.1	Moderate (Positive)
R23	183 – 315 Landen Road	61.9	56.8	Slight (Positive)
R24	317 – 453 Landen Road	52.4	47.3	Slight (Positive)
R25	317 – 453 Landen Road	53.6	48.5	Slight (Positive)
R26	317 – 453 Landen Road	59	53.9	Slight (Positive)
R27	317 – 453 Landen Road	57.5	52.4	Not Significant
R28	Kylemore Drive	54.4	49.3	Moderate (Positive)
R29	Le Fanu Drive	62.6	57.4	Moderate (Positive)
R30	33 - 123 Cloverhill Road	56.9	51.8	Moderate (Positive)
R31	1 – 27 Cherry Orchard Ave	58.2	53.1	Slight (Positive)
R32	1 – 27 Cherry Orchard Ave	64.3	59.1	Moderate
R33	28 - 60 Cherry Orchard Ave	58.3	53.2	Slight (Positive)
R34	44-47 Cherry Orchard Parade	56.6	51.5	Significant (Positive)
R35	45-51 Cherry Orchard Crescent	56	50.8	Not Significant

Receptor ID	Description	Do Something with Mitigation		Significance Rating
		Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	
R36	New Development - Park West Road/Avenue	53.9	49	Significant (Positive)
R36a	New Development - Park West Road/Avenue	66.4	61.4	Slight
R36b	New Development - Park West Road/Avenue	55.7	50.8	Significant (Positive)
R36c	New Development - Park West Road/Avenue	65.2	60.3	Slight (Positive)
R37	Cherry Orchard Court	66.9	61.8	Slight (Positive)
R38	45-48 Barnville Park	59.7	54.6	Slight (Positive)
R39	Park West Ave (Hotel)	48.8	43.5	Moderate (Positive)
R40	Park West Ave	51.6	46.5	Slight
R41	Cooleven Close	62.5	57.4	Moderate (Positive)
R42	Cappagh Ln (East)	52.4	47.2	Moderate (Positive)
R43	Cappagh Ln (West)	54.6	49.5	Slight (Positive)
R44	Lynch's Park 15-20	61	55.9	Not Significant
R45	Kishoge Road	51.7	46.7	Signifcant (Positive)
R46	55 - 75 Tullyhall Drive	65.7	60.7	Not Significant
R47	Hansted Place	66.8	61.7	Not Significant
R48	Adamstown Community College	67.6	62.6	Not Significant
R49	Adamstown Ave/ Adamstown Park	56.5	51.3	Slight
R50	Tubber Lane Road (North of Hillcrest Bridge)	47.9	42.8	Significant (Positive)
R51	Tubber Lane Road (South of Hillcrest Bridge)	55.3	50.2	Slight (Positive)
R51a	Tubber Lane Road (South of Hillcrest Bridge)	51.6	46.6	Significant (Positive)
R52	Loughlinstown Road	50.7	45.6	Significant (Positive)
R53	Intersection of Railway Cottages and Hazelhatch Road	65.3	60.3	Significant (Positive)
R54	Old Station Road	55.5	50.5	Moderate (Positive)
R55	27 - 30 Railway Cottages	63.5	58.5	Significant (Positive)
R56	27 - 30 Railway Cottages	62.6	57.6	Significant (Positive)
R57	Railway Cottages (Opposite Hazelhatch Car Park)	56.5	51.5	Not Significant
R58	Off Hazelhatch Road	51.4	46.6	Significant (Positive)
R59	Lord's Road	51.2	46	Significant (Positive)

With the application of a structured approach to mitigation measures, the overall impact with respect to operational rail noise criteria during daytime periods is positive with the number of noise sensitive locations with predicted noise levels greater than the 55 dB $L_{Aeq,16hr}$ daytime criterion reducing.

However, there is an increase in the overall number of noise sensitive locations with predicted noise level greater than the 45 dB $L_{Aeq,16hr}$ night-time criterion. Overall, the proposed Project with mitigation (Do Something with mitigation) results in a decrease in the median noise level of 0.4 dB during the daytime and 1.1 dB during night-time.

Table 14.71: Predicted Noise Levels with Mitigation Measures – Noise Levels Greater than 55 dB $L_{Aeq,16hr}$ Daytime and 45 $L_{Aeq,8hr}$ Night-time

Receptor Description	$L_{Aeq,16hr}$ Daytime			$L_{Aeq,8hr}$ Night-time		
	Do Minimum	Do Something with Mitigation	Change	Do Minimum	Do Something with Mitigation	Change
All Receptor Types	729	648	-81	1332	1416	84
Residential	675	592	-83	1252	1335	83
Educational and Childcare Facilities	3	3	0	4	4	0
Hotels and Accommodation	0	0	0	1	0	-1
Healthcare	0	0	0	0	0	0
Activities of Religious Organisations	0	0	0	0	0	0
Other	51	53	2	75	77	2

The number of noise sensitive locations with predicted operational rail noise greater than the operational rail noise criteria must also be considered in the context of the existing baseline noise which is comprised of multiple noise sources. Of the 18 noise monitoring locations, four locations had noise levels less than 55 dB $L_{Aeq,16hr}$ during the daytime and these are located adjacent to the Phoenix Park Tunnel Branch Line section and at Hazelhatch. During night-time periods, one location had noise levels less than 45 dB $L_{Aeq,8hr}$ and this was located adjacent the Phoenix Park Tunnel Branch Line section. Although the predicted noise levels are above the operational noise criteria, the baseline measurements indicated that the pre-existing noise levels are general higher than the operational noise criteria and hence, rail noise may not be the dominant noise source at noise sensitive locations.

PA Systems

Iarnród Éireann have a standard procedure for the design of station services which include the design requirements for the PA systems. Section 5 of Iarnród Éireann Standard I-TEL-3930 Station Services – Design, Install and Commission requires that the normal output volume is an average of 10dB(A) above recorded background levels in the station. The design will ensure that PA announcements do not result in extraneous noise outside the station boundary.

Maintenance Activities

During the course of ongoing maintenance, the procedures outlined in Iarnród Éireann operation procedure CCE-QMS-008-002 Noise Management – CCE Activities will be implemented. This document outlines the following noise mitigation measures:

- The Community Liaison Officer (or other nominated person) will notify affected residents in advance of any planned works commencing with a letter drop in the relevant area;
- Where planned work occurs over a 72hr weekend shutdown there will be a noise management plan submitted to the local authority;
- All attempts to avoid, prevent or reduce the harmful effects of exposure to environmental noise arising from CCE work activities must be practical and appropriately risk assessed before implementation;
- The following measures should be implemented where feasible during maintenance activities;
- Carry out as much preparatory work in daylight as possible (sawing or drilling rails);
- Inspect the worksite in daylight if possible and look for the best location to position generators;
- Position generators and lighting away from residential dwellings;
- Take advantage of natural barriers such as vegetation, walls or embankments that can offer noise screening to adjacent neighbours;
- Where necessary, use noise attenuation screens. The screens must be located as close to the receiver or source as possible;
- Consider using additional supply cables and structures so that the generators can be positioned as far away from housing as practicable;
- Where possible, use low-noise plant. Any unsuitable plant should be replaced by higher quality low noise plant, or contained by the use of mufflers/silencers;
- Do not leave equipment or vehicles running/idling unnecessarily;
- Do not shout work instructions when working in residential areas at night unless absolutely necessary; and
- Plan effectively to ensure timely deliveries of materials.

14.7.4. Operational Phase - Vibration

There will be no significant vibration arising from the proposed Project in the operational phase and no mitigation measures are proposed.

14.8. Monitoring

Due to the scale and nature of the activities arising from the proposed Project a comprehensive noise and vibration monitoring programme will be put in place.

14.8.1. Construction Phase

During the construction phase, a noise and vibration monitoring programme will be implemented by the appointed contractor to assess compliance of the construction works with the noise limits set out in Section 14.3.3. The selection of monitoring locations (number and location) will be agreed with the

relevant local authorities but will be based on the nearest representative noise sensitive locations to the working areas which will progress along the length of the proposed Project.

Full details of the Contractor's provision for noise and vibration monitoring and procedures including provisions for publication of monitoring results will be submitted to and approved by the Planning Authority prior to commencement of work.

The CEMP for the Project will detail channels of communication between the Contractor, Dublin County Council, South Dublin County Council and Kildare County Council/ IE and residents including a system for recording and investigating noise complaints relating to the construction operations.

14.8.2. Operational Phase

During the operations phase no specific noise monitoring is proposed but measures in future Noise Action Plans adopted by the Dublin County Council, South Dublin County Council and Kildare County Council are expected to include rail traffic noise monitoring.

14.9. Residual Effects

14.9.1. Construction Noise

A range of mitigation measures will be implemented during construction works to mitigate the noise impacts where possible. Works will be carried out using Best Practicable Means (BPM) to minimise noise and vibration. For the majority of noise sensitive locations within the study area, construction activities undertaken during daytime periods will not be significant. However, for some construction activities where activities occur within 25m of noise sensitive locations, there will be brief and temporary periods where noise levels are predicted to be above the noise limits.

Where piling occurs within 10m of the noise sensitive receptors, predicted noise levels can reach up to 80 dB and higher for secant piling, trench wall works and soil nailing/wall anchoring. The noise levels at the nearest receptors are likely to have a residual negative temporary significant to very significant effect.

Bridge works within 25m and works at Heuston station within 10m are likely to have a residual negative temporary significant effect.

During night-time periods, there is a requirement for construction of piling platforms and piling at some locations. This will likely result in a high magnitude of impact at the closest receptors. The resultant residual effect at the closest receptors will be a negative temporary significant to profound effect.

Given the proximity of construction activity to some noise sensitive locations, the mitigation measures proposed may not be sufficient to fully mitigate the noise impact. Temporary rehousing, or the reasonable costs thereof, will be offered to eligible owners/occupiers where the criteria in Table 14.12 as presented in Section 14.3.4.3 are met.

14.9.2. Construction Vibration

The residual impact of vibration during construction will be negative, slight to moderate and brief to temporary depending on location. All construction activity will be carried out within the vibration thresholds specified in Section 14.3.3.4.

14.9.3. Operational Noise

The results of the assessment indicate that the majority of the receptors adjacent to the proposed Project have rail noise levels above the 55 dB $L_{Aeq,16hr}$ during daytime and 45 dB $L_{Aeq,8hr}$ and/or the Do Something noise levels can be reduced to the equivalent Do Minimum rail traffic noise levels at the majority of locations with the recommended mitigation measures in place. However, a limited number of properties will experience a residual noise impact as a result of the proposed Project. The residual impacts are examined by assessing the change in rail noise between the Do Minimum and Do Something Scenario with mitigation.

A summary of the Do Minimum and the Do Something with mitigation outcomes with respect to the operational rail noise impact rating (outlined in Section 14.3.4.6) during daytime and night-time periods are presented in Table 14.72 and Table 14.73 respectively. As noted in the tables, the proposed Project results in a greater number of receptors with an increase in noise levels. However, this must be considered in the context of the impact rating. Although there is an increase in the number of receptors with higher noise levels, the increase is quantified in the low impact rating. At ratings of low/medium, medium and high, the proposed Project results in a higher number of receptors experiencing lower noise levels. There are several noise sensitive locations where the magnitude of impact is negative with low/medium and medium residual impact. Following further analysis including the consideration of the baseline noise, changes in rail noise level and cumulative noise impacts, four of the noise sensitive locations (facades overlooking the railway at Seven Oaks Apartment Complex and Floraville from the 2nd to 4th floor) were identified as having a significant, negative, long term residual effect. For locations where a significant effect is identified, and in absence of an engineering solution to mitigate the noise impact within the Project boundary, noise insulation, or the reasonable costs thereof, will be offered to eligible owners at properties lawfully occupied as a permanent dwelling.

The aggregate residual effect is slight, negative, and long-term. A smaller number of noise sensitive locations will experience a moderate, negative and long-term residual effect.

Table 14.72: Difference Between Daytime Rail Noise Levels: Do Minimum and Do Something with Mitigation

Change in Rail Noise Level (dB)		EPA Magnitude of Impact	All Receptors	Residential	Educational and Childcare Facilities	Hotels	Healthcare	Activities of Religious Organisations	Other
Decrease in Noise Level	10.0+	High	10.0+	High	5	5	0	0	0
	5.0 – 9.9	Medium	5.0 – 9.9	Medium	93	88	0	1	0
	3.0 – 4.9	Low/Medium	3.0 – 4.9	Low/Medium	229	223	0		0
	1.0 – 2.9	Low	1.0 – 2.9	Low	1701	1668	4 (1*)	0	1
No Change	< 1.0	Negligible	< 1.0	Negligible	3410	3303	5 (1*)	0	4
Increase in Noise Level	1.0 – 2.9	Low	1.0 – 2.9	Low	2622	2503	5 (7*)	2	4 (1*)
	3.0 – 4.9	Low/Medium	3.0 – 4.9	Low/Medium	100	97	0	0	0
	5.0 – 9.9	Medium	5.0 – 9.9	Medium	25	23	1*	0	1*
	10.0+	High	10.0+	High	0	0	0	0	0

* - Denotes locations that are combined residential and childcare or residential and healthcare

Table 14.73: Difference Between Night-time Rail Noise Levels: Do Minimum and Do Something with Mitigation

Change in Rail Noise Level (dB)		EPA Magnitude of Impact	All Receptors	Residential	Educational and Childcare Facilities	Hotels	Healthcare	Activities of Religious Organisations	Other
Decrease in Noise Level	10.0+	High	6	0	0	0	0	0	6
	5.0 – 9.9	Medium	85	0	1	0	0	4	85
	3.0 – 4.9	Low/Medium	206	0	0	0	0	6	206
	1.0 – 2.9	Low	1574	4 (1*)	0	0	0	28	1574
No Change	< 1.0	Negligible	3431	5 (1*)	0	5	2	109	3431
Increase in Noise Level	1.0 – 2.9	Low	2495	5 (7*)	2	4 (1*)	1	94	2495
	3.0 – 4.9	Low/Medium	91	0	0	0	0	3	91
	5.0 – 9.9	Medium	22	1*	0	1*	0	2	22

Change in Rail Noise Level (dB)		EPA Magnitude of Impact	All Receptors	Residential	Educational and Childcare Facilities	Hotels	Healthcare	Activities of Religious Organisations	Other
	10.0+	High	0	0	0	0	0	0	0

* - Denotes locations that are combined residential and childcare or residential and healthcare

14.9.4. Operational Vibration

There will be no significant vibration effect arising from the proposed Project in the operational phase. The residual effects are negative, not significant and long-term.

14.10. Cumulative Effects

The cumulative assessment of relevant plans and projects is undertaken separately in Chapter 26 of this EIAR.

14.11. References

Dowding, C. (1996), Construction Vibrations, Prentice Hall, New Jersey.

American Public Transit Association (1981) Guidelines for Design of Rapid Transit Facilities, Section 2.7, Noise and Vibration

Wiss (1981), Construction Vibrations: State of the Art, Journal of the Geotechnical Engineering Division, ASCE, Vol. 107, Issue 2

Simon (1963), Energy Balance in Rock Drilling, Society of Petroleum Engineers Journal, Dec. 1963, p.298

Orr, T.L.L. and Rahman, M.E. (2008), 'Prediction of ground induced vibrations due to tunnelling', Proceedings of 4th Symposium on Bridge and Infrastructure Research in Ireland, National University of Ireland, Galway, 453-460

CERI (2020), Reilly, C., Meehan, N., Quirke, P., McCarron, R., Vibrations due to horizontal directional drilling in Lucan Formation rock and Dublin Boulder Clay, Civil Engineering Research in Ireland Conference, Cork, August 2020

New (1986), Ground Vibration caused by civil engineering works, Traffic Research Laboratory Report 53, UK

Hiller, D., and Crabb, G., (2000) Ground borne vibration caused by mechanised construction works. TRL Report 429. Wokingham: TRL.