Bonneagar Iompair Éireann
Transport Infrastructure Ireland

NTA
Údarás Náisiúnta Iompair
National Transport Authority

Luas Finglas

Environmental Impact Assessment Report 2024

Chapter 15: Noise and Vibration

BARRY TRANSPORTATION
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Project Ireland 2040
Building Ireland's Future

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GLOSSARY OF FREQUENTLY USED TERMS

Term	Definition
AADT	Annual Average Daily Traffic
CEMP	Construction Environmental Management Plan
CIE	Córas Iompair Éireann
CNL	Construction noise level
CNT	Construction noise threshold
CNVMP	Construction Noise and Vibration Management Plan
CRTN	Calculation of Road Traffic Noise
dB	Decibel (a unit used to measure the intensity of a sound; on a logarithmic scale)
dBA	A-weighted decibel
DCC	Dublin City Council
DMRB	Design Manual for Roads and Bridges
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
FCC	Fingal County Council
GPG	Good practice Guide (Guidance)
HA	Highly annoyed
HGV	Heavy Goods Vehicle
HSD	Highly sleep disturbed
kph	Kilometre per hour
$L_{A90,T}$	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels
$L_{Aeq,T}$	Equivalent sound pressure level in terms of dBA for the time period T
$L_{Ar,T}$	Specific sound level plus any adjustment for the characteristic features of the sound
L_{day}	The A-weighted long-term average sound level as defined in ISO 1996-2, determined over all day periods of a year. The 12-hour daytime period is between 07:00 to 19:00hrs.
L_{den}	24-hour noise rating level determined by the averaging of the L_{day} with the $L_{evening}$ (plus a 5dB penalty) and the L_{night} (plus a 10dB penalty).
$L_{evening}$	A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year. The 4-hour evening period is between 19:00 to 23:00hrs.
L_{night}	A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the night periods of a year. The 8-hour night-time period is between 23:00 to 07:00hrs.
LRT	Light Rail Transit
LRTS	Light Rail Transit System
LRV	Light Rail Vehicle
mm/s	Millimetres per second

Term	Definition
NAP	Noise Action Plan
NSL	Noise Sensitive Location
OCS	Overhead Contact System
On-time	The time when equipment or machinery is in operation
P&R	Park & Ride
PA	Public Address
PPV	Peak Particle Velocity
Receiver	Generic description of a location that is represented in a noise model
RNL	Rail noise level
SEL	Sound exposure level
TII	Transport Infrastructure Ireland
VDV	Vibration Dose Value
WHO	World Health Organisation

SECTION 15: NOISE AND VIBRATION

15.1 Introduction

15.1.1 Purpose of this Report

This Chapter of the Environmental Impact Assessment Report (EIAR) assesses the impact of the Luas Finglas Scheme (hereafter referred to as the proposed Scheme), on noise and vibration during the Construction Phase and Operational Phase. Note that all references within this chapter to noise relate to airborne noise. In accordance with the requirements of Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (i.e., the EIA Directive), it describes and assesses the likely direct and indirect significant effects of the proposed Scheme on noise and vibration. This Chapter also provides a characterisation of the receiving environment within the proposed Scheme and within a wider study area in the vicinity of the proposed Scheme.

This Chapter should be read in conjunction with the following Chapters, and their Appendices, which present related impacts arising from the proposed Scheme and proposed mitigation measures to ameliorate the predicted impacts:

- Chapter 6 (Construction Activities);
- Chapter 7 (Human Health);
- Chapter 8 (Population);
- Chapter 9 (Biodiversity);
- Chapter 18 (Material Assets: Traffic and Transport);
- Chapter 20 (Cultural Heritage);
- Chapter 21 (Landscape and Visual Amenity); and
- Chapter 24 (Cumulative Impacts).

The assessment is based on a reasonable worst-case scenario with respect to potential impacts arising from the proposed Scheme, as described in Chapter 5 (Description of the proposed Scheme) and Chapter 6 (Construction Activities) of this EIAR. The proposed Scheme description is based on the design prepared to inform the planning stage of the proposed Scheme and to allow for a robust assessment as part of the Environmental Impact Assessment (EIA) Process.

In the event where it is required to make assumptions as the basis of the assessment presented here, these assumptions are based on advice from competent project designers and are clearly outlined within the Chapter.

15.1.2 Outline Scheme Description

The proposed Scheme comprises a high-capacity, high-frequency light rail running from Broombridge to Charlestown, connecting Finglas and the surrounding areas with Dublin's wider public transport network by providing a reliable, and efficient public transport service to the city centre via Broombridge.

As shown in Volume 4 - Map Figure 1-1, starting from Broombridge, the proposed Scheme travels northwards, crossing the Royal Canal and the Maynooth railway line adjacent to Broome Bridge. It then runs adjacent to the east of Broombridge Road and the Dublin Industrial Estate. It then crosses the Tolka Valley Park before reaching the proposed St Helena's Stop and then proceeds northwards towards the proposed Luas Finglas Village Stop. From here, the route passes through a new corridor created within the Finglas Garda Station car park, making its eastern turn onto Mellowes Road. The route then proceeds through Mellowes Park, crossing Finglas Road, towards the proposed St Margaret's Road Stop. Thereafter, the proposed line continues along St Margaret's Road before reaching the terminus Stop proposed at Charlestown.

The proposed Scheme has been designed to interchange with existing and future elements of the transport network including interchange opportunities with bus networks at all the new Stops and with mainline rail services at Broombridge, and a Park & Ride facility to intercept traffic on the N/M2. In addition, the proposed Scheme through the inclusion of integrated cycle lanes and cycling infrastructure sets out to facilitate multimodal "cycle-LRT trips" as a key aspect of the Luas Finglas scheme.

The proposed Scheme will comprise a number of principal elements as outlined in Table 15-1 and Table 15-2. A full description of the proposed Scheme is provided in the following chapters of this Environmental Impact Assessment Report (EIAR):

- Chapter 1 (Introduction);
- Chapter 5 (Description of the proposed Scheme); and
- Chapter 6 (Construction Activities).

Table 15-1: Overview of the Key Features of the proposed Scheme

Scheme Key Features	Outline Description
Permanent Scheme Elements	
Light Rail track	3.9km extension to the Luas Green Line track from Broombridge to Finglas (2.8km of grass track, 700m of embedded track and 360m of structure track)
Depot Stabling facility	A new stabling facility (with stabling for eight additional LRVs) will be located just south of the existing Broombridge terminus, as an extension of the Hamilton depot area.
Luas Stops	Four Stops located at: St Helena's, Finglas Village, St Margaret's Road, and Charlestown to maximise access from the catchment area including the recently re-zoned Jamestown Industrial Estate.
Main structures	Two new Light Rail Transit (LRT) bridges will be constructed as part of the proposed Scheme: a bridge over the River Tolka within the Tolka Valley Park and a bridge over the Royal Canal and the Iarnród Éireann (IÉ) railway line at Broombridge. A number of existing non-residential buildings shall be demolished to facilitate the proposed Scheme. In addition, the existing overbridge at Mellowes Park will be demolished.
At Grade Signalised Junctions	10 at grade signalised junctions will be created at: Lagan Road, Ballyboggan Road, Tolka Valley Road, St. Helena's Road, Wellmount Road, Cappagh Road, Mellowes Road, North Road (N2), McKee Avenue, Jamestown Business Park entrance. Note: The junction at Charlestown will be reconfigured but does not have a LRT crossing.
Uncontrolled Crossings	13 at grade uncontrolled crossings (11 pedestrian / cycle crossings and two local accesses located at: Tolka Valley Park, St Helena's, Farnham pitches, Patrickswell Place, Cardiff Castle Road, Mellowes Park, St Margaret's Road, and ESB Networks.
Cycle Facilities	Cycle lanes are a core part of the proposed Scheme in order to facilitate multimodal "cycle-LRT trips". Approximately 3km of segregated cycle lanes and 100m of non-segregated cycle lanes along the route. Covered cycle storage facilities will be provided at Broombridge Terminus, Finglas Village Stop and St Margaret's Road Stop and within the Park & Ride facility. "Sheffield" type cycle stands will be provided at all stop locations.
Power Substations	Two new traction power substations for the proposed Scheme will be located near Finglas Village Stop behind the existing Fire Station, and near the N2 junction before St Margaret's Road Stop where the current spiral access ramp to the pedestrian overbridge is located. A third substation is required for the Park & Ride facility.

Scheme Key Features	Outline Description
Park & Ride Facility	A new Park & Ride facility, with e-charging substation, located just off the M50 at St Margaret's Road Stop will be provided with provision for 350 parking spaces and secure cycle storage. The building will feature photovoltaic (PV) panel roofing and is the location for an additional radio antenna. This strategic Park & Ride connecting the N2 / M50 to the city centre will increase the catchment area of the proposed Scheme.
Temporary Scheme Elements	
Construction Compounds	There will be three principal construction compounds, two located west of Broombridge Road and one located at the northern extents of Mellowes Park. In addition, there are other secondary site compound locations for small works/storage. Details can be found in Chapter 6 (Construction Activities) of this EIAR.

Table 15-2: Summary of New Bridges of the proposed Scheme

Identity	Location	Description
Royal Canal and Rail Bridge	Approximately 10m east of the existing Broome Bridge and then continuing north, parallel with Broombridge Road on its east side	The proposed bridge is an eight-span structure consisting of two main parts: a variable depth weathering steel composite box girder followed by a constant depth solid concrete slab. The bridge has the following span arrangement: 35 + 47.5 + 30 + 17 + 3x22 + 17m. Steel superstructure extends over the first three spans. The bridge deck is continuous over the full length of 212.5m and has solid approach ramps at both ends.
Tolka Valley Park Bridge	Approximately 30m west of the existing Finglaswood Bridge	A three-span structure with buried end spans, thus appearing as a single span bridge. End spans as well as part of the main span consist of post-tensioned concrete variable depth girder, the central section of the main span is a suspended weathering steel composite box girder. The overall length of the bridge is 65m with spans 10m, 45m, 10m.

15.2 Methodology

The assessment was conducted using the following methodology, which is explained in detail in the relevant sections of this chapter that cover each element:

- A detailed baseline noise study has been undertaken to characterise the existing noise environment at areas most likely to be affected by noise associated with the proposed Scheme;
- Baseline vibration surveys have been undertaken at locations which are likely to be affected by the proposed Scheme which are in proximity to existing vibration sources;
- A review of the most applicable standards and guidelines has been reviewed in order to set a range of acceptable noise and vibration criteria for the construction and operational phases of the proposed Scheme;
- Predictive calculations relating to potential Construction Phase impacts for noise have been undertaken at the nearest sensitive locations to construction work areas associated with the proposed Scheme;
- An assessment of the potential Construction Phase impacts for vibration has been undertaken at the worksites where significant risk of vibration generation during construction are proposed;
- Predictive calculations have been performed to assess the potential impacts associated with noise sources associated the Operational Phase of the Scheme at the most sensitive locations; and
- A schedule of mitigation measures has been incorporated where required, to reduce, where necessary, the identified potential impacts relating to noise and vibration from the proposed Scheme.

15.2.1 Study Area

The study area for potential noise and vibration impacts varies between the Construction and Operational Phase within each section. They key study areas for both phases are described below.

15.2.1.1 Study Area - Construction Phase

From a noise and vibration point of view, the key study areas during the Construction Phase include all surrounding sensitive environments to the construction works. This broadly includes noise and vibration sensitive areas adjacent to the Park & Ride Facility, bridge structures, construction compounds, Luas track, Stops and platforms, and construction of ancillary structures and utility works. Noise impacts associated with construction traffic along the designated haul routes and surrounding road network is also assessed as part of the study area for this phase of the works.

For the Construction Phase, this study area covers a geographical area where construction works are near sensitive residential, educational, amenity, religious and commercial receptors. Depending on the sources in question and the local area under consideration, the study area can extend up to 300m from construction works. All impacts discussed in this chapter relate to human receptors. Construction Phase impacts for sensitive ecological receptors are discussed in Chapter 9 (Biodiversity). The proposed Scheme runs from Broombridge to Charlestown through Tolka Valley and Finglas Village and is shown in Volume 4 - Map Figure 1-1. The proposed Scheme is described from south to north and has been sub-divided into four distinct areas as per the following geographical sections:

- Area 30 Broombridge Depot;
- Area 31 Broombridge to Tolka Valley Road;
- Area 32 Tolka Valley Road to Finglas Village Stop; and
- Area 33 North of Finglas Village Stop to the Terminus (Charlestown Stop).

An outline of the study area is set out below as relevant to the assessment Areas defined for the proposed Scheme.

Area 30 Broombridge Depot

Area 30 includes the construction of the extended Broombridge Hamilton depot stabling area, modifications to the existing Broombridge Luas Stop and landscaping works. Noise sensitive locations (NSLs) in this assessment zone include residential dwellings within Hamilton Square to the south and Broombridge Educate Together school. The extent of the study area is typically up to 300m from each construction area with a focus on sensitive receptors within 100m of construction areas which are those most impacted by the works based on modelling results. Beyond 300m most NSLs are substantially screened from construction works by intervening buildings and construction noise levels are well below the construction noise and vibration threshold values. Therefore, they are not assessed beyond this distance. Notwithstanding this, each construction work area is considered on its own merits depending on the proximity and sensitivity of noise and vibration sensitive areas and the specific works involved.

Area 31 Broombridge to Tolka Valley Road

Area 31 includes the construction of three new structures: the crossing of the existing Maynooth Railway line, Royal Canal and Greenway and the crossing of Tolka Valley Park and River Tolka. In addition, new track will be constructed as well as utility diversions, junction upgrades and landscaping works.

There are no residential properties in this area. However, Tolka Valley Park is considered to be a noise sensitive receptor. The extent of the study area is typically up to 300m from each construction area with a focus on sensitive receptors within 100m of construction areas which are those most impacted by the works based on modelling results.

Area 32 Tolka Valley Road to Finglas Village Stop

Area 32 includes the construction of two new Stops, St Helena's and Finglas Village, two traction substations, Luas track and cycle paths. In addition, there will be demolition work to Finglas Garda Station, utility diversions, junction upgrades and landscaping works.

NSLs in this area include residential properties in Carrigallen, Barnmore, St Helena's, Dunsink Road, Casement Road, Farnham Crescent, Wellmount, Aylward Green, Assumption Convent, Cardiff Castle, Mellowes Court and Ravens Court. In addition, St Helena's Childcare Centre, Erin's Isle CLG and Finglas Garda Station are also considered. The extent of the study area is typically up to 300m from each construction area with a focus on NSLs within 100m of construction areas which are those most impacted by the works based on modelling results.

Area 33 North of Finglas Village Stop to the Terminus (Charlestown Stop)

Area 33 includes the construction of two new Stops, St Margaret's Road and Charlestown Terminus. This area also includes a major road junction with Finglas Road / North Road, and a major upgrade of the whole section along St. Margaret's Road. This area also includes a 350-space Park & Ride facility accessible off North Road. In addition, there will be track construction, demolition work, utility diversions, junction upgrades and landscaping works.

NSLs in this area include residential properties on Casement Road, McKee Avenue, North Road, St Margaret's Road and Melville Lawn areas. The extent of the study area is typically up to 300m from each construction areas with a focus on NSLs within 100m of construction areas which are those most impacted by the works based on modelling results.

15.2.1.2 Study Area Operational Phase

The following noise sources have the potential to impact NSLs in the immediate vicinity of these sources. The study area is defined by the distance beyond which significant impacts are no longer expected. Operational Phase effects on sensitive ecological receptors are discussed in Chapter 9 (Biodiversity). All impacts discussed in this chapter relate to human receptors and will arise from:

- Light Rail Transit System (LRTS) movements;
- Operational noise from substations and LRT Stop Cubicles;
- Park & Ride;
- Maintenance of Railway System; and
- Changes in road traffic along the surrounding road network.

An overview of the specific areas is presented in the following sections. The specific receptor locations within the study area are displayed in Volume 4 – Map Figure 15-2.

Area 30 Broombridge Depot

Area 30 includes the extended Broombridge Hamilton depot stabling area and the modified Broombridge Stop. NSLs in this assessment zone include residential dwellings within Hamilton Square to the south and Broombridge Educate Together school. The extent of the study area is limited to the NSLs immediately adjacent to the proposed Scheme. Beyond the closest NSLs other locations will be screened and have the benefit of additional attenuation due to distance, resulting in lower noise impacts.

Area 31 Broombridge to Tolka Valley Road

Area 31 includes the operation of Luas movements.

There are no residential properties in this area, however, Tolka Valley Park is considered a noise sensitive receptor. The extent of the study area is limited to the park area immediately adjacent to the proposed Scheme. Beyond the closest receptors other locations will be screened and have the benefit of additional attenuation due to distance, resulting in lower noise impacts.

Area 32 Tolka Valley Road to Finglas Village Stop

Area 32 includes the operation of Luas movements, traffic on local roads and traction substations.

NSLs in this area include residential properties in Carrigallen, Barnmore, St Helena's, Dunsink Road, Casement Road, Farnham Crescent, Wellmount, Aylward Green, Assumption Convent, Cardiff Castle, Mellowes Court and Ravens Court. In addition, St Helena's Childcare Centre, Erin's Isle CLG and Finglas Garda Station are also considered. The extent of the study area is limited to the NSLs immediately adjacent to the proposed Scheme. Beyond the closest receptors other locations will be screened and have the benefit of additional attenuation due to distance, resulting in lower noise impacts.

Area 33 North of Finglas Village Stop to the Terminus (Charlestown Stop)

Area 33 includes the operation of Luas movements, traffic on local roads and traction substations. This area also includes a 350-space P&R facility accessible off North Road.

NSLs in this area include residential properties in Casement Road, McKee Avenue, North Road, St Margaret's Road and Melville Lawn areas. The extent of the study area is limited to the NSLs immediately adjacent to the proposed Scheme. Beyond the closest receptors other locations will be screened and have the benefit of additional attenuation due to distance, resulting in lower noise impacts.

15.2.2 Relevant Guidelines, Policy and Legislation

The assessment has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration and 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 (hereafter referred to as the EPA Guidelines) (EPA, 2022)

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. These are summarised below:

- British Standard Institute (BSI) British Standard (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 7385 (1993) Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration;
- BS 6472 (2008) Guide to Evaluation of human exposure to vibration in buildings, Part 1 Vibration sources other than blasting;
- BS 8233:2014 Sound Insulation and Noise Reduction for Buildings;
- BS 4142 (2014+A1 2019) Methods for rating and assessing industrial and commercial;
- UK Highways Agency (UKHA) Design Manual for Roads and Bridges (DMRB) LA 111 Sustainability & Environmental Appraisal. Noise and Vibration Rev 2, 2020 (hereafter referred to as DMRB Noise and Vibration);
- Dublin Agglomeration Third Environmental Noise Action Plan December 2018 – November 2023;
- Draft Dublin Agglomeration Noise Action Plan 2024 – 2028;
- European Communities (Environmental Noise) Regulations 2018 (S.I. No. 549 / 2018);
- European Communities (Environmental Noise) (Amendment) Regulations 2021 (S.I. No. 663/2021);
- EC (Environmental Noise) Regulations 2006 (S.I. No. 140/2006);
- EC Noise Emission by Equipment for Use Outdoors (Amendment) Regulations (S.I. No. 241 / 2006);
- International Organization for Standardization (ISO) 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation;

- 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;
- Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1, 2004;
- Transport Infrastructure Ireland (TII) Code of engineering practice for works on, near, or adjacent the Luas light rail system, 2016;
- Good Practice Guide for the Treatment of Noise during the Planning of National Road Schemes, 2014;
- Reken en Meetvoorschrift Railverkeerslawaai (RMR) '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996. (Calculation and Measurement requirements for rail transport noise. Dutch Ministry Housing, Spatial Planning and the Environment);
- The UK Department of Transport Calculation of Road Traffic Noise (CRTN), 1988; and
- World Health Organization (WHO) Environmental Noise Guidelines for the European Region, 2018.

15.2.3 Data Collection and Collation

15.2.3.1 Data Sources

A variety of data sources have been used to obtain noise and vibration input data for construction and operational modelling and impact assessment. These are summarised as follows,

- Construction noise data - British Standard Institute (BSI) British Standard (BS) 5228 (2009 +A1 2014) Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise;
- Construction vibration data - BS 5228 (2009 +A1 2014) Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration;
- Operational Luas vehicle emissions - combination of SEL measurements of existing Luas infrastructure by AWN & ISVR Consulting;
- Luas Broombridge BXD Line EIS; and
- Substation noise - Eirgrid Evidence Based Environmental Studies Study 8: Noise (2016).

15.2.3.2 Baseline Desk Study

The key sources of available baseline data comprise published noise mapping studies undertaken by Córas Iompair Éireann (CIÉ), TII and DAA (formerly Dublin Airport Authority) which feed into the strategic noise mapping requirements of the Environmental Noise Regulations (S.I. 549 / 2018 and S.I. No. 663/2021). These are published and available via the Dublin City Council website for Noise Maps Round 4 (2022) (https://www.dublincity.ie/residential/environment/air-quality-monitoring-and-noise-control-unit/dublin-city-noise-maps/dublin-city-dublin-agglomeration-strategic-noise-maps). The modelled noise maps include existing sources of major rail, road and aircraft noise within the Dublin Agglomeration area and will form the basis of the forthcoming Dublin Agglomeration Noise Action Plan 2024 – 2028. This information provides a useful high-level overview of noise levels in the study area. The parameters presented in terms of the noise mapping are the L_{den} and L_{night} noise parameters which are both long term noise indicators based on annual traffic and transport modes.

L_{den} is the 24-hour noise rating level determined by the averaging of the L_{day} with the $L_{evening}$ (plus a 5dB penalty) and the L_{night} (plus a 10dB penalty). L_{den} is calculated using the following formula, as defined within the Environmental Noise Regulations (S.I.549 / 2018).

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

Where:

L_{day} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all day periods of a year. The 12-hour daytime period is between 07:00 to 19:00hrs.

$L_{evening}$ is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year. The 4-hour evening period is between 19:00 to 23:00hrs.

L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the night periods of a year. The 8-hour night-time period is between 23:00 to 07:00hrs.

15.2.3.3 Field Surveys

Baseline Noise Surveys

Baseline noise surveys have been conducted at locations representative of the nearest noise sensitive areas which have the potential to be impacted by the Construction Phase and/or those likely to be impacted during the Operational Phase of the proposed Scheme. Unattended surveys (typically 24 hours in duration) were conducted at a total of 8 locations. Attended surveys (day-time measurements), conducted at a total of 15 locations along the length of the proposed Scheme, were used to supplement the unattended surveys.

A description of the survey locations is included in Table 15-20. The survey results are summarised and discussed in Section 15.3.1 and illustrated in Volume 4 – Map Figure 15-1.

Full details of the survey methodologies, acoustic terminology, survey results and discussion are included in full in Volume 5 – Appendix A15-1.

Baseline Vibration Surveys

Baseline vibration surveys have been conducted at locations representative of the nearest sensitive structures which have the potential to be impacted during the Construction Phase and/or those likely to be impacted during the Operational Phase which currently are exposed to sources of vibration.

Two locations have been monitored. The baseline vibration locations are described in Table 15-23 and illustrated in Volume 4 – Map Figure 15-1. The vibration survey results are summarised and discussed in Section 15.3.2. Full details of the vibration survey methodologies, parameter definitions and results of the baseline surveys are included in full in Volume 5 – Appendix A15-1.

15.2.4 Methodology for the Assessment of Impacts

The potential noise and vibration impact on the surroundings are considered for each of two distinct stages:

- Construction Phase; and
- Operational Phase

The analytical methods used to assess the potential noise and vibration impacts during each phase are discussed in the following sections.

15.2.4.1 Construction Phase Noise and Vibration Assessment Methodology

During the Construction Phase of the proposed Scheme, potential impacts will arise from the following:

- Enabling works & demolition;
- Sections of rail and trackwork;
- Utility works;
- Structures;
- Road works; and
- Construction traffic.

Table 15-3 summarises the approach adopted to address the activities noted above which have been assessed as part of the Construction Phase.

Table 15-3: Overview of Construction Phase Noise and Vibration Assessment Procedures

Source	Assumptions	Prediction Method	Key Considerations	Impact Assessment
Construction noise at fixed sites & linear sections of track laying	Working hours as per the Working hours Table 15-25. Primary piling method when required is non-percussive	Construction calculations methodology using BS 5228-1, 2014 Annex F: sound power level method	Calculations consider, plant sound power level, on-time, distance from activity and screening effects	Results compared against construction noise significance thresholds (CNTs).
Utility Diversions	Linear sections of work over temporary periods	Construction calculations methodology using BS 5228-1, 2014 Annex F: sound power level method	Calculations consider, plant sound power level, on-time, distance from activity and screening effects	Results compared against construction noise significance thresholds (CNTs).
Construction Vibration	Primary piling method when required is non-percussive	Methodology from (BS 5228-2, 2014)	Proximity of sensitive buildings / structures / construction methodologies and published data and monitored data from comparable works	Comparison against building construction thresholds and human response to vibration to categorize significant effects
Construction Traffic	Construction traffic access site compounds during normal working hours – unless otherwise noted.	Methodology from CRTN (HMSO, 1998) Noise & acoustic principles	Changes in noise level with and without construction traffic - Calculated relating to volume flow changes in AADT & % HGV	Significance of impact dependent on change in traffic noise level

It is important to note that calculation of specific construction noise levels during the Construction Phase is limited to information available at EIAR stage. Whilst the phasing of works, location of activities, plant items and work sites have been progressed to detailed stages as part of this EIAR, the nature of the source is dynamic in nature and will vary over the course of the proposed Scheme at any one location subject to site conditions, work scheduling, contractor proposals and potential updated technology and methodologies.

Construction noise levels will fluctuate at any one location over the full duration of the proposed Scheme given the variations in the items above on a week to week or month-to-month basis. The approach undertaken therefore is to review the likely significant effects across the proposed Scheme based on the comprehensive information provided by the Luas Team and contained within the EIAR. This includes prediction of construction noise levels associated with the key work stages deemed representative of the likely worst-case scenarios for each activity using expected plant types and numbers, and site layout plans provided by the design team. This approach allows the likelihood of significant effects to be identified and to address the way in which potential construction impacts will be managed, including mitigation and the codes of practices that will be applied. The construction noise calculations undertaken as part of the assessment are used to identify the likely significant effects and, in turn, inform the requirement for noise mitigation and the approach for controlling and managing significant effects.

Notwithstanding the above, a series of noise predictions have been conducted in the vicinity of each of the key construction work areas using the approach described in Table 15-3. The assessments have been undertaken through detailed review of plant and vehicles, site layouts, proposed work phasing, operational on-time for plant and equipment, and operational hours provided by the design team. Calculations have been performed at the NSLs identified within each study area with potential to experience significant construction impacts for each construction work site which include:

- Enabling & demolition works;
- Boundary / retaining wall construction;
- Drainage and utility works;
- Earthworks;
- Road construction;
- Structure works;
- Installation of trackbed and rails;
- Installation of overhead contact system (OCS);
- Proposed ancillary structures (Park & Ride Facility, Substations, LRT Stop Cubicles, etc.); and
- Construction of Stops and surface finishes.

In addition, there will be nine construction compounds used as part of the proposed Scheme - three primary compounds and six secondary compounds. Potential compound locations have been identified along the route and these are shown on the drawing in Volume 4 – Map Figure 6-1. They are also listed within Table 6-5 of Chapter 5 (Construction Activities) which is replicated below in Table 15-4.

Table 15-4: Locations of Site Compounds

No.	Area/ Section	Location	Use (Primary/ Secondary)	Approximate Size
C-31A	S31.1	West of Broombridge Road – on southern side of rail and canal crossing adjacent depot entrance	S	2036m^2
C-31B	S31.1	West of Broombridge Road – use of green area to north of railway	P	3427m^2
C-31C	S31.1	West of Broombridge Road – use of unit in the Glen Industrial estate prior to demolition	P	1522m^2
C-31D	S31.3	Tolka Park – The Parks Building	S	2519m^2
C-32A	S32.1	Adjacent to St Helena's Stop	S	5448m^2
C-32B	S32.2	Northwest corner of Wellmount Road crossing	S	1034m^2
C-33A	S33.1	Old Park Superintendent's House and land to north next to Finglas Fire station	S	1829m^2
C-33B	S33.3	Northern extents of Mellowes Park	P	2017m^2
C-33C	S33.3	St Margaret's / Mckee's Avenue Junction	S	948m^2

The primary compounds will contain a main site office, and welfare facilities for the Employer's personnel and Contractor's personnel. An area for materials to be stored for reuse as necessary will be provided. Items of plant and equipment will also be stored within the compound. Limited parking for construction vehicles will be allowed at the construction compound.

The secondary compounds will contain some local site office and welfare facilities. They will also contain localised storage for material, plant and equipment within the compound. Limited parking for construction vehicles will also be available.

Plant and equipment will be stored at both the primary and secondary compounds. Materials for reuse such as topsoil, subsoil, concrete, rock etc., may also be stored at the construction compounds for reuse as necessary where space permits. Crushing of materials may be undertaken in the construction compounds by a mobile crusher.

The potential source of noise from the various construction site compounds relate to construction plant activity and construction traffic. An assessment has been made of the impact of construction vehicles along the surrounding road network serving each of the construction compounds.

All construction noise calculations have been performed in accordance with Annex F of BS 5228-1 2014, using the plant sound power level method. The standard includes recommended methodologies for calculating construction noise levels and includes a range of best practice mitigation and management measures for the control of noise and vibration from construction sites.

In terms of calculation, this standard sets out sound power levels for a wide range of plant items encountered on construction sites, which in turn enables the prediction of indicative noise levels at distances from the works.

The calculation predicts noise levels taking into account a range of factors affecting the propagation of sound, including:

- The magnitude of the noise source in terms of sound power;
- The percentage on-time of a source;
- The distance between the source and receiver;
- The presence of obstacles such as buildings, screens or barriers in the propagation path;
- The presence of reflecting surfaces;
- The hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity.

Input Data

The following input data was used to develop the noise calculations for each work area:

- OS mapping;
- Constructability descriptions for key working areas per Chapter 6 (Construction Activities);
- Plant equipment list and numbers, operating on-time per period, plant noise levels provided by the design team;
- Construction traffic – Chapter 18 (Material Assets: Traffic & Transport);
- For each construction compound or linear working area, the plant list was broken down into the key construction stages and calculations performed for each;
- Sound power data (octave band) for items of plant to be used on site were sourced from BS 5228 -1 (BS 5228-1, 2014); and
- Average daily HGV movements accessing the construction site over a typical working day.

A detailed description of the proposed construction works is presented in Chapter 6 (Construction Activities). The modelled equipment and sound power data corresponding to each modelled construction activity is presented in Volume 5 – Appendix A15.2.

During the Construction Phase of the proposed Scheme, there will be construction-related traffic using the local road network and dedicated haul routes. Information relation to road closures, diverted routes etc. during the Construction Phase, are discussed in Chapter 18 (Material Assets: Traffic and Transport) and Chapter 6 (Construction Activities). The expected change in noise level will be determined based on the traffic changes provided.

Receiver Locations

For each construction activity assessed, receiver locations have been positioned at the closest NSLs to the construction work boundaries which have the potential to experience moderate to significant impacts. The study area for each site is dependent on the site orientation and layout, proximity of NSLs, and the presence of surrounding buildings and structures which fully screen a NSL from a working area.

All construction traffic will travel along the existing road network onto defined and approved haul routes (Volume 4 – Map Figure 6-1). A significant portion of construction traffic will travel along the existing road network, which already carries traffic volumes. Therefore, it is appropriate to consider the change in traffic noise level that will arise as a result of changes in traffic flow. The key consideration in terms of impact assessment therefore relates changes in traffic noise levels and the related impact associated with same.

Assessment Periods

Noise levels have been assessed over daytime weekday periods (07:00 to 19:00hrs) and Saturday morning periods (07:00 to 13:00hrs) periods in accordance with the proposed construction working hours for the proposed Scheme (refer to Table 15-25).

Output Data

For each construction noise receiver location, a construction noise level (CNL) has been calculated for each of the major construction phases outlined previously. CNLs are calculated initially without screening for each location.

All results are expressed as $L_{Aeq, T}$ and are free field. For daytime weekday periods, the T (time) value is expressed over a 12-hour period (07:00 to 19:00hrs) and for Saturday morning periods over a 6-hour period (07:00 to 13:00hrs).

For construction traffic, the difference in the traffic noise levels between the Do Minimum and Do Something (Construction Phase) scenario was used to determine the initial screening exercise of potential traffic noise effects. The relevant appraisal methods used for assessing traffic-related noise impacts are discussed in Section 15.2.4.5.

Where significant changes in noise levels were calculated, the specific traffic noise level was calculated to the nearest NSL along the identified road and was used to compare against baseline noise levels and range of typical traffic noise levels across the study area.

The determination of significance of changes in traffic noise levels is set out in Section 15.2.4.5.

Vibration

For construction works reference has been made to BS5228-2 2014, and measurement data compiled by AWN Consulting during other construction projects. 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.

15.2.4.2 Operational Phase – Noise

During the Operational Phase of the proposed Scheme, potential impacts will arise from the following sources and activities:

- Noise from operational LRTS;
- Operational noise associated with substations and LRT Stop Cubicles;
- Car parking and traffic noise at the Park & Ride facility; and
- Changes in road traffic noise along surrounding road network.

Note that there are no PA system announcements at Luas Stops and therefore the noise impact assessment does not discuss this further. Table 15-5 summarises the approach adopted to address the sources noted above which have been assessed as part of the Operational Phase. The specific methodologies, input and output data sets are set out in the following sections.

Table 15-5 Overview of Operational Phase Noise Assessment Procedures

Source	Prediction Method	Key Considerations	Impact Assessment
Noise from operational LRTS	SoftNoise Predictor Version 2023 (RMR 2012 Methodology)	Rail noise level over day and night-time periods and peak hours at NSLs.	Results compared against operational noise significance thresholds, baseline noise levels and mitigation trigger values
Park & Ride, Substations & LRT Stop Cubicles	Operational Sources: ISO 9613-2, 1996	Operational car parking, mechanical & electrical plant and vehicle movements within the parking structure	Results compared against operational noise thresholds and baseline noise levels to determine significance magnitudes
Operational Traffic Noise	Calculation in terms of $L_{A10,18hr}$ of change in traffic noise levels between Do Minimum and Do Something scenarios. CRTN basic noise level calculation with correction for speed and percentage heavy goods vehicles has been used to determine a noise level in terms of $L_{A10,18hr}$ at a distance of 10m from the nearside carriageway	Changes in noise level with and without Luas Finglas operational phase – Calculated relating to volume flow changes in AADT	Where significant impact is determined, the absolute noise level is considered for overall ranking of impact (discussed in Section 15.2.4.5)

The appraisal methods associated with the operational phase are set out in the Section 15.2.4.5.

Rail Noise Model

Predictive noise calculations associated with the rail line have been conducted in accordance with the RMR (Dutch Housing, Spatial Planning and the Environment, 2012). The calculations have been performed using the acoustic modelling software SoftNoise *Predictor,* Version 2023 which calculates rail noise levels in accordance with RMR 2012 and updated rail categories from the RMR-2 2006 publication.

The RMR rail noise calculation method is based on a prediction methodology, sub-divided broadly into the calculation of the rail noise source and the calculation of the noise propagation.

The first step of the calculation process is to define the emission value for each section of rail. This is based on the track type, speed and headway of each section. In the case of the proposed Scheme, emission values have been determined from measured Sound Exposure Levels (SELs) of existing Luas operating on the network.

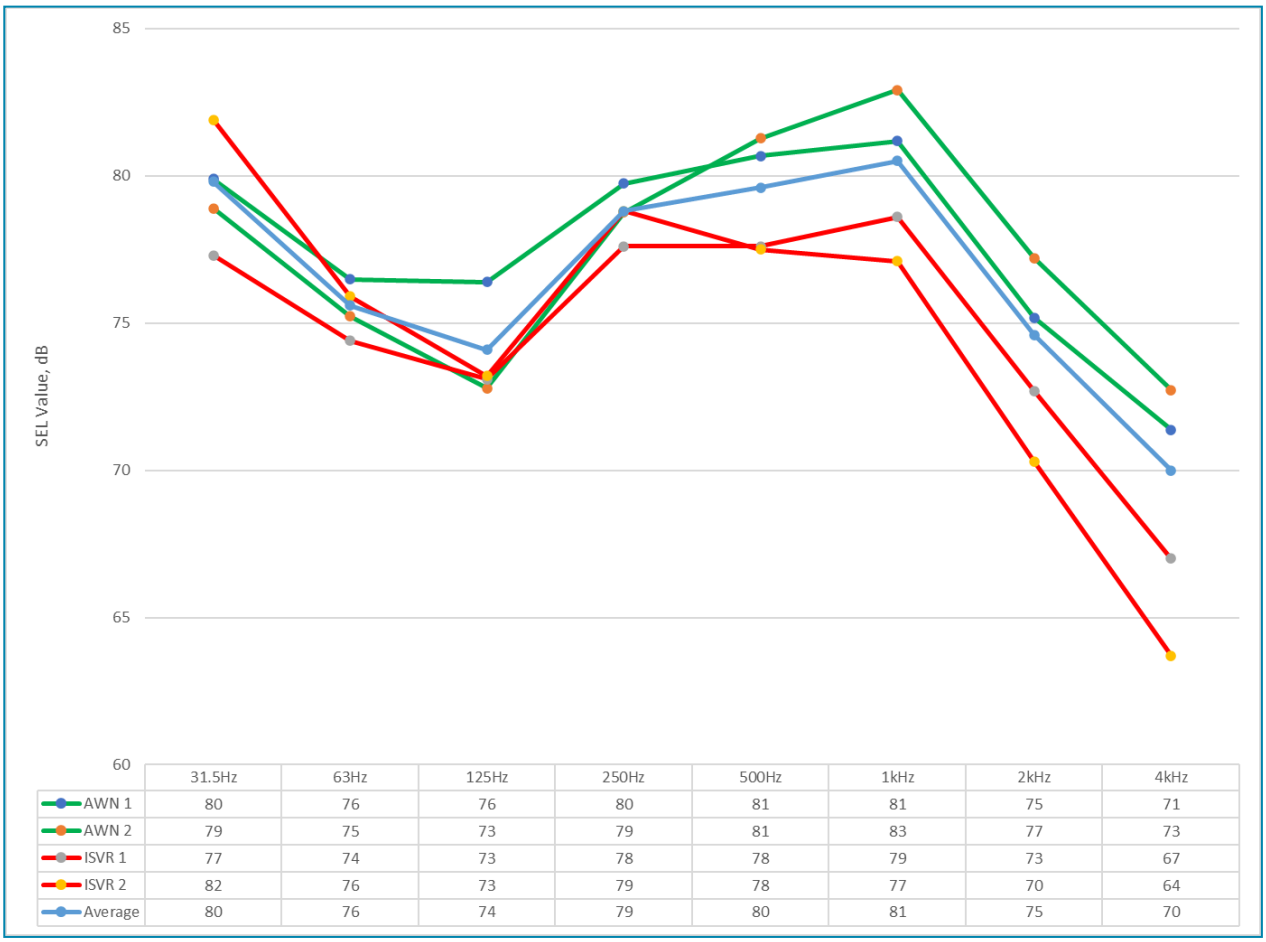
The second step of the calculation process is to calculate the propagation of railway noise to receptor points taking into account the following factors which are built into the calculation model:

- Reflection factors from buildings and other vertical surfaces;
- Distance attenuation & air absorption;
- Ground factors (absorbent and reflecting surfaces);
- Ground height differences (cuttings/embankments);
- Screening effects (boundary treatments, buildings, retaining walls, etc.); and
- Meteorological conditions.

Input Data

The first stage is to obtain a comparative source emission value obtained from a comparable rail system.

In this instance SEL measurements have been taken for the existing Luas Citadis 502 movements by AWN and ISVR on behalf of TII. Measurements were taken at Leahy Meany Bent Park, St Columbus Road, Dublin 14. This location has an embedded grass track and speed similar to that proposed for the majority of the proposed Scheme. Figure 15-1 presents the measured SEL values at a distance of 7.5m from the track and a height of 1.2m. For the purposes of the noise model of the proposed Scheme, the average value has been used.



	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
AWN 1	80	76	76	80	81	81	75	71
AWN 2	79	75	73	79	81	83	77	73
ISVR 1	77	74	73	78	78	79	73	67
ISVR 2	82	76	73	79	78	77	70	64
Average	80	76	74	79	80	81	75	70

Figure 15-1 Grass Track SEL @ 40kph

While grass track is the predominant track type, there are small lengths of embedded and ballast track on the proposed Scheme. Table 15-6 details the SEL values used for these track types based on site measurements of existing Luas LRVs for the track conditions discussed below.

Table 15-6 SEL Values for Embedded and Ballast Track

Track Type	Sound Exposure Level, dB							
	1/1 Octave Band							
	63	125	250	500	1k	2k	4k	8k
Embedded / Structure	81	79	84	83	82	78	73	63
Ballast	81	80	85	83	82	79	74	64

Table 15-7 details the extent of each track type, as advised by the Luas team.

Table 15-7: Summary of the Key Rail Noise Inputs

Track Type	Length	Drawing Ref	Speed Range
Grass Track	2.8 km	Refer to Alignment / Landscape Arrangement Drawings provided in the RO Drawing Pack	20 to 40kph
Embedded Track	0.7 km	Refer to Alignment / Landscape Arrangement Drawings provided in the RO Drawing Pack	20kph to 40kph
Structure Track	0.36 km	Refer to Alignment / Landscape Arrangement Drawings provided in the RO Drawing Pack	40kph

To reflect the speed variation across the proposed Scheme, a correction has been applied to the SEL values presented here to reduce the noise emission by 2dB for each 5kph reduction in speed. This correction has been adopted following a review of the RMR calculation methodology where there is a logarithmic relationship between speed and noise emission.

LRV numbers for the Operational Phase per day, evening and night-time period have been provided by the Luas Team. LRV numbers for both the opening year of 2035 and a future year of 2057 have been modelled.

The following LRV numbers have been modelled:

Opening Year 2035

- Daytime (07:00 to 19:00hrs): 83 Luas trips per direction / 8 peak hour (per direction);
- Evening (19:00 to 23:00hrs): 21 Luas trips per direction / 7 peak hour (per direction); and
- Night-time (23:00 to 07:00hrs): 13 Luas trips per direction / 5 peak hour (per direction).

Operational Year 2057

- Daytime (07:00 to 19:00hrs): 118 Luas trips per direction / 12 peak hour (per direction);
- Evening (19:00 to 23:00hrs): 31 Luas trips per direction/ 10 peak hour (per direction); and
- Night-time (23:00 to 07:00hrs): 19 Luas trips per direction/ 6 peak hour (per direction).

Receiver Locations

Receiver locations have been positioned at the closest NSLs to the proposed Scheme alignment which have the potential to experience perceptible changes to their noise environment. For each receiver location, a calculation height representing the highest floor of the building with a noise sensitive façade is inputted to the noise model. All calculations are made to the receiver external façade and are free field. Receiver locations have been positioned at the areas summarised in Table 15-8. The table notes the rail line section, key sensitive receptors and their noise sensitivity, along with the potential noise risk based on proximity to the proposed Scheme alignment. The rail sections are split into Areas by geographical location, further information on each Area is available within Chapter 5 (Description of the Proposed Scheme). The sensitivity of a receptor location is based on the receptor use and the time period it is occupied. These are categorized in Table 15-8.

Table 15-8: Overview of Noise Sensitive Areas to Rail Noise

Rail Line Section	Key Sensitive Receivers	NSL Sensitivity
Area 30 Luas Broombridge Hamilton Depot	Broombridge Educate Together Hamilton Square	High
Area 31 Broombridge Road to Tolka Valley Road	Tolka Valley Park	Medium
Area 32 Tolka Valley Road to Finglas Village Stop	Carrigallen, Barnmore, St Helena's, Dunsink Road, Casement Road, Farnham Crescent, Wellmount, Aylward Green, Assumption Convent, Cardiff Castle, Mellowes Court, Ravens Court residential areas	High
	St Helena's Childcare Centre	High
	Patrickswell Place	Medium (Noise), High (Vibration)
	Erin's Isle	Medium
	Garda Station	Medium
Area 33 North of Finglas Village Stop to Terminus at Charlestown Stop	Casement Road, McKee Avenue, North Road, St Margaret's Road & Melville Lawn residential areas	High
	Mellowes Park	Medium

Assessment Periods and Output Data

Noise levels have been calculated and presented in terms of the daytime $L_{Aeq,16hr}$ period (07:00 to 23:00hrs), Night-time $L_{Aeq,8hr}$ periods (23:00 to 07:00hrs), L_{den} and the peak hour per day and night-time period ($L_{Aeq,1hr}$).

Rail noise levels (RNLs) are calculated at the upper floor height for each modelled location in order to model the most exposed receptor location on any given property.

Changes in Road Traffic Flow

There is a potential for changes in traffic patterns and flows on the surrounding road network once Luas Finglas becomes operational. Traffic modelling for the Operational Phase of the proposed Scheme has been undertaken on the primary road links affected by the scheme by traffic consultants. This information has been used to determine potential noise impacts using the methodology outlined in the document Calculation of Road Traffic Noise (CRTN) ((UK), Department of Transport, 1988).

The approach adopted for operational traffic noise analysis involves calculating the change in traffic noise levels between the Do Minimum and Do Something traffic scenarios because of increased or reduced traffic on the road network.

The determination of significance of changes in traffic noise levels associated with the Operational Phase is set out in Section 15.2.4.5.

Fixed Noise Sources

Fixed noise sources associated with the proposed Scheme include substations and all other line-side equipment.

The final design of fixed sources including substations serving the proposed Scheme will form part of the detailed design of the scheme at procurement stage. In this instance, the noise impact assessment has focused on setting a range of allowable operational levels to ensure the impact from their operation does

not lead to any significant increase in the existing noise environment. This has been undertaken using guidance taken from BS 4142 (BS 4142, 2019) and BS 8233 (BS 8233, 2014).

Noise from PA systems is not considered in this assessment as there are no general announcements made at each platform other than emergency or unexpected delay announcements. Therefore, under normal operation noise is not generated by the PA system at each Stop.

15.2.4.3 Operational Phase - Vibration

During the Operational Phase of the proposed Scheme, potential impacts will arise from vibration caused by the dynamic forces between the train wheels and track during the operational phase.

Rail vibration impacts at sensitive locations have been assessed using measured vibration levels from existing Luas movements on other parts of the network.

Input Data

The degree of vibration that will be experienced at locations close to the tracks will be determined by the track type and profile at that location, the ground conditions and the train operation (e.g. speed, frequency, etc.).

Output Data

Output data for operational vibration relates to the Vibration Dose Value (VDV) for the daytime period of 07:00hrs to 23:00hrs and night-time period 23:00hrs to 07:00hrs. This will be assessed to a fixed distance from the track that is representative of the closest sensitive locations. At further distances, vibration levels will be lower due to the attenuation over the additional distance.

15.2.4.4 Sensitivity of Receptors

This chapter assesses the potential noise and vibration impact on human receptors. The following locations will be considered as noise and vibration sensitive locations (NSL),

- Dwellings (daytime and night-time);
- Long stay residential (daytime and night-time);
- Emergency responders (Gardaí & Dublin Fire Brigade) (daytime and night-time);
- Schools, Childcare & Colleges (daytime only);
- Places of Worship (daytime only);
- Amenity spaces e.g. playing pitches, parks etc (daytime only); and
- Workplaces (daytime only).

15.2.4.5 Significance of Effects

The significance of effects has been assessed in accordance with the EPA Guidelines (EPA, 2022). The relevant definitions relating to quality, significance and durations of effects are defined per the EPA Guidelines (EPA, 2022). These have been used to define the category of impacts throughout this Chapter.

As these guidelines do not quantify the criteria for assessing impacts specifically for noise or vibration, reference has been made to relevant guidelines and standards relating to noise and vibration in order to further define significance ratings. These are discussed in the following sections.

15.2.4.6 Criteria for Rating Construction Phase Noise Effects

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the Construction Phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion. In general, higher noise levels are tolerated during a Construction Phase of a project compared to its long-term Operational Phase. As construction works will last less than three and a half years and are varied over the course of the proposed Scheme, they are defined as short term in accordance with the EPA Guidelines (EPA, 2022). The following sections set out the criteria for rating construction noise significance effects.

British Standard BS 5228 – 1: 2009+A1:2014 – Fixed Limits

To provide context on typical fixed noise limits commonly applied for major construction projects, reference is made to Section E.2 of BS 5228-1. This sets recommended threshold levels using a fixed limit value set depending on the setting of the noise environment rather than the prevailing baseline noise levels. For example, paragraph E.2 states:

'Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut.'

Paragraph E.2 goes on to state:

'Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed: -

70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;

75 decibels (dBA) in urban areas near main roads in heavy industrial areas'

These limits apply to daytime working outside living rooms and offices. The document notes that where works occur outside other noise sensitive situations with daytime sensitivities, e.g. near hospitals and educational establishments or if works are occurring outside of normal daytime working hours, reduced construction noise levels may be more appropriate.

For previously approved large-scale rail infrastructure projects in Ireland, including Dart Underground, Metro North and Luas Green Line, similar fixed noise limits to those in Section E.2 (BS 5228-1, 2014) were applied by An Bord Pleanála for residential and other sensitive receptors. In the context of the proposed Scheme, this limit value applies on the basis of the following:

- Residential receptors: Upper noise limits for construction noise of 75 dB ($L_{Aeq,12hr}$) during the day; 65 dB ($L_{Aeq,1hr}$) during the evening; or 55 dB ($L_{Aeq,1hr}$) during the night, or above the existing ambient if this is higher;
- For commercial buildings (offices, industrial facilities, sport clubs etc.) which are less noise sensitive, the following fixed noise limit per Section E.2 of BS5228–1 for urban areas near main roads in heavy industrial areas is applied i.e.:
  - Commercial, offices and industrial facilities: 75 dBA daytime & Saturday AM; and
- Similarly, for construction activities across the proposed Scheme associated with mobile working areas with temporary to short term durations, the same fixed limits are applied. These relate to utility diversion works:
  - Utility diversion: 75 dBA daytime & Saturday AM.

DCC – Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition

Dublin City Council's (DCC) *"Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition*" (DCC, 2022) outlines a risk assessment methodology directly applicable to the specific construction activities on the proposed Scheme.

The proposed Scheme has been classed as a high-risk category site based on the DCC GPG risk assessment factors as detailed below:

- Duration of the works;
- Distance to NSLs;
- Ambient noise levels;
- Site operating hours;

- Location of works;
- Duration of demolition; and
- Intrusive noise activities, including vibration generating activities.

The duration, nature and extent of construction activities associated with the Construction Phase of the proposed Scheme would categories it within the high-risk category. The monitoring section (S.6) of the DCC GPG (DCC, 2022) 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 following sections set out the relevant ABC guidance taken from BS 5228–1 (BSI 2014a), and also refer to DMRB Noise and Vibration (UKHA, 2020) in order to review and set appropriate construction noise significance ratings or significance thresholds.

British Standard BS 5228 – 1: 2009+A1:2014 – ABC Method

The ABC method detailed in Paragraph E.3.2 of BS 5228 –1 calls for the designation of a noise sensitive location into a specific category (A, B or C) based on the existing rounded ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates that a potential significant noise impact is associated with the construction activities, depending on context. Table 15-9 sets out the values which, when exceeded, signify a potential significant effect.

Table 15-9: BS 5228-1 Example of Thresholds of Potential Significant Effect

Assessment Category & Threshold Value Period (L_{Aeq})	Construction Noise Threshold (CNT) (dB)		
	Category A	Category B	Category C
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75
Evenings & Weekends (19:00 – 23:00hrs weekdays) (13:00 - 23:00hrs Saturdays) (07:00 – 23:00hrs Sundays)	55	60	65
Night-time (23:00 to 07:00hrs)	45	50	55
Notes	Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.	Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.	Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

The construction noise thresholds (CNTs) have been applied at the façade of residential buildings, hotels and hostels, buildings in educational use and buildings in health and /or community that are noise sensitive. Other buildings that are assessed for construction noise impacts are compared to the Category C CNTs.

The determination of significance at an individual NSL or group of NSLs will therefore depend on the calculated construction noise level (CNL), the prevailing baseline noise environment and the duration and extent of the works.

In order to assist with interpretation of significance, Table 15-10 includes guidance as to the likely magnitude of noise impact associated with construction activities, relative to the CNT. This guidance is derived from

Table 3.16 of DMRB Noise and Vibration (DMRB, 2020) and adapted to include the relevant significance effects from the EPA Guidelines (EPA, 2022).

In accordance with the DMRB Noise and Vibration (DMRB, 2020), construction noise and construction traffic noise impacts shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- Ten or more days or nights in any 15 consecutive days or nights; and
- A total number of days exceeding 40 in any six consecutive months.

Table 15-10: Construction Noise Significance Ratings

Range of Construction Noise level	Guidelines for Noise Impact Assessment Significance (DMRB)	EPA EIAR Significance Effects	Determination
Below or equal to baseline noise level	Negligible	Not Significant	Depending on CNL, duration & baseline noise level
Above baseline noise level and below or equal to CNT	Minor	Slight to Moderate	
Above CNT and below or equal to CNT +5 dB	Moderate	Moderate to Significant	
Above CNT +5 and below or equal to CNT +15 dB	Major	Significant, to Very Significant	
Above +15 dB		Very Significant to Profound	

The adapted DMRB Noise and Vibration (DMRB, 2020) guidance is used to assess the overall significance of construction noise at NSLs across the proposed Scheme.

Criteria for Rating Construction Traffic Noise Impacts

In the absence of any Irish guidelines or standards relating to describing the effects associated with changes in road traffic noise levels, reference has been made to the DMRB Noise and Vibration document (DMRB, 2020). This document provides magnitude rating tables relating to changes in road traffic noise. The document suggests that changes in traffic noise levels are assessed against the short-term magnitudes.

Table 15-11 includes guidance as to the likely magnitude of impact associated with changes in traffic noise levels along an existing road. This is compiled from Table 3.17 of the DMRB Noise and Vibration (DMRB, 2020) and the relevant sections of the document.

Table 15-11: Magnitude of Impact Relating to Changes in Road Traffic Noise Level - Construction Phase

Magnitude of Impact	Increase in Traffic Noise Level (dB)	Duration	Initial Significance Rating
Major	Greater than or equal to 5.0	>10 days/nights over 15 consecutive days / nights and >40 days over 6 consecutive months	Significant
Moderate	Greater than or equal to 3.0 and less than 5.0		Significant
Minor	Greater than or equal to 1.0 and less than 3.0		Not Significant
Negligible	Less than 1.0		Not Significant

The overall significance rating is determined taking account of the change in road traffic noise levels in addition to the specific absolute noise level (Refer to Table 15-10).

15.2.4.7 Criteria for Rating Construction Phase Vibration Effects

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, it is appropriate to consider the magnitude of vibration in terms of Peak Particle Velocity (PPV).

Building Response Criteria

BS 7385 – 2 gives guidance regarding acceptable vibration to avoid damage to buildings. BS 5228 – 2 reproduces these same guidance values.

These standards differentiate between transient and continuous vibration. Surface construction activities are transient because they occur for a limited period at a given location. Both documents recommend that, for soundly constructed residential property and similar light-framed structures that are generally in good repair, a threshold for minor or cosmetic damage (i.e. non-structural damage) should be taken as a PPV (in frequency range of predominant pulse) of 15mm/s at 4 Hertz (Hz) increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above. The standard also notes that below 12.5mm/s PPV, the risk of damage tends towards zero. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in BS 5228 – 2 Table B.2 might need to be reduced by up to 50%. On a cautious basis, therefore, continuous vibration limits are set as 50% of those for transient vibration across all frequency ranges. Historically important buildings that are difficult to repair might require special consideration on a case-by-case basis, but buildings of historical importance should not be assumed to be more sensitive unless they are structurally unsound.

If a building is in an unstable state, then it will tend to be more vulnerable to the possibility of damage arising from vibration or any other groundborne disturbance. The vibration limit range for protected and historical buildings is equal to or up to 50% of that for light framed buildings, depending on structural integrity. Where no structural defects are noted, the same limit to that for light framed buildings apply. For other structures and buildings that are determined to be potentially vulnerable to vibration due to significant structural defects, more stringent criteria have been applied for transient vibration. It is assumed that known buildings and structures of this kind, will be subject to condition surveys well in advance of the works, and any defects identified repaired. The results of conditions surveys will determine whether a building or structure is classed as “vulnerable”.

Table 15-12 sets out the limits as they apply to vibration frequencies at 4Hz where the most conservative limits are required. At higher frequencies, the relevant limit values for transient vibration within Table B.2 and Figure B.1 of BS5228-2 (BS 5228-2, 2014) will apply, with similar reductions applied for continuous vibration and those for protected structures. For line 2 of Figure B.1. at frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded. Taking the above into consideration, the vibration criteria for building response are set out in Table 15-12.

Table 15-12: Recommended Construction Vibration Thresholds for Buildings

Vibration Limits for Buildings (PPV) at the closest part of building to the source of vibration, at a frequency of 4Hz		
Building Type	Transient Vibration	Continuous Vibration
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s	25 mm/s
Unreinforced or light framed structures. Residential or light commercial-type buildings	15 mm/s	7.5 mm/s
Protected and Historic Buildings *Note 1	6 mm/s – 15 mm/s	3 mm/s – 7 mm/s

Vibration Limits for Buildings (PPV) at the closest part of building to the source of vibration, at a frequency of 4Hz	
Identified Potentially Vulnerable Structures and Buildings with Low Vibration Threshold	3 mm/s
Note 1: The relevant threshold value to be determined on a case-by-case basis. Where sufficient structural information is unavailable at the time of assessment, the lower values within the range will be used, depending on the specific vibration frequency.	

Human Response Criteria

Humans are sensitive to vibration stimuli, and perception of vibration at high magnitudes may cause concern to building occupants. BS 5228 – 2 notes that vibration typically becomes perceptible at around 0.15mm/s to 0.3mm/s and may become disturbing or annoying at higher magnitudes. During surface construction works associated with breaking of ground, piling, and excavation, depending on the methodologies involved have the potential to be perceptible to building occupants and have the potential to cause significant effects.

However, higher levels of vibration are tolerated typically for single events or events of temporary duration, particularly during construction projects and when the origin of vibration is known. For example, piling can typically be tolerated at vibration levels up to 2.5mm/s during the daytime and the evening if those affected are aware of the timeframe and origin of the vibration, and if they have been informed about the limit values relating to the structural integrity of neighbouring properties. Table 15-13 presents the significance table relating to potential impacts to building occupants during construction-based on guidance from BS 5228 – 2 and reference to the Association of Noise Consultants (ANC) Measurement and Assessment of Groundborne Noise and Vibration (ANC, 2020).

Table 15-13: Human Response Vibration Significance Ratings

Criteria	Description of Effect	Possible Significance Rating
≥10 mm/s PPV	Vibration is likely to be intolerable for any more than a brief exposure to a level of 10 mm/s	Very Significant
≥1 to 10 mm/s PPV	Increasing likelihood of complaints in residential environments but can be tolerated at the lower end of the scale if prior warning and explanation has been given to residents	Significant to Very Significant
≥0.3 to <1 mm/s PPV	Increasing likelihood of perceptible vibration in residential environments	Slight to Moderate
<0.3 mm/s PPV	Vibration is unlikely to be perceptible in even the most sensitive situations for most vibration frequencies associated with construction	Not significant

Further consideration of where an effect is significant is undertaken using professional judgement based on the duration of and frequency of the effect, as well as the time of the day.

Disturbance of Vibration Sensitive Equipment or Processes

There are no standard criteria for assessing the potential impact of vibration on sensitive equipment or processes. BS 5228 – 2 provides guidance on vibration sensitivities of differing types of sensitive equipment, ranging from microscopes to microelectronic manufacturing equipment. However, these ranges are generic

and relate to the sensitivity of the equipment as installed, not the external façade of the building. The Luas Team is unaware of any such sensitive equipment within the study area.

Disturbance of Existing Luas Track

As presented in Table 15-14, the following maximum allowable vibration levels are set by TII with respect to preventing damage to the Luas Light rail system (TII Code of Engineering practice for works on, near, or adjacent the Luas light rail system - Appendix 3 Vibration and Settlement (2016)) (TII, 2016).

Table 15-14: Maximum Vibration Levels for Prevention of Damage to Luas Light Rail System

Frequency Range	Level 1	Level 2	Level 3
Above 50Hz	10 mm/s	12 mm/s	15 mm/s
50Hz and below	10 mm/s	10 mm/s	10 mm/s
Actions above trigger levels	Initiate review of techniques to reduce vibration magnitudes	Cessation of associated works & propose alternative techniques to reduce to below Level 1	As level 2

15.2.4.8 Criteria for Rating Operational Phase Rail Noise Effects

There is no applicable national guidance specifying noise limits from rail operations, therefore precedence from other rail projects has been used. A review of relevant criteria relating to operational train noise has been undertaken for several large-scale approved or operational urban rail projects, namely Dublin Luas, Channel Tunnel Rail Link-London and Cross Rail-London. This is in addition to guidance documents relating to environmental noise, including the WHO Environmental Noise Guidelines (WHO, 2018). The criteria noted in this section are also aligned with the proposed MetroLink and DART+ West rail projects.

Table 15-15 proposes noise operational rail criteria based on a review of the most applicable Irish rail projects.

Table 15-15: Operational Rail Noise Threshold

Sensitive Locations	Receptor Sensitivity	Noise Significance Threshold Values during Operational Phase
Locations that are highly sensitive during daytime and night-time periods All residential buildings Health care facilities (hospitals, nursing homes) Hotels, student accommodation, hostels, etc.	High	Daytime: 55 dB $L_{Aeq,16hr}$ (07:00 – 23:00hrs) Night-time: 45dB $L_{Aeq,8hr}$ (23:00 – 07:00hrs)
Locations that are only sensitive during daytime periods, and are sensitive to noise: Educational Establishments Theatres Places of worship (churches & other religious buildings) Offices	High	Daytime: 55 dB $L_{Aeq,16hr}$ (07:00 – 23:00hrs)
Locations that are only sensitive during daytime but are less sensitive to noise then the categories above: Commercial buildings	Medium	Assessed on a case-by-case basis, depending on the sensitivity of the specific use, the level of sound insulation that may be afforded by

Sensitive Locations	Receptor Sensitivity	Noise Significance Threshold Values during Operational Phase
Outdoor recreational areas Cinemas		the building & the prevailing noise environment
Industrial Warehouses Indoor recreational areas Shopping centres / retail park	Low	

Where operational rail noise is calculated to be below the threshold values in Table 15-15, the impact is determined to be not significant. Where operational rail noise levels are above these threshold levels, the impact rating is dependent on the magnitude above the threshold value and the increase above the baseline noise environment.

Where pre-existing noise levels are already very high (well above the threshold value), a small change in noise levels may be unnoticeable. However, 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 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 change criteria and associated impact ratings are summarised in Table 15-16.

Table 15-16: Rail Noise Impact Magnitude and Significance Rating

Calculated noise level above threshold or baseline	Impact Magnitude	Residential Significance Rating	Commercial Significance Rating
>10 dB	Very High	Very Significant	Significant
5 – 10 dB	High	Significant	Moderate
3 – 5 dB	Medium	Moderate	Not Significant
1 – 3 dB	Low	Slight	
Less than 1 dB	Very Low	Not Significant	

15.2.4.9 WHO Environmental Noise Guidelines for the European Region

The World Health Organisation (WHO) published Environmental Noise Guidelines for the European Region (WHO, 2018). The objective of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks.

The following recommendations are noted from the WHO 2018 guidelines relating to rail noise:

- For average noise exposure, WHO strongly recommends reducing noise levels produced by railway traffic below 54 dB L_{den}, as railway noise above this level is associated with adverse health effects; and
- For night noise exposure, WHO strongly recommends reducing noise levels produced by railway traffic during night-time below 44 dB L_{night}, as night-time railway noise above this level is associated with adverse effects on sleep.

The recommended noise exposure levels are similar to the absolute levels proposed in Table 15-15.

It should be noted that the WHO guideline values referred to here 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.'

It is therefore not intended to refer to the WHO guidelines in an absolute sense as part of this assessment and it will be a decision for national and local policy makers to adopt the WHO guidelines and propose noise limits for use.

As the WHO guidelines are intended to allow policy makers make health-orientated recommendations, further commentary will be presented in this chapter on the health effects of the calculated noise levels both in terms of prevalence of highly annoyed population using the percentage highly annoyed (%HA) metric, and sleep disturbance using the percentage highly sleep disturbed (%HSD) metric based on the community response studies for rail noise on which the WHO datasets are based.

15.2.4.10 Criteria for Rating Operational Phase Road Noise Effects

Impacts associated with changes in road traffic noise levels during the Operational Phase are also assessed using guidance from the DMRB Noise and Vibration document (DMRB, 2020). The document suggests that during the year of opening (the short-term period), the magnitude of impacts between the Do-Minimum and the Do-Something scenarios are likely to be greater compared to the longer-term period (+15 years post-opening) when people become more habituated to the change.

For the proposed Scheme, the initial significance criteria are used to describe the magnitude of change for the short- and medium-term period, (i.e. the year of opening up to 15 years post). For this assessment year, a 1 dB change between the Do-Minimum and Do-Something scenarios is the smallest that is considered perceptible. Table 15-17 summarises the potential impact associated with defined changes in traffic noise level during the year of opening, 2035. This rating scale was used in Section 15.4.1.5 when assessing predicted impacts.

Table 15-17: Significance of Change Criteria – Short-Term

Change in Noise Level, dB	Short-Term Magnitude	Initial Significance Rating
Greater than or equal to 5.0	Major	Significant
3.0 to 4.9	Moderate	Significant
1.0 to 2.9	Minor	Not Significant
Less than 1.0	Negligible	Not Significant

Where changes in traffic noise levels in the short-term are less than 3 dB, the impact is deemed not significant. Where changes in traffic noise levels are greater than 3 dB, the impact is deemed to be potentially significant.

Further consideration of the magnitude of change in noise levels is determined for the long-term period (i.e. between the year of opening Do Minimum and the design year Do Something). For this assessment year (design year 2050), a 3 dB change is the smallest that is considered to pose any notable impact when considered over the life span of the project i.e. over a long-term 15-year post year of opening in accordance with the DMRB Noise and Vibration guidance document. Table 15-18 summarises the likely impact associated with defined changes in traffic noise level between the Do-Minimum and Do-Something scenarios during the long-term period.

Table 15-18: Significance of Change Criteria – Long-Term

Long-Term Magnitude	Change in Noise Level, dB	Initial Significance Rating
Major	Greater than or equal to 10.0	Significant
Moderate	5 to 9.9	Significant
Minor	3.0 to 4.9	Not Significant
Negligible	Less than 3.0	Not Significant

15.2.4.11 Criteria for Rating Operational Phase Rail Vibration Effects

Once operational, there is potential for operational vibration impacts associated with the LRTS at adjacent sensitive buildings. Reference is made to BS 6472 – 1 which provides the following Vibration Dose Value (VDV) ranges which result in various probabilities of adverse comment resulting from exposure to vibration within residential buildings. An adverse comment is an unfavourable human reaction or response. Note that non-residential buildings can tolerate higher levels of vibration without adverse effects. Table 15-19 summarises the thresholds of vibration effects.

Table 15-19: Vibration During Operation - Threshold of Significant Effects on Building Occupants

BS 6472-1 2008 Rating	In the Absence of Appreciable Existing Levels of Vibration (1), (2)	
	VDV $ms^{-1.75}$ Daytime (07:00-23:00)	VDV $ms^{-1.75}$ Night-time (23:00-07:00)
Adverse Comment not expected	≤ 0.2	≤ 0.1
Low probability of adverse comment	> 0.2 – 0.4	> 0.1 – 0.2
Adverse comment possible	> 0.4 – 0.8	> 0.2 – 0.4
Adverse comment probable	> 0.8 – 1.6	> 0.4 – 0.8
	> 1.6	> 0.8

(1) Highest impact category used, daytime or night-time.

(2) Where there is an appreciable existing level of vibration and daytime and night-time vibration dose values (VDVs) exceed 0.22 $ms^{-1.75}$ and 0.13 $ms^{-1.75}$

15.2.4.12 Criteria for Rating Operational Phase Fixed Noise Source Effects

For consideration of the potential impact of the noise emissions from operational plant associated with the proposed Scheme, British Standard BS 4142 were referred to.

In the absence of any applicable Irish standards, BS 4142 is the industry standard method for analysing building services plant sound emissions to residential receptors. BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

For an appropriate BS 4142 assessment, it is necessary to compare the measured external background sound level (i.e. the $L_{A90,T}$ level measured in the absence of plant items) to the rating level ($L_{Ar,T}$) of the various plant items, when operational. Where sound emissions are found to be tonal, impulsive, intermittent or to have other sound characteristics that are readily distinctive against the residual acoustic environment, BS 4142 advises that penalties be applied to the specific level to arrive at the rating level.

The subjective method for applying a penalty for tonal sound characteristics outlined in BS 4142 recommends the application of a 2 dB penalty for a tone which is just perceptible at the receptor, 4 dB where

it is clearly perceptible, and 6 dB where it is highly perceptible. In relation to intermittency, BS 4142 recommends that if the intermittency is readily distinguishable against the residual acoustic environment, a penalty of 3 dB can be applied. The following definitions, as discussed in BS 4142, are summarised below:

'ambient sound level, $L_{Aeq,T}$'	equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at any given time, usually from many sources near and far, at the assessment location over a given time interval, T.
'residual sound level, $L_{Aeq,T}$'	equivalent continuous A-weighted sound pressure level of the residual sound (i.e. ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound) at the assessment location over a given time interval, T.
'specific sound level, $L_{Aeq,T}$'	equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr.
'rating level, $L_{Ar,T}$'	specific sound level plus any adjustment for the characteristic features of the sound.
'background sound level, $L_{A90,T}$'	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.

In order to establish an initial estimate of impact, BS 4142 states the following:

'Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and consider the following:

a. *Typically, the greater this difference, the greater the magnitude of the impact.*

b. *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*

c. *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*

d. *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 is an indication of the specific sound source having a low impact, depending on the context.'*

Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

15.3 Baseline Environment

The following section describes the receiving noise and vibration environment within the study area. The baseline environment has been characterized through a series of noise and vibration surveys. The following sections summarise the results of the baseline noise and vibration surveys.

15.3.1 Baseline Noise Surveys

Baseline noise surveys have been conducted at locations representative of the nearest noise sensitive areas which have the potential to be impacted by construction works and/or those likely to be impacted during the Operational Phase. Baseline noise measurements were made using both unattended and attended surveys to inform the assessment. Unattended surveys (typically 24 hours in duration) were made at a total of 8 locations. Attended surveys (daytime measurements), made at a total of 15 locations along the length of the proposed Scheme.

Full details of the survey methodologies, equipment, acoustic parameters and terminology and results of the baseline surveys are included in Volume 5 – Appendix A15.1.

The location reference and a description of survey positions are included in Table 15-20. Locations labelled UT relate to the unattended measurement positions whilst AT relate to the attended measurement positions.

Table 15-20: Noise Monitoring Locations

Location	Description of Survey Location	Survey Date
Unattended Noise Survey Locations		
UT1	Colorman Ireland printing factory (Broombridge Road)	9 – 13 June 2022
UT2	No.10 Gortmore Drive (private dwelling)	1 – 2 June 2022
UT3	St Helena's Childcare and Community Resource Centre	1 – 2 June 2022
UT4	No.19 Farnham Crescent (private dwelling)	13 – 15 June 2022
UT5	No.11 Aylward Green (private dwelling)	1 – 2 June 2022
UT6	Finglas Garda Station	8 – 9 June 2022
UT7	No.234 McKee Avenue (private dwelling)	8 – 9 June 2022
UT8	ESB, St Margaret's Road	6 – 8 December 2022
Attended Noise Survey Locations		
AT1	Junction of St Margaret's Road / Melville Road	27 May 2022
AT2	Outside private dwelling at corner of McKelvey Ave / St Margaret's Road	27 May 2022
AT3	Entrance to Polonez Finglas on St Margaret's Road	27 May 2022
AT4	Mellowes Park (Northern End)	27 May 2022
AT5	Mellowes Park (Southern End)	27 May 2022
AT6	Entrance to Mellowes Park Depot on Mellowes Road	1 June 2022
AT7	Greenspace on Cardiff Castle Road	1 June 2022
AT8	Farnham Drive outside Erin's Isle club entrance	1 June 2022
AT9	Greenspace walkway between R102 & St Helena's Road	2 June 2022
AT10	Junction of Broombridge Road / Ballyboggan Road	2 June 2022
AT11	Bridge over River Tolka in Tolka Valley Park	9 June 2022
AT12	Bridge on Broombridge Road	9 June 2022
AT13	Boundary of Broombridge Stop and Hamilton Square	27 March 2024
AT14	Boundary of Broombridge Depot and Broombridge Educate Together NS	27 March 2024
AT15	Eastern Boundary of Broombridge Depot	27 March 2024

For unattended survey locations, results are presented in terms for the 16-hour daytime period (07:00 – 23:00hrs) in terms of the L_{Aeq} and L_{A90} parameters and the eight-hour night-time period (23:00 – 07:00hrs) in terms of the L_{Aeq} and L_{A90} parameters. The derived L_{den} for each day is also presented.

For attended surveys, the survey results are presented as the average daytime L_{Aeq} and L_{A90} parameters over the three-hour survey periods and the calculated L_{den} parameter.

The noise survey results recorded during baseline surveys are summarised in Table 15-21 and Table 15-22.

Table 15-21: Unattended Noise Survey Results within Study Area

Unattended Location	Daytime dB $L_{Aeq,16hr}$	Daytime dB $L_{A90,16hr}$	Night-time, dB $L_{Aeq,8hr}$	Night-time, dB $L_{A90,8hr}$	dB L_{den}
UT1	59	48	52	42	61
UT2	54	40	43	36	54
UT3	54	45	48	38	56
UT4	49	42	44	37	52
UT5	60	45	50	38	61
UT6	55	49	50	43	58
UT7	58	56	54	48	62
UT8	69	61	63	53	71

Table 15-22: Attended Noise Survey Results within Study Area

Attended Location	dB $L_{Aeq,15min}$	dB $L_{A90,15min}$	dB L_{den}
AT1	68	62	74
AT2	66	58	72
AT3	70	62	76
AT4	63	59	69
AT5	61	58	67
AT6	68	53	74
AT7	50	43	56
AT8	67	50	73
AT9	48	42	54
AT10	70	61	76
AT11	58	54	64
AT12	65	51	71
AT13	55	46	58
AT14	53	44	54
AT15	52	47	54

Within the study area, both local and distant road traffic are the dominant noise sources at the survey positions in the vicinity of the proposed Scheme. During daytime periods, average ambient noise levels were recorded in range of 49 to 69 dB $L_{Aeq,16hr}$ at the unattended survey positions (UT1 to UT8). At the attended survey locations (AT1 to AT15), daytime noise levels were measured in the range of 48 to 70 dB $L_{Aeq,15mins}$.

Background noise levels were measured in the range of 40 to 61dB $L_{A90,16hr}$ at the unattended survey positions and between 42 and 62dB $L_{A90,15mins}$ at the attended survey locations.

Night-time noise levels at the survey locations are dominated by road traffic noise. Average ambient night-time noise levels were measured in the range of 43 to 63 dB $L_{Aeq,8hr}$. Average background noise levels during this time period were measured in the range of 36 to 53 dB $L_{A90,8hr}$.

The measured L_{den} values in the study area from the unattended survey locations ranged between 52 and 71dB L_{den}. At attended survey locations, calculated L_{den} values are in the range of 54 to 76dB L_{den}.

The measured noise levels in the study area align closely with those included within the EPA noise maps, as discussed in Section 15.2.3.2, in this assessment zone for road traffic noise:

- At survey locations UT1 & UT7, mapped road traffic noise levels are in the 60 to 64dB L_{den} noise contour which align with those measured at these survey locations;
- At survey location UT6, mapped road traffic noise levels are in the 55 to 59dB L_{den} noise contour which align with those measured at the survey location; and
- At survey location UT8, mapped road traffic noise levels are in the 65 to 69dB L_{den} noise contour which align with those measured at the survey location.

15.3.2 Baseline Vibration Surveys

Baseline vibration surveys have been conducted at locations adjacent to known sensitive structures which have the potential to be impacted by construction works, and/or those likely to be impacted during the Operational Phase which currently are exposed to sources of vibration.

Baseline vibration measurements were conducted over attended day-time periods, for two 15-minute periods on a cyclical basis between locations using logging survey equipment. A total of two locations have been monitored.

Full details of vibration survey methodologies, equipment, parameter and terminology definitions and results of the baseline surveys are included in Volume 5 – Appendix A15.1.

Volume 4 – Map Figure 15-1 of the EIAR presents the baseline vibration survey locations.

The location reference, and a description of survey positions are included in Table 15-23. Locations labelled VM relate to attended vibration monitoring positions.

Table 15-23: Vibration Monitoring Locations

Location	Description of Survey Location
VM01	Bridge on Broombridge Road
VM02	Bridge over River Tolka in Tolka Valley Park

The vibration survey results recorded during the baseline surveys are summarised in the following section and in full in Volume 5 – Appendix A15.1.

Table 15-24 presents the vibration results in terms of the Peak Particle Velocity (PPV) parameter in mm/s. For this parameter, the range of vibration magnitudes measured over each day and night-time period are presented for the vertical and horizonal axes. Full survey results and discussion on the range of measured data is included in Volume 5 – Appendix A15.1.

Table 15-24: Vibration Survey Results – PPV

Location	Measurement	Daytime Period (07:00-23:00Hhrs)		
		X Axis PPV (mm/s)	Y Axis PPV (mm/s)	Z Axis PPV (mm/s)
VM01	1	0.14	0.17	0.21
VM01	2	0.19	0.27	0.62
VM02	1	0.42	0.72	0.45
VM02	2	0.75	0.63	17.18 Note A

Note A This level was as a result of an accidental impact on the geophone and has been excluded from future analysis.

At survey location VM01, PPV values measured less than 1mm/s, indicating a low vibration environment. The maximum events recorded are expected to be as a result of passing traffic on the bridge and occasional train movements on the tracks below.

At survey location VM02, PPV values also measured less than 1mm/s indicating a low vibration environment. The maximum events recorded are as a result of passing pedestrians on the bridge.

15.4 Potential Impacts

15.4.1 Characteristics of the proposed Scheme

15.4.1.1 Do Minimum Scenario

The 'Do Minimum' scenario (Opening Year 2035, Design Year 2050) represents the likely noise & vibration conditions of the study area, including for any transportation schemes which have taken place, been approved or have significantly progressed through the planning process, without the proposed Scheme in place. In the context of the noise & vibration assessment, the Do Minimum scenario will be compared to the Do Something scenario in the assessment of noise impacts of additional traffic on the road network.

15.4.1.2 Construction Phase - Noise

Introduction

Construction noise calculations for each of the key construction activities are set out in the following sections using the methodology described in Section 15.2.4.1. The results for all scenarios discussed in this section assume that there is no screening around the work sites.

Construction Phase Working Hours

Standard working hours, as set out in Table 15-25, will range from 07:00hrs to 19:00hrs on weekdays (excluding Bank and Public Holidays) and from 07:00hrs to 13:00hrs on Saturdays. The appointed contractor(s) will require staff and subcontractors to adhere to these core working hours for each site, insofar as reasonably practicable, unless otherwise permitted by the relevant Local Authority.

Table 15-25: Standard Working Hours for Construction Activity

Day	Typical Working Hours
Monday to Friday:	07:00hrs to 19:00hrs (this includes a half hour to prepare site at each end, giving 11 hours working: 07:30hrs to 18:30hrs)
Saturday:	07:00hrs to 13:00hrs (this includes a half hour to prepare site at each end, giving 6 hours working: 07:30hrs to 12:30hrs)
Sunday / Bank & Public Holiday, including annual and extraordinary events:	None (apart from the exceptions listed below)

The Standard working times will be included in construction contract documentation (Works Requirements) and construction will take consideration of sensitive receptors, in particular any nearby residential areas. Working hours on roads requiring lane closures will be restricted so as to minimise impact on traffic during peak traffic hours. These traffic management restrictions will be agreed with DCC and included in the Works Requirements.

Most construction activities will be undertaken during the proposed standard working hours, as outlined in Table 15-25 with the exception of the following works,

- Utilities, roadworks and other works affecting traffic may be extended to working outside of standard hours;
- Large structure works and concrete pours and may require working outside of standard hours;
- Track bed and track laying and associated concrete batching may require working outside of standard hours;
- Dewatering excavations, the pumping of groundwater will be continuous (24 hours a day, seven days a week) for the duration required for construction at each location; and
- 'Special/abnormal' deliveries: may require extended hours or overnight deliveries.

Occasional night-time works may be required for specific activities such as traffic management, works close to Broome Bridge, footbridge demolition / installation, etc. If night works are required timings/activities are to be planned in advance and agreed with the Local Authority, taking sensitive receptors into consideration, particularly local residents.

Chapter 6 (Construction Activities) includes further detail on all working hours for the proposed Scheme. This information has been used to inform the noise and vibration impact assessment.

Potential Impacts

Detailed information relating to the proposed construction methodologies are included in Chapter 6 (Construction Activities) and the relevant supporting appendices. This information, in addition to plant lists per activity, have been provided by the design team to inform the noise impact assessment. The noise emission value used for the construction noise calculations are included in Volume 5 – Appendix A15.2.

This section sets out the calculated noise levels at the closest representative receptors. The calculations are based on the activities and expected plant provided by the Luas Team and listed in Table 15-26.

Table 15-26: Peak HGVs and Plant by Activity

Activity	HGVs; Activity
Demolition Works	6 Trucks/Lorries
	2 Demolition track machines; 2 excavators/track machines; mobile crane
Boundary / Retaining Wall Construction	4 Trucks / Lorries; concrete truck deliveries; large goods vehicles deliveries

Activity	HGVs; Activity
	2 Excavators / track machines; 2 dumpers; 2 Rollers; Vacuum Excavator; and dewatering pumps
Drainage and Utility / Ducting Works	4 Trucks / Lorries; concrete truck deliveries; flatbed / large goods vehicle deliveries
	4 Excavators; 2 dumpers; 2 rollers; Vacuum Excavator; dewatering pumps, HDD drilling machine; and grab lorry
Earthworks	8 Trucks / Lorries
	3 Excavators / track machines; 2 dumpers; 4 Rollers; 2 dozers / graders; and dewatering pumps
Road Construction	8 Trucks / Lorries; concrete truck deliveries; and flatbed / large goods vehicle deliveries
	3 Excavators / track machines; backhoe mounter hydraulic breakers; 2 dumpers; mobile crane; 2 Road Planers; 2 Pavers; 3 Rollers; Road Sweepers / Jet Washers; and Tack Coater
Principal Structure Works – Royal Canal and Rail Overbridge	4 Trucks / Lorries; concrete truck deliveries; and flatbed / large goods vehicle deliveries
	Mobile crane; crawler crane; self-propelled modular transporter; piling rig; 3 excavators / track machines; dewatering pumps; 2 Rollers; mobile concrete pump; and 2 forklifts / telehandlers
Principal Structure Works – Tolka Valley Park Bridge	4 Trucks / Lorries; concrete truck deliveries; and flatbed/large goods vehicle deliveries
	Mobile crane; piling rig; 3 excavators / track machines; dewatering pumps; 2 rollers; mobile concrete pump; and 2 forklifts / telehandlers
Park & Ride Facility	6 Trucks / Lorries; concrete truck deliveries; and flatbed / large goods vehicle deliveries
	Mobile crane; piling rig; 4 excavators / track machines; dewatering pumps; 4 rollers; mobile concrete pump; and 3 forklifts/telehandlers
Substation Construction	Flatbed / large goods vehicles; concrete truck deliveries
	2 excavators; 2 dumpers; 2 Rollers; forklift / telehandler; and mobile crane
Track Works (including Stabling Works)	4 tippers; flatbed/large goods vehicle deliveries; and concrete truck deliveries
	2 Track machines; 2 rollers / compactors; dozers / grader; welding machines; and road-rail vehicle
OCS (including P&S Installation)	Flatbed / large goods vehicle deliveries
	2 track machines; road-rail vehicle
Stops and Surface Finishing Works	4 Trucks / Lorries; flatbed / large goods vehicles deliveries; and concrete truck deliveries
	2 excavators / track machines; 2 dumpers; 2 rollers; and forklift / telehandler

Assessment of Potential Impacts on Receptors

During construction of the proposed Scheme, a number of construction elements will take place over different sequences. The sequencing of work within these sections is detailed in Chapter 6 (Construction Activities).

The results discussed in the following section are associated with the base scenario, not including for any screening or mitigation except for any pre-existing boundary walls between sensitive locations and the construction work.

Table 15-27 presents the calculated construction noise level (CNL) for each of the sensitive locations alongside the CNT determined from the most representative baseline survey location. The CNL is calculated based on the assumption that for a given activity adjacent to the sensitive locations there will be one of each item of plant in operation. Mixed ground cover of 50% hard and 50% soft ground has been adopted. To account for the fact that construction work is not continuous over the assessment period an “on-time” correction has been applied as follows,

- Truck / Lorries – active for 2hrs out of 12hrs (17%); and
- All other activity – active for 8hrs out of 12hrs (66%).

Where potential significant effects are calculated, they are discussed. Note that not all construction activities will occur at each location, and where an activity is not relevant there is no CNL presented and the symbol “--" is used.

Table 15-27: Calculated Construction Noise Levels at Sensitive Locations

Receiver Name	Location	Shortest Distance to Works	Representative Survey Location	Construction Noise Threshold	Predicted Noise Level, dB $L_{Aeq,T}$											
					Demolition Works	Boundary Wall	Drainage and Utility Works	Earthworks	Road Construction	Principal Structure Works Royal Canal	Principal Structure Works Tolka Valley	Park & Ride	Substation Works	Track Works	OCS Works	Stops and Surface Works
CNR01	Broombridge Educate Together	160m	AT14	65	63	57	61	59	60	58	--	--	--	60	55	58
CNR02	Hamilton Square	45m	AT13	65	73	67	71	69	70	74	--	--	--	70	65	68
CNR03	Tolka Valley Park Playground	100m	AT11	65	--	58	61	60	61	--	55	--	--	61	56	59
CNR04	Carrigallen Drive	45m	UT2	65	--	67	71	69	70	--	--	--	--	71	65	68
CNR05	Barnmore Grove	43m	UT2	65	--	63	66	65	65	--	--	--	--	66	61	64
CNR06	St Helena's Court	35m	UT2	65	--	70	73	72	72	--	--	--	--	73	68	71
CNR07	St Helena's Childcare Centre	20m	UT3	65	--	76	79	78	78	--	--	--	--	79	74	77
CNR08	Dunsink Road	210m	UT4	65	--	50	54	52	53	--	--	--	--	54	48	51
CNR09	Erin's Isle	185m	AT8	70	--	50	54	53	54	--	--	--	--	55	49	52
CNR10*	Farnham Crescent	20m	UT4	65	--	70	73	72	72	--	--	--	--	73	68	71
CNR11	Casement Road	45m	UT4	65	--	66	70	68	69	--	--	--	--	70	64	67
CNR12	Wellmount Parade	24m	UT5	65	--	69	72	71	72	--	--	--	--	72	67	70
CNR13	Assumption Convent	45m	UT5	65	--	68	71	70	70	--	--	--	--	71	66	69

Receiver Name	Location	Shortest Distance to Works	Representative Survey Location	Construction Noise Threshold	Predicted Noise Level, dB $L_{Aeq,T}$											
					Demolition Works	Boundary Wall	Drainage and Utility Works	Earthworks	Road Construction	Principal Structure Works Royal Canal	Principal Structure Works Tolka Valley	Park & Ride	Substation Works	Track Works	OCS Works	Stops and Surface Works
CNR14	Aylward Green	20m	UT5	65	--	72	75	74	74	--	--	--	--	75	69	72
CNR15	Cardiff Castle Road	22m	UT6	65	80 Demolition of Garda Station @ 26m)	76	79	78	78	--	--	--	--	79	73	76
CNR16	Mellowes Court	40m	UT6	65	66 (Demolition of Garda Station @ 80m)	69	72	71	72	--	--	--	--	72	67	70
CNR17	Ravens Court	33m	UT6	65	72	73	77	75	76	--	--	--	--	76	71	74
CNR18	Finglas Garda Station	6m	UT6	75**	88	80	84	82	83	--	--	--	58	83	78	81
CNR19	Casement Road	97m	AT5	65	--	58	62	60	61	--	--	70 (P&R at 45m)	--	62	56	59
CNR20	North Road	13m	AT3	75	71 (Demolition of Footbridge @ 45m)	81	84	83	83	--	--	64 (P&R at 107m)	73	79	74	82
CNR21	St Margaret's Road	11m	AT3	75	--	82	86	84	85	--	--	67 (P&R at 84m)	--	86	80	83
CNR22	Melville Lawn	56m	AT1	70	--	68	71	70	70	--	--	--	--	71	65	68

Depending on the location and the activity, some construction noise levels exceed the CNT, in some instances by the order of 5dB. Making reference to Table 15-10 and the CNL's outlined in Table 15-27, the significance rating of effects at each location is outlined in Table 15-28.

Table 15-28: Construction Noise Significance Ratings

Receiver Name	Location	Construction Noise Significance Rating
CNR01	Broombridge Educate Together	Negative, slight to moderate, short-term
CNR02	Hamilton Square	Negative, moderate to very significant, short-term
CNR03	Tolka Valley Park	Negative, slight to moderate, short-term
CNR04	Carrigallen Drive	Negative, slight to moderate, short-term
CNR05	Barnmore Grove	Negative, moderate to significant, short-term
CNR06	St Helena's Court	Negative, moderate to significant, short-term
CNR07	St Helena's Childcare Centre	Negative, significant to very significant, short-term
CNR08	Dunsink Road	Negative, slight to moderate, short-term
CNR09	Erin's Isle	Negative, slight to moderate, short-term
CNR10	Farnham Crescent	Negative, significant to very significant, short-term
CNR11	Casement Road	Negative, slight to moderate, short-term
CNR12	Wellmount Parade	Negative, moderate to significant, short-term
CNR13	Assumption Convent	Negative, moderate to significant, short-term
CNR14	Aylward Green	Negative, significant to very significant, short-term
CNR15	Cardiff Castle Road	Negative, significant to very significant, short-term
CNR16	Mellowes Court	Negative, moderate to significant, short-term
CNR17	Ravens Court	Negative, significant to very significant, short-term
CNR18	Finglas Garda Station	Negative, significant to very significant, short-term
CNR19	Casement Road	Negative, slight, short-term
CNR20	North Road	Negative, significant to very significant, short-term
CNR21	St Margaret's Road	Negative, significant to very significant, short-term

Receiver Name	Location	Construction Noise Significance Rating
CNR22	Melville Lawn	Negative, slight to moderate, short-term

In addition, there are nine construction compounds proposed, as described previously in Table 15-4. These are also illustrated in Volume 4 - Map Figure 6-1. The compounds will be used primarily for storage of materials and equipment as well as providing office and welfare facilities. The noise emissions from activity at the compounds are not significant, except for crushing of materials in primary compounds, should that be required. Noise emission from a tracked crushing machine, BS 5228-1 (BS 5228-1, 2014) reference C1:14, is 82dB(A) at 10m. A review of the primary compound locations indicates that the closest sensitive locations to the primary compounds are more than 50m away. Accounting for the attenuation over distance across mixed ground and on-time correction (66%), the noise from crushing activities (if they occur) would be of the order of 64dB(A) at the nearest sensitive locations. This would be a negative, not significant and temporary impact.

Mitigation measures to reduce the impacts are outlined in Section 15.5.1.

15.4.1.3 Construction Phase – Traffic

Using the methodology discussed in Section 15.2.4.6, the assessment of potential construction traffic noise impacts has been undertaken using the following approach:

- Traffic noise levels have been calculated in accordance with CRTN in terms of $L_{A10,18hr}$ along all roads within the study area associated with the Do Minimum and Construction scenarios for the year 2035 using the AADT data per fleet type for each road;
- Roads with changes in traffic noise levels below 3dB are determined to experience a neutral, imperceptible, and short-term impact to a negative, not significant, and short-term impact, due to the relatively low volume of additional traffic along the road network during the Construction Phase; and
- Along all roads with a calculated change in noise level of 3dB and above, the closest NSLs to the road edge have been identified and the daytime traffic noise level has been calculated. The magnitude of change rating and the absolute traffic noise level have been used to categorise the significance of the impact at the closest properties with reference to Table 15-11.

Through assessment it has been determined that the effect due to construction traffic along the majority of roads will result in a less than +3 dB increase. For these roads the effect is predicted to be negative, short-term and not significant.

However, there are four road links with a predicted increase of between 3dB and 6dB. All the road links predicted to be affected in relation to construction are on the route along Finglas Wood Road and Casement Drive. Figure 15-2 highlights the affected area in relation to noise from construction traffic.

Figure 15-2: Road Links Affected by Construction Traffic Noise

To assess the potential noise impact, further calculations have been carried out to assess the absolute construction noise level at the properties along this route, Table 15-29 outlines the road links impacted by construction traffic as per Table 15-11.

Table 15-29: Calculated Construction Traffic Noise Level, dB $L_{A10,18hr}$

Road Link Location	Increase in Noise Level Due to Construction Traffic (dB)	Absolute Construction Traffic Level (dB)	Significance of Effect
Mellowes Road onto Cardiff Castle Road	+3.6	51	Not Significant
Casement Drive onto Plunkett Road	+3.5	54	Not Significant
Casement Drive	+5.8	54	Not Significant
Casement Drive	+5.8	54	Not Significant

The outcome of this assessment is that in all instances the noise level at locations adjacent to the roads are less than 55dB(A). This noise level is well below the threshold of significance for construction noise as defined in section 15.2.4.1. Therefore, it is concluded that notwithstanding the increase in noise above the baseline, the noise effect in relation to construction traffic on existing roads serving the Scheme is found to be negative, short-term, and not significant.

In addition, there are a series of haul routes proposed that will result in HGV movements in locations that are not on the existing public road. The routes are illustrated in Volume 4 – Map Figure 6-1 and will operate along the proposed Scheme alignment as follows:

- Through Tolka Valley Park between Ballyboggan Road and Tolka Valley Road;
- Through the green space between Tolka Valley Road and St Helena's Road;
- Through the sports pitches and green space between St Helena's Road and Wellmount Road; and
- Through Mellowes Park between Mellowes Road and the roundabout at the junction between the North Road and St Margaret's Road.

The potential noise impact of these routes has been assessed taking into account the following input data:

- Closest noise sensitive locations to the haul routes are 25m away;
- Speed of HGV on unsurfaced haul roads will be 10 km/h; and
- Peak hour volume of HGVs will be 8 vehicles per hour (in each direction) – refer to Chapter 18 (Material Assets: Traffic and Transport) of this EIAR.

Taking all the above into consideration and applying the methodology found in Annex F2.5 of BS 5228-1 which specifies that the L_{Aeq} level alongside a haul route can be predicted using the following equation,

$$L_{Aeq} = L_{WA} - 33 + 10log_{10}Q - 10log_{10}V - 10log_{10}d$$

Where

L_{WA} = sound power of a HGV which is 106dB as per Table D.9 of BS 5228-1 for a dumptruck at 10 km/h

Q = number of vehicles per hour

V = average speed of vehicles in kilometres per hour (km/h)

d = distance between centre of haul road and noise sensitive location

The resultant noise level from haul road activity during the peak hour period is 61dB $L_{Aeq,1hr}$ at locations 25m from the haul road. This noise level is well below the threshold of significance for construction noise as defined in Section 15.2.4.1. Therefore, it is concluded that notwithstanding the increase in noise above the baseline, the noise effect in relation to construction traffic on haul roads serving the Scheme is found to be negative, short-term, and not significant.

15.4.1.4 Construction Phase - Vibration

The range of activities with the greatest potential to generate vibration will be demolition works, piling for structure foundations and rolling to compact material. Vibration levels generated during such activities have been compiled from a variety of sources including BS 5228 -2 (BS 5228-2, 2014), and measurements made adjacent to items of specific plant by the Luas team.

The piling methodology to be employed for the proposed Scheme is anticipated to be predominantly rotary-bored piling, however, depending on ground conditions, it may be necessary to adopt impact piling.

A review of measured data from BS 5228-2 (BS 5228-2, 2014) pertaining to rotary or auger driven piles, confirms that at a distance of 3.5m to 7m, piling activities (including auguring, driving and hammer hitting base of hole) do not result in any significant vibration levels (i.e. typically of the order of <1 to 3mm/s PPV) and are below the criteria set for this scheme for significant effects to people within buildings or to protected or vulnerable structures. These values are also in line with measured results from other construction projects, conducted by AWN Consulting.

Vibration levels associated with driven piles are assessed in order to determine potential worst-case impacts. BS 5228-2 (BS 5228-2, 2014) includes measured magnitude of vibration associated with different piling types. Table 15-30 reproduces those associated with steel sheet piling.

Table 15-30: Vibration Magnitudes Associated with Sheet Steel Piling

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

The vibration magnitudes outlined in Table 15-30 indicate that at distances beyond 20m, vibration magnitudes are significantly reduced to well below those associated with any form of cosmetic damage to protected and historic buildings. At distances up to 20m, the low vibration threshold for identified vulnerable buildings is likely to just be exceeded. A negative moderate to significant impact is likely for people within buildings within 20m of this activity. It is worth reiterating that the preferred piling technique will be the low vibration bored piling technique. Furthermore, piling work is limited to the principal structural works for the Royal Canal and Rail Overbridge, the Tolka Valley Park Bridge and the Park and Ride facility. There are no residential properties within 20m of any of these sites.

During demolition activity, there is also potential for vibration to be generated through the ground. Empirical data for this activity is not provided in the BS 5228- 2 (BS 5228-2, 2014) standard. However, the likely levels of vibration from this activity are expected to be significantly below the vibration criteria for building damage, based on experience from other sites. Table 15-31 lists the location of significant demolition works required and the distance to the nearest sensitive locations.

Table 15-31: Demolitions

No.	Area/ Section	Location
1	S31.1	Irish Rail ramp from Broombridge Road to Northern Platform
2	S31.1	Unit 124 Broombridge Close, Glen Industrial Estate to west of Broombridge Road. The building to the north of the existing entrance into Glen Industrial Estate
3	S31.1	Former Layertite building to East of Broombridge Road
4	S31.2	Park Building in Tolka Valley Park at Proposed Compound Location
5	S32.3	Finglas Garda Station PEM building and boundary reconfiguration works (OPW)
6	S33.1	Two DCC-owned Parks building along the proposed alignment just to north of Mellowes Road and behind the Parks Superintendent's House
7	S33.1	Pedestrian bridge at southern end of St Margaret's Road over N2
8	S33.3	North Road Motor Company and associated buildings at southern end of St Margaret's Road
9	S32.3	Pizza Hut building and outbuilding at southern end and to the east of St Margaret's Road
10	S32.3	Shed at 234 McKee Avenue along boundary with Pizza Hut

No.	Area/ Section	Location
11	S32.3	Outbuilding at Kylemore's plot adjacent to 234 McKee Avenue
12	S33.3	Discount DIY North Road for Park and Ride at southern end and to the west of St Margaret's Road and beside Aldi
13	S33.4	Manhattan Peanuts Ltd. Substation Building at western end of the site and to the east of St Margaret's Road
14	S33.4	Four outbuildings / extensions at Jamestown Business Park: Side extension to south of Finglas Auto Building; Outbuilding to rear of Envision Health and Fitness; Outbuilding in green area to rear of Dunns Seafare Ltd.; Lean-to extension at loading bay of Sail Installations and Logistics
15	Various	Existing boundaries being altered / replaced along route (mainly on Broombridge Road, Finglas Village and St Margaret's Road areas)

A negative, temporary, significant impact is likely for people within buildings within 20m of this activity. At increasing distances towards 50m and beyond, impacts to structures and people are not significant from this type of activity.

Notwithstanding the information above, any activities undertaken at the construction sites will be required to operate below the vibration limits set out within Table 15-12 and Table 15-14.

Note that there will be several properties in the vicinity of the works that would be considered as vulnerable to vibration impacts, including but not limited to St Helena's House (Resource Centre), historic bridges and the upstanding wall at Patrickswell Court (King William's Rampart). Where these properties are in close proximity to construction activity, the lower vibration thresholds defined in Table 15-12 will apply. In addition, the mitigation measures outlined in Section 15.5.1.3 will be applied, in particular monitoring of vibration levels to avoid significant impacts occurring.

15.4.1.5 Operational Phase

Introduction

Once operational, sources of noise include the operational railway, operational plant, maintenance activities and changes to road traffic. These sources are discussed in following sections and the potential for cumulative effects at NSLs from each discussed, where relevant.

Potential Impacts

During the operational phase the sources of potential impacts on the environment are:

- Operational rail noise;
- Vibration from rail;
- Luas Broombridge Hamilton depot stabling noise;
- Operational noise associated with substations;
- Noise from ongoing maintenance of the proposed Scheme;
- Car parking, plant and traffic noise at the Park & Ride facility; and
- Changes in road traffic noise along surrounding road network;

Each of these sources are assessed in turn within the following sections.

Assessment of Noise from Rail

Using the methodology, input and source data discussed in Section 15.2.4.2, operational rail noise levels have been calculated at the closest NSLs across the proposed Scheme. The modelled locations are presented in Volume 4 – Map Figure 15-2. The calculated rail noise level at each NSL for day and night-time periods for the opening year of 2035 are presented in full in Table 15-32.

The calculated rail levels take into account any existing boundary treatments along the proposed Luas route and also take into account the new 2m high solid masonry boundary wall along the perimeter of Ravens Court which will be incorporated into the design.

Table 15-32 Calculated Rail Noise Levels for Each NSL – Opening Year 2035

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R001	713243	737109	Residential	52	53	47	52	55
R002	713169	737135	Commercial	50	51	45	50	53
R003	713111	737167	Commercial	44	45	39	44	47
R004	713078	737190	Commercial	41	42	36	41	44
R005	713166	737231	Commercial	53	54	48	53	56
R006	713153	737263	Commercial	56	57	51	56	59
R007	713058	737304	Commercial	44	45	39	44	47
R008	713150	737303	Commercial	55	56	49	54	58
R009	713115	737353	Commercial	54	55	49	54	57
R010	713151	737391	Commercial	55	56	49	54	57
R011	713112	737407	Commercial	54	55	48	53	57
R012	713122	737450	Commercial	59	60	54	59	62
R013	713111	737482	Commercial	54	55	48	53	57
R014	713093	737503	Commercial	47	48	41	46	50
R015	713140	737497	Commercial	60	61	54	59	63
R016	713146	737513	Commercial	53	54	47	52	56
R017	713016	737638	Commercial	47	48	41	46	50
R018	713011	737645	Amenity	50	51	45	50	53
R019	712990	737655	Commercial	50	51	44	49	53
R020	712860	737843	Residential	40	41	35	40	43
R021	712983	737840	Residential	42	43	37	42	45
R022	712966	737873	Residential	44	45	39	44	47
R023	712966	737904	Residential	45	46	39	44	48
R025	712880	737930	Residential	41	42	35	40	44
R026	712887	737944	Residential	45	46	39	44	48
R027	712992	737939	Residential	42	43	36	41	45
R028	713025	737972	Residential	39	40	34	39	42
R029	713020	738007	Residential	40	41	34	39	43
R030	713010	738025	Residential	41	42	35	40	44
R031	713010	738036	Residential	41	42	35	40	44
R032	712995	738070	Residential	43	44	37	42	46
R033	712891	737976	Residential	45	46	39	44	48

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R034	712902	738003	Residential	46	47	40	45	49
R035	712911	738043	Residential	47	48	41	46	50
R036	712910	738076	Residential	47	48	41	46	49
R037	712897	738129	Amenity	45	46	39	44	47
R038	713011	738111	Residential	41	42	35	40	44
R039	712970	738152	Residential	45	46	39	44	48
R040	712968	738195	Residential	44	45	39	44	47
R041	713055	738273	Amenity	46	47	41	46	49
R042	713025	738317	Education	58	59	52	57	61
R043	712856	738295	Residential	40	41	34	39	43
R044	713031	738326	Education	57	58	51	56	60
R045	713167	738354	Amenity	34	35	28	33	37
R046	712851	738384	Residential	39	40	33	38	42
R047	712850	738419	Residential	38	39	32	37	41
R048	712848	738454	Residential	37	38	31	36	40
R049	712846	738490	Residential	36	37	30	35	39
R050	712920	738539	Residential	42	43	36	41	45
R051	712911	738571	Residential	44	45	39	44	47
R052	712881	738605	Residential	45	46	39	44	47
R053	712855	738625	Residential	44	45	38	43	47
R054	712995	738569	Residential	47	48	41	46	50
R055	712947	738645	Residential	47	48	41	46	49
R056	713007	738599	Residential	43	44	38	43	46
R057	712910	738691	Residential	44	45	38	43	47
R058	712872	738750	Education	44	45	38	43	47
R059	712783	738740	Residential	49	50	43	48	52
R060	712791	738796	Residential	46	47	40	45	49
R061	712768	738824	Residential	49	50	43	48	52
R062	712712	738791	Residential	44	45	38	43	47
R063	712710	738832	Residential	48	49	42	47	50
R064	712689	738846	Amenity	45	46	39	44	48
R065	712684	738858	Amenity	44	45	39	44	47
R066	712738	738903	Residential	48	49	42	47	51
R067	712738	738930	Residential	46	47	40	45	48
R068	712721	738959	Residential	46	47	41	46	49
R069	712670	738901	Residential	45	46	39	44	48

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R070	712674	738910	Residential	48	49	42	47	51
R071	712668	738931	Residential	49	50	43	48	51
R072	712661	738962	Residential	50	51	45	50	53
R073	712653	738985	Residential	52	53	47	52	55
R074	712645	739000	Residential	52	53	46	51	55
R075	712631	739010	Residential	47	48	41	46	50
R076	712699	738983	Residential	47	48	41	46	50
R077	712687	738986	Residential	50	51	44	49	53
R078	712701	739000	Residential	49	50	43	48	52
R079	712700	739022	Residential	45	46	39	44	48
R080	712684	739034	Residential	48	49	42	47	51
R083	712660	739058	Garda Station	53	54	48	53	56
R084	712662	739108	Education	53	54	47	52	56
R085	712715	739111	Amenity	59	60	53	58	61
R086	712761	739113	Amenity	59	60	53	58	62
R087	712784	739123	Amenity	50	51	44	49	53
R088	712806	739115	Amenity	48	49	42	47	51
R089	712809	739143	Commercial	48	49	42	47	51
R090	712804	739155	Commercial	50	51	44	49	53
R091	712805	739185	Commercial	55	56	49	54	58
R092	712720	739179	Amenity	44	45	38	43	46
R093	712644	739259	Residential	40	41	34	39	42
R094	712646	739280	Residential	40	41	34	39	43
R095	712647	739333	Residential	41	42	35	40	44
R096	712645	739371	Residential	42	43	36	41	44
R097	712642	739413	Residential	42	43	36	41	45
R098	712639	739455	Residential	43	44	37	42	46
R099	712636	739494	Residential	44	45	38	43	46
R100	712633	739536	Residential	44	45	38	43	47
R101	712629	739579	Residential	44	45	38	43	47
R102	712885	739322	Residential	40	41	34	39	43
R103	712875	739420	Residential	41	42	35	40	44
R104	712864	739432	Residential	41	42	35	40	44
R105	712856	739442	Residential	41	42	35	40	44
R106	712845	739445	Residential	42	43	36	41	45

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R107	712844	739466	Residential	41	42	36	41	44
R108	712826	739472	Residential	43	44	37	42	45
R109	712817	739484	Residential	43	44	37	42	46
R110	712805	739500	Residential	43	44	38	43	46
R111	712923	739375	Residential	38	39	33	38	41
R112	712918	739391	Residential	39	40	33	38	41
R113	712789	739556	Residential	44	45	38	43	47
R114	712790	739572	Residential	44	45	38	43	46
R115	712765	739600	Residential	45	46	39	44	48
R116	712627	739623	Residential	44	45	38	43	47
R117	712625	739667	Residential	44	45	38	43	47
R118	712785	739644	Residential	44	45	38	43	47
R119	712772	739662	Residential	45	46	39	44	48
R120	712769	739676	Residential	45	46	39	44	48
R121	712767	739693	Residential	47	48	41	46	49
R122	712763	739701	Residential	46	47	41	46	49
R123	712757	739708	Residential	47	48	41	46	50
R124	712753	739716	Residential	48	49	42	47	51
R125	712623	739702	Residential	44	45	38	43	46
R126	712619	739723	Residential	43	44	37	42	46
R127	712616	739760	Residential	42	43	36	41	45
R128	712613	739804	Residential	42	43	37	42	45
R129	712611	739843	Residential	42	43	36	41	45
R130	712608	739884	Residential	41	42	35	40	44
R131	712785	739746	Residential	46	47	40	45	49
R132	712775	739763	Residential	48	49	42	47	50
R133	712767	739778	Residential	50	51	44	49	53
R134	712759	739792	Residential	52	53	46	51	54
R135	712751	739805	Residential	54	55	47	52	56
R136	712750	739814	Residential	55	56	48	53	57
R137	712760	739835	Commercial	64	65	58	63	67
R138	712795	739862	Residential	53	54	48	53	56
R139	712724	739909	Commercial	49	50	43	48	52
R140	712748	739943	Commercial	50	51	44	49	53
R141	712761	739972	Commercial	52	53	46	51	55
R142	712799	739963	Commercial	60	61	54	59	63

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R143	712822	739944	Commercial	48	49	42	47	51
R144	712810	740015	Commercial	52	53	46	51	55
R145	712804	740029	Commercial	56	57	50	55	59
R146	712766	740050	Commercial	52	53	46	51	54
R147	712812	740061	Commercial	56	57	50	55	59
R148	712820	740085	Commercial	56	57	51	56	59
R149	712770	740109	Residential	49	50	43	48	52
R150	712799	740127	Residential	53	54	48	53	56
R151	712830	740118	Residential	58	59	52	57	61
R152	712868	740197	Commercial	55	56	49	54	58
R153	712799	740172	Residential	51	52	45	50	53
R154	712815	740188	Residential	52	53	46	51	55
R155	712823	740215	Residential	51	52	46	51	54
R156	712875	740164	Commercial	47	48	41	46	50
R157	712785	740172	Residential	45	46	39	44	48
R158	712879	740240	Commercial	56	57	50	55	58
R159	712827	740244	Residential	51	52	45	50	54
R160	712826	740279	Residential	50	51	44	49	52
R161	712833	740286	Residential	48	49	42	47	51
R162	712839	740295	Residential	52	53	46	51	55
R163	712917	740293	Commercial	47	48	41	46	50
R164	712917	740320	Commercial	48	49	43	48	51
R165	712835	740305	Residential	49	50	43	48	51
R166	712887	740386	Commercial	54	55	49	54	57
R167	712918	740378	Commercial	48	49	42	47	51
R168	712881	740395	Commercial	56	57	51	56	59
R169	712895	740445	Commercial	55	56	50	55	58
R170	712942	740526	Residential	40	41	35	40	43
R171	712848	740559	Commercial	41	42	35	40	44

Luas movements are anticipated to increase after the design year of 2050. This increase in Luas movements has been accounted for and calculated using the methodology, input and source data discussed in Section 15.2.4.2.The calculated rail noise level at each NSL for day and night-time periods for the operational year of 2057 are presented in full in Table 15-33.

Table 15-33 Calculated Rail Noise Levels for Each NSL – Operational Year 2057

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R001	713243	737109	Residential	52	53	47	51	55
R002	713169	737135	Commercial	50	51	45	49	53
R003	713111	737167	Commercial	44	45	39	43	47
R004	713078	737190	Commercial	41	42	36	40	44
R005	713166	737231	Commercial	53	54	48	52	56
R006	713153	737263	Commercial	56	57	51	55	59
R007	713058	737304	Commercial	44	45	39	43	47
R008	713150	737303	Commercial	55	56	49	53	58
R009	713115	737353	Commercial	54	55	49	53	57
R010	713151	737391	Commercial	55	56	49	53	58
R011	713112	737407	Commercial	54	55	48	52	57
R012	713122	737450	Commercial	59	60	54	58	62
R013	713111	737482	Commercial	56	57	50	54	59
R014	713093	737503	Commercial	48	49	43	47	51
R015	713140	737497	Commercial	62	63	56	60	65
R016	713146	737513	Commercial	54	55	49	53	57
R017	713016	737638	Commercial	49	50	43	47	52
R018	713011	737645	Amenity	52	53	47	51	55
R019	712990	737655	Commercial	52	53	46	50	54
R020	712860	737843	Residential	42	43	36	40	45
R021	712983	737840	Residential	43	44	38	42	46
R022	712966	737873	Residential	46	47	41	45	49
R023	712966	737904	Residential	47	48	41	45	50
R025	712880	737930	Residential	43	44	37	41	46
R026	712887	737944	Residential	47	48	41	45	50
R027	712992	737939	Residential	44	45	38	42	47
R028	713025	737972	Residential	41	42	36	40	44
R029	713020	738007	Residential	42	43	36	40	45
R030	713010	738025	Residential	43	44	37	41	46
R031	713010	738036	Residential	43	44	37	41	46
R032	712995	738070	Residential	45	46	39	43	48
R033	712891	737976	Residential	47	48	41	45	50
R034	712902	738003	Residential	48	49	42	46	51
R035	712911	738043	Residential	49	50	43	47	52

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R036	712910	738076	Residential	48	49	43	47	51
R037	712897	738129	Amenity	46	47	41	45	49
R038	713011	738111	Residential	43	44	37	41	46
R039	712970	738152	Residential	47	48	41	45	49
R040	712968	738195	Residential	46	47	41	45	49
R041	713055	738273	Amenity	46	47	41	45	49
R042	713025	738317	Education	58	59	52	56	61
R043	712856	738295	Residential	40	41	35	39	43
R044	713031	738326	Education	57	58	51	55	60
R045	713167	738354	Amenity	35	36	29	33	37
R046	712851	738384	Residential	39	40	34	38	42
R047	712850	738419	Residential	39	40	33	37	41
R048	712848	738454	Residential	38	39	32	36	40
R049	712846	738490	Residential	36	37	31	35	39
R050	712920	738539	Residential	43	44	38	42	46
R051	712911	738571	Residential	46	47	41	45	49
R052	712881	738605	Residential	46	47	41	45	49
R053	712855	738625	Residential	46	47	40	44	48
R054	712995	738569	Residential	49	50	43	47	52
R055	712947	738645	Residential	48	49	43	47	51
R056	713007	738599	Residential	45	46	40	44	48
R057	712910	738691	Residential	45	46	40	44	48
R058	712872	738750	Education	45	46	39	43	48
R059	712783	738740	Residential	51	52	45	49	54
R060	712791	738796	Residential	48	49	42	46	51
R061	712768	738824	Residential	51	52	45	49	53
R062	712712	738791	Residential	46	47	40	44	49
R063	712710	738832	Residential	49	50	44	48	52
R064	712689	738846	Amenity	47	48	41	45	50
R065	712684	738858	Amenity	46	47	41	45	49
R066	712738	738903	Residential	50	51	44	48	52
R067	712738	738930	Residential	47	48	42	46	50
R068	712721	738959	Residential	48	49	43	47	51
R069	712670	738901	Residential	47	48	41	45	50
R070	712674	738910	Residential	50	51	44	48	52
R071	712668	738931	Residential	50	51	45	49	53

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R072	712661	738962	Residential	52	53	47	51	55
R073	712653	738985	Residential	53	54	48	52	56
R074	712645	739000	Residential	52	53	47	51	55
R075	712631	739010	Residential	47	48	42	46	50
R076	712699	738983	Residential	49	50	43	47	52
R077	712687	738986	Residential	51	52	46	50	54
R078	712701	739000	Residential	49	50	43	47	52
R079	712700	739022	Residential	45	46	40	44.0	48
R080	712684	739034	Residential	49	50	44	48	52
R083	712660	739058	Garda Station	55	56	49	53	58
R084	712662	739108	Education	53	54	47	51	56
R085	712715	739111	Amenity	59	60	53	57	61
R086	712761	739113	Amenity	59	60	53	57	62
R087	712784	739123	Amenity	52	53	46	50	55
R088	712806	739115	Amenity	49	50	44	48	52
R089	712809	739143	Commercial	50	51	44	48	53
R090	712804	739155	Commercial	52	53	46	50	55
R091	712805	739185	Commercial	56	57	49	53	58
R092	712720	739179	Amenity	44	45	38	42	47
R093	712644	739259	Residential	41	42	35	39	44
R094	712646	739280	Residential	41	42	36	40	44
R095	712647	739333	Residential	42	43	37	41	45
R096	712645	739371	Residential	43	44	38	42	46
R097	712642	739413	Residential	44	45	38	42	47
R098	712639	739455	Residential	45	46	39	43	48
R099	712636	739494	Residential	45	46	40	44	48
R100	712633	739536	Residential	46	47	40	44	49
R101	712629	739579	Residential	46	47	40	44	49
R102	712885	739322	Residential	42	43	36	40	45
R103	712875	739420	Residential	43	44	37	41	46
R104	712864	739432	Residential	43	44	37	41	46
R105	712856	739442	Residential	43	44	37	41	46
R106	712845	739445	Residential	44	45	38	42	47
R107	712844	739466	Residential	43	44	38	42	46
R108	712826	739472	Residential	44	45	39	43	47

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R109	712817	739484	Residential	45	46	39	43	47
R110	712805	739500	Residential	45	46	40	44	48
R111	712923	739375	Residential	40	41	34	38	43
R112	712918	739391	Residential	40	41	35	39	43
R113	712789	739556	Residential	45	46	40	44	48
R114	712790	739572	Residential	45	46	40	44	48
R115	712765	739600	Residential	47	48	41	45	50
R116	712627	739623	Residential	46	47	40	44	49
R117	712625	739667	Residential	46	47	40	44	49
R118	712785	739644	Residential	46	47	40	44	49
R119	712772	739662	Residential	47	48	41	45	50
R120	712769	739676	Residential	47	48	41	45	50
R121	712767	739693	Residential	48	49	43	47	51
R122	712763	739701	Residential	48	49	42	46	51
R123	712757	739708	Residential	49	50	43	47	52
R124	712753	739716	Residential	49	50	44	48	52
R125	712623	739702	Residential	45	46	40	44	48
R126	712619	739723	Residential	44	45	39	43	47
R127	712616	739760	Residential	44	45	38	42	47
R128	712613	739804	Residential	43	44	38	42	46
R129	712611	739843	Residential	42	43	37	41	45
R130	712608	739884	Residential	41	42	36	40	44
R131	712785	739746	Residential	47	48	41	45	50
R132	712775	739763	Residential	48	49	43	47	51
R133	712767	739778	Residential	50	51	45	49	53
R134	712759	739792	Residential	52	53	47	51	55
R135	712751	739805	Residential	56	57	50	54	59
R136	712750	739814	Residential	57	58	52	56	60
R137	712760	739835	Commercial	64	65	58	62	67
R138	712795	739862	Residential	53	54	48	52	56
R139	712724	739909	Commercial	49	50	44	48	52
R140	712748	739943	Commercial	51	52	46	50	54
R141	712761	739972	Commercial	54	55	48	52	57
R142	712799	739963	Commercial	62	63	56	60	65
R143	712822	739944	Commercial	49	50	44	48	52
R144	712810	740015	Commercial	54	55	48	52	57

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R145	712804	740029	Commercial	57	58	52	56	60
R146	712766	740050	Commercial	53	54	48	52	56
R147	712812	740061	Commercial	58	59	52	56	61
R148	712820	740085	Commercial	58	59	53	57	61
R149	712770	740109	Residential	50	51	45	49	53
R150	712799	740127	Residential	55	56	50	54	58
R151	712830	740118	Residential	60	61	54	58	63
R152	712868	740197	Commercial	57	58	51	55	60
R153	712799	740172	Residential	52	53	46	50	55
R154	712815	740188	Residential	53	54	48	52	56
R155	712823	740215	Residential	53	54	48	52	56
R156	712875	740164	Commercial	48	49	42	46	51
R157	712785	740172	Residential	46	47	41	45	49
R158	712879	740240	Commercial	57	58	52	56	60
R159	712827	740244	Residential	52	53	47	51	55
R160	712826	740279	Residential	51	52	45	49	54
R161	712833	740286	Residential	49	50	44	48	52
R162	712839	740295	Residential	53	54	48	52	56
R163	712917	740293	Commercial	48	49	42	46	51
R164	712917	740320	Commercial	49	50	44	48	52
R165	712835	740305	Residential	50	51	44	48	53
R166	712887	740386	Commercial	55	56	49	53	58
R167	712918	740378	Commercial	48	49	42	46	51
R168	712881	740395	Commercial	57	58	52	56	60
R169	712895	740445	Commercial	56	57	50	54	58
R170	712942	740526	Residential	40	41	35	39	43
R171	712848	740559	Commercial	41	42	35	39	44

To assess the noise impact, the following criteria have been applied:

- Residential: Daytime ($L_{Aeq,16hr}$) levels ≤55dB and Night-time (L_{night}) levels ≤45dB = Not significant;
- Commercial/Offices: Daytime ($L_{Aeq,16hr}$) levels ≤60dB = Not significant;
- For noise levels above these thresholds, the degree of impact is determined based on the change in noise level relative to the baseline as per the impact and significant scale in Table 15-16; and
- The rail noise level is added to the measured baseline noise levels deemed representative of each location to calculate a cumulative noise level. The cumulative level is compared against the baseline noise level to determine the increase in noise level. The measured baseline noise levels are considered to remain a valid representation of the future traffic noise level in this area.

Due to the increases in LRV movements beyond the design year of 2050, and for the purposes of a worst-case assessment, the calculated levels for the year 2057 have been used to assess where there are exceedances of the criteria outlined above.

Table 15-34 presents the impact assessment for those locations for the year 2057 where calculated rail noise levels are above the significance thresholds for daytime periods for NSLs.

Table 15-34 Rail Noise significance ratings at Impacted Locations – Daytime 2057

Receptor		Rail Noise Threshold	Calculated Rail Noise Level	Measured Baseline Noise Level (Reference location)	Cumulative Noise Level	Increase above Baseline	Significance Rating of Noise Change from Baseline
ID	Description	Daytime, dB $L_{Aeq,16hr}$					
R015	Commercial	60	62	70 (AT10)	71	+0.6	Not Significant
R042	Education	55	58	54 (UT3)	59	+5.6	Significant
R044	Education	55	57	54 (UT3)	58	+4.9	Significant
R135	Residential	55	56	58 (UT7)	64	+1.9	Slight
R136	Residential	55	57	58 (UT7)	69	+2.5	Slight
R137	Commercial	60	64	58 (UT7)	71	+6.4	Moderate
R142	Commercial	60	62	58 (UT7)	59	+5.1	Moderate
R151	Residential	55	60	69 (UT8)	65	+0.5	Not Significant

The assessment has determined that highest operational daytime rail noise impacts are significant at NSLs in proximity to the track at St Helena's Childcare Centre (R042 & R044) where mitigation will be specified. Some commercial receptors will experience a moderate impact. However, mitigation is not proposed for those locations.

Further analysis of the peak daytime hour is presented in Table 15-35 The proposed peak daytime hours for the proposed Scheme are between 07:30 and 10:30hrs. A comparison of the calculated peak hour rail noise level has been made with the average ambient baseline noise level during this period, i.e. between 07:00 and 10:00hrs.

Table 15-35 Rail Noise significance ratings at Impacted Locations – Daytime Peak 2057

Receptor		Calculated Rail Noise Level	Measured Baseline Noise Level (08:00 – 09:00hrs)	Cumulative Noise Level	Increase above Baseline	Significance Rating of Noise Change from Baseline
ID	Description	Daytime, dB LAeq,1hr				
R012	Commercial	60	58 (UT1)	62	+4.6	Moderate
R015	Commercial	63	70 (AT10)	71	+0.7	Not Significant
R016	Commercial	55	70 (AT10)	70	+0.1	Not Significant
R042	St Helena's	59	54 (UT3)	60	+4.6	Moderate

Receptor		Calculated Rail Noise Level	Measured Baseline Noise Level (08:00 – 09:00hrs)	Cumulative Noise Level	Increase above Baseline	Significance Rating of Noise Change from Baseline
ID	Description	Daytime, dB LAeq,1hr				
R044	St Helena's	58	54 (UT3)	60	+4.0	Moderate
R083	Garda Station	56	56 (UT6)	59	+3.1	Moderate
R135	Residential	57	58 (UT7)	61	+2.3	Slight
R137	Commercial	65	58 (UT7)	66	+7.1	Moderate
R142	Commercial	63	58 (UT7)	64	+5.8	Moderate
R150	Residential	56	69 (UT8)	69	+0.2	Not Significant
R151	Residential	61	69 (UT8)	70	+0.6	Not Significant

The assessment confirms a moderate daytime noise impact at NSLs in proximity to the track at St Helena's Childcare Centre (R042 & R044) during the daytime peak hours.

Table 15-36 presents the impact assessment for those locations where calculated rail noise levels are above the significance thresholds above for night-time periods. Commercial and educational locations are not included in this assessment table for night-time periods due to not being sensitive during the night-time hours.

Table 15-36 Rail Noise significance ratings at Impacted Locations – Night-time 2057

Receptor		Rail Noise Threshold	Calculated Rail Noise Level	Measured Baseline Noise Level (Reference location)	Cumulative Noise Level	Increase above Baseline	Significance Rating of Noise Change from Baseline
ID	Description	Night-time, dB L_{night}					
R001	Residential	45	47	52 (UT1)	53	+1.1	Slight
R059	Residential	45	45	50 (UT5)	51	+1.3	Slight
R072	Residential	45	47	50 (UT6)	52	+1.6	Slight
R073	Residential	45	48	50 (UT6)	52	+2.0	Slight
R074	Residential	45	47	50 (UT6)	52	+1.7	Slight
R077	Residential	45	46	50 (UT6)	51	+1.3	Slight
R083	Garda Station	45	49	50 (UT6)	53	+2.6	Slight
R134	Residential	45	47	54 (UT7)	55	+0.8	Not Significant
R135	Residential	45	50	54 (UT7)	56	+1.6	Slight
R138	Residential	45	48	54 (UT7)	55	+0.9	Not Significant
R150	Residential	45	50	63 (UT8)	63	+0.2	Not Significant
R151	Residential	45	54	63 (UT8)	64	+0.5	Not Significant
R153	Residential	45	46	63 (UT8)	63	+0.5	Not Significant

Receptor		Rail Noise Threshold	Calculated Rail Noise Level	Measured Baseline Noise Level (Reference location)	Cumulative Noise Level	Increase above Baseline	Significance Rating of Noise Change from Baseline
ID	Description	Night-time, dB L_{night}					
R154	Residential	45	48	63 (UT8)	63	+0.1	Not Significant
R155	Residential	45	48	63 (UT8)	63	+0.1	Not Significant
R159	Residential	45	47	63 (UT8)	63	+0.1	Not Significant
R160	Residential	45	45	63 (UT8)	63	+0.1	Not Significant
R162	Residential	45	48	63 (UT8)	63	+0.1	Not Significant

The assessment has determined that all locations experience a slight or not significant impact. Further analysis of the peak night-time hour is presented in Table 15-37. The proposed peak night-time hours for the proposed Scheme are between 05:30 and 06:30hrs. A comparison of the calculated peak hour rail noise level has been made with the average ambient baseline noise level during this period, i.e. between 05:00 and 07:00hrs.

Table 15-37 Rail Noise significance ratings at Impacted Locations – Night-Time Peak 2057

Receptor	Rail Noise Threshold	Calculated Rail Noise Level	Measured Baseline Noise Level (Reference location)	Cumulative Noise Level	Increase above Baseline	Significance Rating of Noise Change from Baseline
ID	Description	Night-time, dB $L_{Aeq,1hr}$				
R001	Residential	51	57 (UT1)	58	+0.9	Not Significant
R023	Residential	45	48 (UT2)	50	+1.8	Slight
R026	Residential	45	48 (UT2)	50	+1.7	Slight
R033	Residential	45	48 (UT2)	50	+1.7	Slight
R034	Residential	46	48 (UT2)	51	+2.2	Slight
R035	Residential	47	48 (UT2)	51	+2.5	Slight
R036	Residential	47	48 (UT2)	51	+2.3	Slight
R054	Residential	47	48 (UT4)	51	+2.4	Slight
R055	Residential	47	48 (UT4)	51	+2.3	Slight
R059	Residential	49	55 (UT5)	56	+1.0	Slight
R066	Residential	48	55 (UT5)	56	+0.7	Not Significant
R067	Residential	46	53 (UT6)	53	+0.8	Not Significant
R068	Residential	47	53 (UT6)	54	+1.0	Slight
R069	Residential	45	53 (UT6)	53	+0.8	Not Significant
R070	Residential	48	53 (UT6)	54	+1.3	Slight
R071	Residential	49	53 (UT6)	54	+1.5	Slight
R072	Residential	51	53 (UT6)	55	+2.1	Slight
R073	Residential	52	53 (UT6)	55	+2.6	Slight

Receptor	Rail Noise Threshold	Calculated Rail Noise Level	Measured Baseline Noise Level (Reference location)	Cumulative Noise Level	Increase above Baseline	Significance Rating of Noise Change from Baseline
ID	Description	Night-time, dB $L_{Aeq,1hr}$				
R075	Residential	46	53 (UT6)	53	+0.8	Not Significant
R076	Residential	47	53 (UT6)	54	+1.1	Slight
R077	Residential	50	53 (UT6)	54	+1.8	Slight
R078	Residential	47	53 (UT6)	54	+1.2	Slight
R080	Residential	48	53 (UT6)	54	+1.2	Slight
R083	Garda Station	53	53 (UT6)	56	+3.3	Moderate
R122	Residential	46	53 (UT6)	56	+0.4	Not Significant
R123	Residential	47	56 (UT7)	57	+0.5	Not Significant
R124	Residential	48	56 (UT7)	57	+0.6	Not Significant
R131	Residential	45	56 (UT7)	56	+0.3	Not Significant
R132	Residential	47	56 (UT7)	57	+0.5	Not Significant
R133	Residential	49	56 (UT7)	57	+0.8	Not Significant
R134	Residential	51	56 (UT7)	57	+1.2	Slight
R135	Residential	54	56 (UT7)	58	+2.3	Slight
R138	Residential	52	56 (UT7)	57	+1.3	Slight
R150	Residential	54	56 (UT7)	64	+0.4	Not Significant
R151	Residential	58	64 (UT8)	65	+1.0	Slight
R153	Residential	50	64 (UT8)	64	+0.2	Not Significant
R154	Residential	52	64 (UT8)	64	+0.3	Not Significant
R155	Residential	52	64 (UT8)	64	+0.3	Not Significant
R159	Residential	51	64 (UT8)	64	+0.2	Not Significant
R160	Residential	49	64 (UT8)	64	+0.2	Not Significant
R161	Residential	48	64 (UT8)	64	+0.1	Not Significant
R162	Residential	52	64 (UT8)	64	+0.3	Not Significant
R165	Residential	48	64 (UT8)	64	+0.1	Not Significant

Whilst rail noise during the calculated peak night-time hour is higher than those associated with the total 8-hour emission value, the ambient baseline noise level during this period is also high due to road traffic flows during peak hours. The assessment confirms a not significant to slight noise impact at all residential locations.

Assessment of Vibration from Rail

Vibration caused by the dynamic forces between the train wheels and track is a potential source of impact during the Operational Phase. The degree of vibration that will be experienced at locations close to the tracks will be determined by the track profile at that location, the ground conditions and the train operation (e.g. speed, frequency etc).

Future vibration levels from the operation of the proposed Scheme can be assessed based on measured vibration levels from existing Luas infrastructure. Historical noise and vibration monitoring has taken place along the existing Luas network on a biannual basis. The results of this monitoring have found that measured VDV levels from operational Luas movements do not exceed the thresholds for adverse impacts outlined in Table 15-13, even at properties immediately adjacent to the track at comparable speeds and track types to those associated with the proposed Scheme.

Furthermore, previous studies carried out for the Luas Green Line project (Annex D and D1 of Book 5 of the Luas Broombridge St Stephen's Green to Broombridge (Line BXD) EIAR) found that sections of track where decelerating, stopping and accelerating had the potential to generate perceptible vibration levels within occupied buildings at a distance of 4.5m or less from the track. Other sections of track were not found to generate adverse vibration levels, in accordance with BS6472-1 and as outlined in Table 15-19.

Applying this approach to Luas Finglas the closest receptor to sections of track where decelerating, stopping and accelerating occur, is the dwelling at the Junction of North Road and St Margaret's Road - a distance of 5.8m from the track. Therefore, it is concluded that vibration from operational rail will not generate adverse impacts at this location.

It is also known that embedded track on a curve can generate higher levels of vibration than linear straight track. On the proposed Scheme there is a section of curved embedded track approaching the Finglas Village stop from both directions. There is a risk of adverse vibration levels being generated within buildings close to this curved section of track. Previous measurements by AWN on the Luas Green line between Harcourt Street Stop and Charlemont Bridge has found that vibration levels from embedded track on a curve can exceed the criteria outlined in Table 15-19. As a result of this risk of adverse effects mitigation is outlined in Section 15.5.2.

Assessment of Operational Noise from Substations & LRT Stop Cubicles

There are two Traction Substations in the proposed Scheme, one near the Finglas Village Stop and one at Finglas Road / North Road junction, before St Margaret's Road Stop. No significant noise emissions are expected from the substations. The Eirgrid Evidence Based Environmental Studies Study 8: Noise (Eirgrid, 2016) concludes that for 110kV and 220kV substations the noise emission from the substation building is less than 42dB L_{Aeq} at 10m from the building.

LRT Stop Cubicles are also provided as part of the proposed Scheme. The cubicles contain electrical and communication equipment and include small mechanical fans for ventilation. New cubicles are proposed at the following locations:

- St Helena's Stop;
- Finglas Village Stop (within Traction Substation building);
- St Margaret's Road Stop (within Traction Substation building); and
- Charlestown Stop.

In order to determine the noise output from the LRT Stop Cubicles, AWN carried out a measurement at various LRT Stop Cubicles on the Luas Green Line in March 2024. Measurements were taken using a Rion NL52 sound level meter on 21 March 2024. Measurements were taken at 1m distance from the LRT Stop Cubicles to capture the noise emission from the LRT Stop Cubicles. The following noise levels were measured from the LRT Stop Cubicles:

- Beechwood LRT Stop Cubicles – 60dB(A) at 1m;
- Windy Arbour LRT Stop Cubicles – 62dB(A) at 1m; and
- Milltown LRT Stop Cubicles – 59dB(A) at 1m.

No audible tones were noted to be emitted from the LRT Stop Cubicles.

In this instance, the nearest sensitive locations to the new traction substations are Finglas Fire Station, some 65m from the Finglas Village substation, and residential dwellings on North Road, some 30m from the

Finglas Road / North Road substation. The nearest sensitive locations to the LRT Stop Cubicles are St Helena's Resource Centre, at a distance of 30m and Melville Lawn, at a distance of 100m. Given the additional attenuation due to distance, noise impact at these locations due to the operation of the substations or LRT Stop Cubicles is calculated to be in the range of 20 to 32dB L_{Aeq}. This noise level is considerably lower than the prevailing background noise level and therefore the noise impact is expected to be imperceptible.

An additional substation for EV charging will be located with the Park & Ride facility. This is addressed within the noise assessment of the Park & Ride facility.

Assessment of Noise from Ongoing Maintenance

Maintenance of the Luas trackbed will be required over the lifespan of the proposed Scheme. A detailed maintenance plan will be developed for all the proposed Scheme assets. The following maintenance activities will be undertaken to ensure efficient and reliable services:

- On-going condition-monitoring of assets;
- Inspection and maintenance of electrical and mechanical equipment;
- Rail re-profiling and rail grinding;
- Preventative maintenance for other equipment including 'maintenance by replacement' whereby components are exchanged and serviced offline in a depot or factory;
- Planned periodic refurbishment and replacement of assets; and
- General housekeeping, cleaning including all public areas, pest control and weed control.

In order to minimise impacts on services, maintenance schedules will cover both day and night, with certain activities possible only at night when services have ceased, including rail line maintenance. Weekend maintenance will be undertaken in cases where more extensive maintenance work is required, that could not be achieved over a night-time period. Where rail maintenance activities are scheduled over night-time periods, advance notice will be provided to affected residents providing notification of the dates and durations of the planned works.

Assessment of Noise from People Accessing Stops

Pedestrians accessing the Luas from the Stops along the proposed Scheme may generate some low levels of noise due to conversations, etc. Measurements taken by AWN at the existing Broombridge Stop were taken as part of the baseline noise survey. Specifically, attended measurement location AT13 is representative of noise at a typical Luas Stop. Reference to the results in Table 15-22 finds that the noise level at a distance of 25m from the Luas Stop was 55dB $L_{Aeq,15min}$, noting that this also includes contributions from LRV movements and vehicle movements to and from the passenger drop facility at Broombridge.

New Stops serving the proposed Scheme will be located at St Helena's, Finglas Village, St Margaret's Road and Charlestown. Only the St Helena's and St Margaret's Road Stops are within 25m of NSLs. At St Helena's, mitigation is being provided as described in Section 15.5.2. At St Margaret's Road the existing baseline environment at that location (AT3 in Table 15-22) is dominated by road traffic noise and of the order of 70dB $L_{Aeq,15min}$. Therefore, the existing soundscape will not change as a result of pedestrian activity at the Luas Stop.

In summary, the resultant noise impact from people accessing the Luas Stops is negative, slight to imperceptible and long term.

Assessment of Noise from the Park & Ride Facility

A Park & Ride (P&R) facility is proposed adjacent to the existing Lidl store at the site of the existing Discount DIY store on the North Road. The main vehicle access will be from the North Road.

Noise sources associated with the facility are associated with traffic along the internal roads and entering and leaving the facility via the access points described above. Vehicle movements within the car parking areas of the building are another source - however breakout will be minimal once inside the building. Whilst

noise from a car parking facility is variable, the main sources are vehicles manoeuvring and car doors opening and closing. Noise levels from busy commercial car parks are of the order of 55dB at 10m from the boundary, as measured for previous applications by AWN Consulting which accounts for the normal day to day movements described above. For this assessment, sources representative of a sound pressure level of 55dB at 10m have been modelled around the building perimeter at different floor heights to calculate car parking noise breakout from the building. Substation noise is modelled at this location also, representative of a sound pressure level of 55 dB(A) at 2m from the unit.

Traffic will access the P&R facility from the North Road. The noise impact of additional traffic arriving or departing the P&R facility is assessed within the operational traffic assessment contained in this Chapter.

The closest NSL to the P&R facility is the residential property to the south of the proposed site access along the North Road.

Noise levels associated with the Park & Ride car parking activities, traffic flow and rail sources from this area have been combined to obtain a cumulative noise level. The results at the two closest NSLs are summarised in Table 15-38. In summary, the change in noise level results in a negative, slight to imperceptible and long-term impact.

Table 15-38: Park & Ride and Rail Sources – Operational Noise Levels

Receptor		Daytime (07:00 – 23:00hrs)				Night-time (23:00 – 07:00hrs)			
ID	Description	Baseline	Operational Sources (rail, road, car parking)	Cumulative (baseline + operation)	Magnitude of Change in Noise	Baseline	Operational Sources (rail, road, car parking)	Cumulative (baseline + operation)	Magnitude of Change in Noise
R130	Residential	58	43	58	0.0dB	54	35	54	0.0dB
R139	Residential	58	49	59	+1.0dB	54	43	54	0.0dB

Assessment of Noise from Additional Road Traffic on Surrounding Roads

For the purposes of assessing the potential noise impact, the relative increase in noise level associated with traffic movements on existing roads and junctions, with and without the proposed development, has been determined.

The noise level at various junctions for the Do Minimum Scenarios have been assessed against the predicted traffic noise levels for the Do Something Scenarios for the year opening year of 2035 and the design year of 2050.

The Do Minimum and Do Something traffic volumes on all road links in the study area have been provided by the Luas Team. Noise increases on all road links have been assessed against the criteria in Section 15.2.4.10. The roads have been assessed at a consistent speed of 30km/h so as to provide consistency within the calculation method and to accurately present the change in noise level as a product of the changes in traffic flow.

2035 – Do Minimum v Do Something – Operational Traffic

For the year 2035, 95.1% of road links experience a change in noise level of less than 3dB. For these road links, reference to the criteria in Table 15-17 indicates that the predicted effect in relation to operational traffic noise in the short term is negative, long term and not significant.

There are seven road links within the study area of the proposed Scheme which are identified to experience an increase in noise level ranging from 3 to 10 dB as a result of operational traffic in the opening year. Four of these road links are within the Casement Drive geographical section of the proposed Scheme and the others on Lanesborough Park, Lanesborough Drive and the M50 slip. The calculated traffic noise level is between 45 and 65 dB L_{Aeq} at a distance of 10m from the road edge. Considering the absolute traffic noise level in the context of the baseline noise environment it is concluded that the resulting impact is not significant along these roads.

Further information on the location of road links that experience an increase in noise is presented below.

Casement Drive: Noise levels at four road links within the Casement Drive area of the proposed Scheme rise by 3 to 4 dB along the sections highlighted below in Figure 15-3. The Do Something absolute noise level at 10m from the road edge is less than 55dB in this area which indicates the noise impact is not significant.

Figure 15-3: 2035 Operational Traffic Noise Casement Drive

Lanesborough Park and Lanesborough Drive: Noise levels at two road links within the Lanesborough Park and Lanesborough Drive area of the proposed Scheme rise by the order of 10dB along the sections highlighted below in Figure 15-4. However, the absolute traffic noise level along this route at 10m from the road edge is of the order of 45 dB L_{Aeq} indicating a low noise impact in the opening year.

Figure 15-4: 2035 Operational Traffic Noise Lanesborough Park and Lanesborough Drive

M50 Slip Junction 5: Noise levels along the slip road onto the M50 at Junction 5 rise by the order of 5dB, from 60 to 65dB at 10m from the road edge, this section is highlighted below in Figure 15-5. At this location nearby buildings are commercial in nature and less sensitive to noise increases. Therefore, the impact is not considered significant.

Figure 15-5: 2035 Operational Traffic Noise M50 Junction 5 Slip Road

2050 – Do Minimum v Do Something – Operational Traffic

For the year 2050, 94.3% of road links experience a change in noise level of less than 3dB. For these road links reference to the criteria in Table 15-18 indicates that the predicted effect in relation to operational traffic noise in the short term is negative, long term and not significant.

There are fifteen road links within the study area of the proposed Scheme which are identified to experience an increase in noise level ranging from 3 to 9dB as a result of operational traffic in the opening year. The calculated traffic noise level is between 35 and 61dB L_{Aeq} at a distance of 10m from the road edge. This distance has been selected as being representative of the closest NSLs to the road. Considering the absolute traffic noise level in the context of the baseline noise environment it is concluded that the resulting impact is not significant along these roads.

Further information on the location of road links that experience an increase in noise is presented below.

Casement Drive: Noise levels at five road links within the Casement Drive area of the proposed Scheme rise by 3 to 8 dB along the sections highlighted in Figure 15-3. The Do Something absolute noise level at 10m from the road edge is in the range of 46 to 53dB L_{Aeq} at four of the links which indicates the noise impact is not significant. For the section between Barry Road and Casement Drive the absolute noise level at 10m from the road edge is 56dB L_{Aeq} which is slightly above the absolute threshold of 55dB L_{Aeq}. Taking everything into account within this area, the predicted effect in relation to operational traffic noise for the year 2050 is negative, long term and not significant.

Lanesborough Park and Lanesborough Drive: Noise levels at two road links within the Lanesborough Park and Lanesborough Drive area of the proposed Scheme rise by the order of 5dB along the sections highlighted in Figure 15-4. The Do Something absolute noise level at 10m from the road edge is less than

55dB in this area which indicates the noise impact is not significant. Within this area the predicted effect in relation to operational traffic noise for the year 2050 is negative, long term and not significant.

M50 Slip Junction 5: Noise levels along the slip road onto the M50 at Junction 5 rise by the order of 3dB, from 61 to 64dB, this section is highlighted in Figure 15-5. At this location nearby buildings are commercial in nature and less sensitive to noise increases. Therefore, the impact is not considered significant.

Beneavin Road: Noise levels at Beneavin Road rise by the order of 4dB along two road links at the sections highlighted below in Figure 15-6. The Do Something absolute noise level at 10m from the road edge is less than 55dB in this area which indicates the noise impact is not significant.

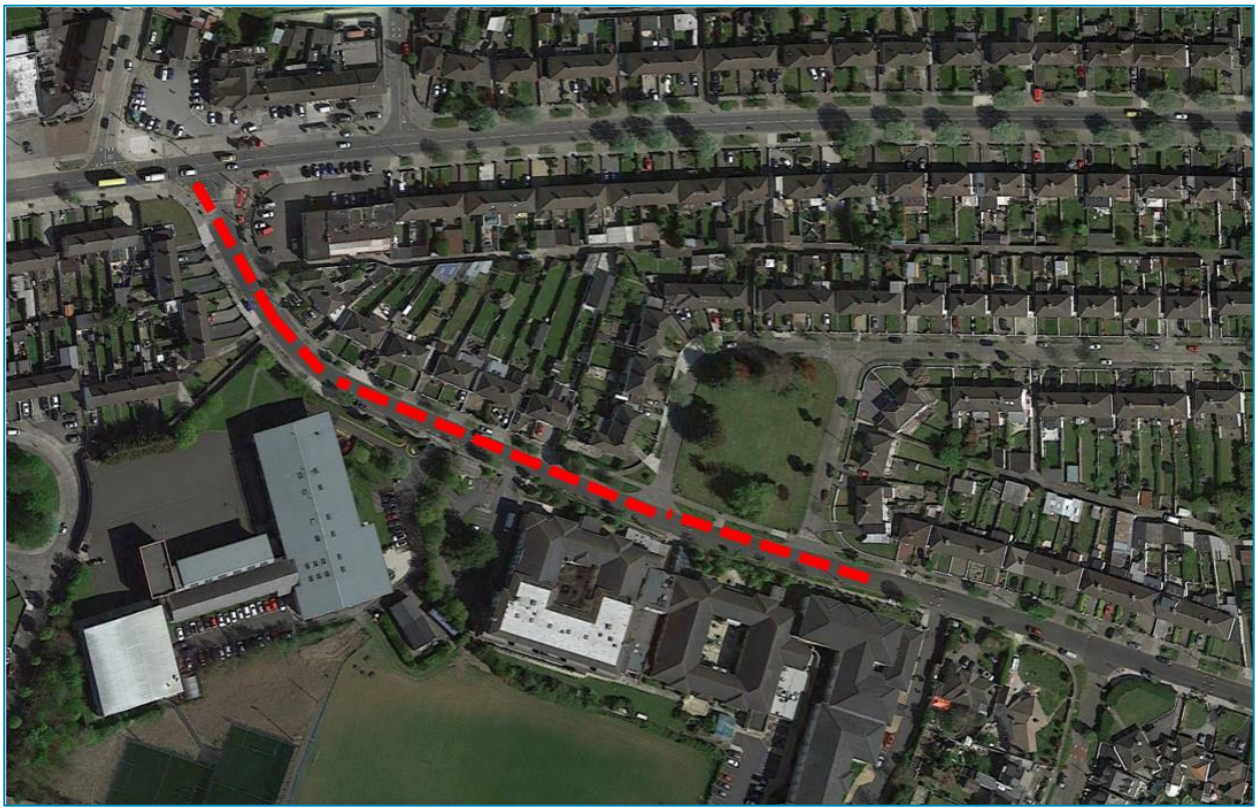


Figure 15-6: 2050 Operational Traffic Noise Beneavin Road

Ballygall Road West: Noise levels along Ballygall Road West rise by the order of 3dB along the sections highlighted below in Figure 15-7. The Do Something absolute noise level at 10m from the road edge is of the order of 46dB L_{Aeq} in this area which indicates the noise impact is not significant.

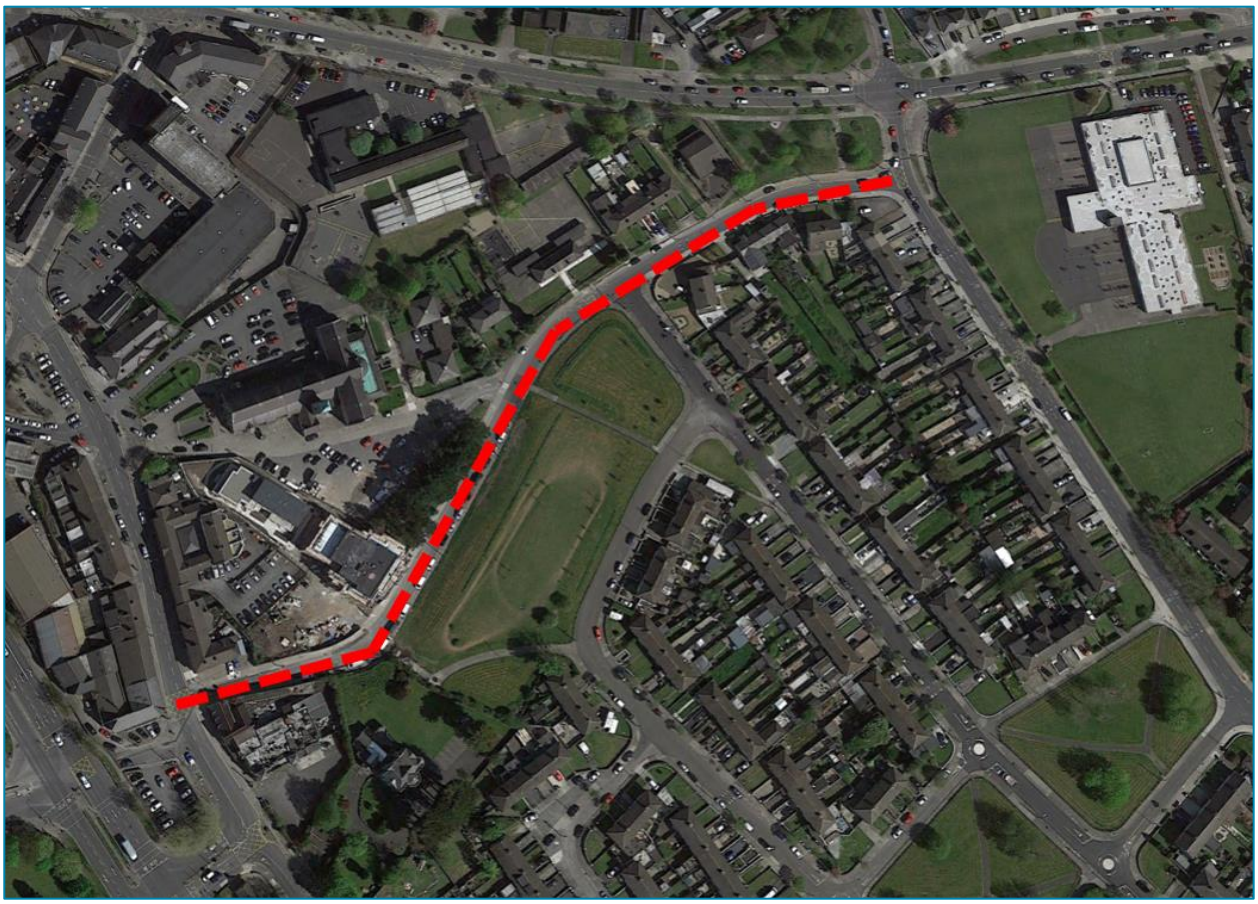


Figure 15-7: 2050 Operational Traffic Noise Ballygall Road West

Grove Park Road and Grove Park Avenue: Noise levels along Grove Park Road and Grove Park Avenue are predicted to rise by the order of between 3 and 5dB along the sections highlighted below in Figure 15-8. The Do Something absolute noise level at 10m from the road edge is less than 55dB L_{Aeq} in this area which indicates the noise impact is not significant.

Figure 15-8: 2050 Operational Traffic Noise Grove Park Road and Grove Park Avenue

Sycamore Park: Noise levels along Sycamore Park are predicted to rise by the order of 9dB along the sections highlighted below in Figure 15-9. The Do Something absolute noise level at 10m from the road edge is less than 46dB L_{Aeq} in this area which indicates the noise impact is not significant.

Figure 15-9: 2050 Operational Traffic Noise Sycamore Park

Assessment of Operational Noise from Luas Broombridge Hamilton Depot

The existing depot at Broombridge is being retained and additional stabling will be constructed. The extended stabling area consists of three ballasted tracks and a fourth embedded track lane to facilitate vehicular access. The stabling area will have provision for eight LRVs.

Noise impacts from the extended stabling area are not expected to be significant. Light rail vehicle storage at the additional stabling is located away from existing sensitive receptors and, when stabled, noise generating activity is minimal. Furthermore, noise and vibration from rail crossovers points / tracks / turnbacks is not significant given the low speed of LRVs in this area and the distance from the additional stabling area to nearby sensitive receptors.

15.5 Mitigation and Monitoring Measures

15.5.1 Construction Phase

The proposed Scheme has, where possible, designed a construction programme to avoid and reduce environmental impacts as is best practicable. Mitigation measures set out in this Section are those additional measures which are deemed necessary to further reduce identified negative impacts.

A Construction Environmental Management Plan (CEMP) has been prepared and is included as Volume 5 – Appendix A6.1. A Construction Noise and Vibration Management Plant (CNVMP) is contained in Section 1.8.5 of the CEMP. The CEMP is a dynamic document, and the appointed contractor(s) will ensure that it remains up to date for the duration of the construction period. The CEMP may need to be altered during the lifecycle of the construction period to take account of monitoring results, legislative changes, outcomes of third-party consultations, etc. Additional appendices may be added to the CEMP to accommodate monitoring results, permits, etc. However, the finalisation of the CEMP by the appointed contractor(s) will not affect the robustness and adequacy of the information presented here and relied upon in this EIAR.

In addition to the various measures detailed in the CEMP, the following sections outline the noise mitigation measures required across the proposed Scheme in order to control airborne noise impacts during the Construction Phase.

Reference is made to the experience of constructing previous Luas projects in Dublin. Specifically, the construction of the extension to the Luas Green Line between 2013 and 2017 can be used as a benchmark for lessons learnt and to promote effective noise management and mitigation strategies during construction.

15.5.1.1 Noise

The main principles and standards required for noise mitigation are outlined as follows:

- The Contractor undertaking the construction of the works will be required to take specific noise abatement measures to the extent required and comply with the recommendations of BS 5228–1 (BS 5228-1, 2014);
- The Contractor will undertake a reassessment of noise levels once further information is available as part of the identification of mitigation measures. This will include details of all anticipated out of core hours work;
- The selection of plant items will be required to comply and European Communities Noise Emissions by Equipment for Use Outdoors (Amendment) Regulations 2006 (EC, 2006);
- The Contractor will prepare an updated CNVMP which will be formulated for the Construction Phase and used by all contractors based on the mitigation measures outlined in this chapter, and the CEMP. The CNVMP will be a live document; and
- As part of the CNVMP, a baseline noise study will be undertaken prior to the commencement of construction works in order to characterise the prevailing noise environment at impacted NSLs. This information will be used to inform the relevant CNTs.

The key principles relating to noise mitigation will be applied across all construction activities for the proposed Scheme:

- Noise control at Source: Selection of quiet plant, site layout, attenuation at source, operational control (hours and periods); and
- Noise Control along Pathway: Localised screening to plant items on site, enclosures, site buildings, site hoarding and noise barriers.

The impact assessment has identified that mitigation measures are required across the proposed Scheme to control construction noise impacts. The approach for mitigation will follow the construction noise control hierarchy as above. BS 5228–1 (BS 5228-1, 2014) includes guidance on these measures which are set out briefly in the following paragraphs.

Note that the mitigation measures specified here are also part of the CEMP.

Selection of Quiet Plant

The potential for any item of plant to result in exceedance of construction noise thresholds will be assessed prior to the item being brought onto the site. The least noisy item of plant will be selected wherever practicable (e.g. plant items with sound attenuation incorporated). Should a particular item of plant already onsite be found to exceed the construction noise thresholds, the first action will be to identify whether the item can be replaced with a quieter alternative.

The Contractor will evaluate the choice of piling, excavation, breaking or other working methods taking into account various ground conditions and site constraints. Where alternative lower noise generating equipment that would economically achieve, in the given ground conditions, equivalent structural/excavation/breaking results, these will be selected to control noise emissions, where deemed feasible.

The use of non-percussive piling methodologies will be used where possible across the proposed Scheme to control noise and vibration impacts.

Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, noise control “at source” will be followed. This refers to the modification of an item of plant, or the application of improved sound reduction methods in consultation with the supplier or the best practice use of equipment and materials handling to reduce noise. Proposed techniques will also be evaluated considering their potential effect on occupational health and safety. The following guidance relates to practical noise control at source techniques which relate to specific site considerations:

- For static plant such as compressors, generators, motors and pumps within each construction compound, the units will be surrounded by acoustic lagging or have acoustic enclosures providing air ventilation, as required, to ensure CNTs are not exceeded, particularly if required at night;
- Where practicable, equipment powered by mains electricity shall be used in preference to equipment powered by internal combustion engines or locally generated electricity;
- For mobile plant items such as dump trucks, cranes, excavators and loaders, the installation of an acoustic exhaust, utilizing an acoustic canopy to replace the normal engine cover and/or maintaining enclosure panels closed during operation can be used to reduce noise levels by up to 10dB;
- Reverse alarms from mobile plant within construction compounds, will be broadband to reduce tonal elements from this source;
- For piling plant, noise reduction can be achieved by enclosing the driving system in an acoustic shroud. For steady continuous noise, such as that generated by diesel engines, it is possible to reduce the noise emitted by fitting a more effective exhaust silencer system or utilising an acoustic canopy to replace the normal engine cover;
- Mobile and stationary plant will be switched off or throttled back to a minimum when not in use (engines, motors and generators). Lorries, trucks and concrete vehicles will not be permitted to queue outside site compounds with engines left idling;

- For percussive tools such as pneumatic concrete breakers and tools used for utility diversion works and surface level ground breaking for track construction, a number of noise control measures include fitting a muffler or sound reducing equipment to the breaker 'tool', and ensuring any leaks in the air lines are sealed;
- For all materials handling within compounds, the Contractor will ensure that best practice site noise control measures are implemented including ensuring that materials are not dropped from excessive heights and drop chutes / dump trucks are lined with resilient materials. This is an important consideration for site compounds where materials are loaded and unloaded;
- Resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can be controlled by fixing resilient materials in between the surfaces in contact;
- All items of plant will be subject to regular maintenance. All vehicles and mechanical plant will be maintained in good working order for the duration of the contract. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures; and
- The impact from works will be controlled using the best practicable means set out above and restricting significant noise and vibration generating activities to daytime hours where possible.

Construction Working - Hours of Work

From a consideration of construction working hours, a number of points arise:

- One of the key principles relating to control of noise impacts from construction relates to the periods and hours during which the construction works will take place. The construction working hours for the proposed Scheme are set out in Table 15-25;
- The proposed construction working hours are mostly limited to daytime hours only from Monday to Friday and to Saturday morning periods. This approach assists with limiting the duration over which NSLs are exposed to construction noise impacts;
- It will be necessary to work overtime (including weekends) and night shifts at certain critical stages during the project, e.g. during works adjacent to live rail lines at Broombridge and some road works;
- Activities will be scheduled in a manner that reflects the location of the site and the nature of NSLs. Construction activities/plant items will be considered with respect to their potential to exceed CNTs at NSLs and will be scheduled according to their noise level, proximity to sensitive locations and possible options for noise control; and
- For work areas where night-time activities will be required, as far as practicable, activities with highest noise emissions will be scheduled during daytime periods and/or daytime shifts will set up the relevant sites for night-time periods to avoid unnecessary use of mobile plant, cranes, and material handling to occur during night-time periods.

Screening

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

Given the linear nature of the works, it is likely that a standard construction hoarding will not be practical for many locations. Previously on Luas Green Line, the use of temporary mobile noise screens was a successful measure to screen the works. It is proposed that a similar strategy be adopted for the proposed Scheme.

BS 5228–1 (BS 5228-1, 2014) states that on level sites the screen should be placed as close as possible to either the source or the receiver. The construction of the barrier will be such that there are no gaps or openings at joints in the screen material. In most practical situations the effectiveness of the screen is limited by the sound transmission over the top of the barrier rather than the transmission through the barrier itself. In practice, screens constructed of materials with a mass per unit of surface area greater than 10kg/m^2 will give adequate sound insulation performance.

Consultation with Stakeholders

A key lesson learned from the Luas Green Line project was the importance of thorough consultation with all stakeholders. The following measures should be adopted:

- The proposed Scheme team including Employer, Contractor and Local Authorities will engage in regular meetings to discuss the approach to noise management during construction;
- A particular emphasis should be placed on the risk of noise impacts during any out of hours work;
- The Contractor will provide proactive community relations and will notify the public and vibration sensitive premises before the commencement of any works forecast to generate appreciable levels of noise or vibration, explaining the nature and duration of the works;
- The Contractor will distribute information circulars informing people of the progress of works and any likely periods of significant noise and vibration; and
- A designated noise liaison officer will be appointed to site during construction works. All noise complaints will be logged and followed up in a prompt fashion by the liaison officer.

Monitoring

During the Construction Phase, the Contractor will be required to carry out noise and vibration monitoring at representative NSLs to evaluate and inform the requirement and/or implementation of noise and or vibration management measures.

A full monitoring and auditing programme will form part of the CNVMP which will be agreed with the Local Authorities prior to the commencement of the Construction Phase. At a minimum, the monitoring programme will include an alert system for threshold exceedances, remote access and a platform for sharing monitoring results between the contractor, TII and DCC.

Note that it will be important to ensure that the monitoring regime accurately captures the baseline environment prior to construction beginning. Once construction work begins the monitoring will capture total noise from both construction and other environmental noise sources, e.g. traffic. It will therefore be necessary to use the baseline noise measurements to accurately assess the contribution of construction to the total noise.

15.5.1.2 Construction Traffic

Mitigation measures to reduce noise from construction traffic are limited to restricting speed limits, maintaining road surfaces and ensuring that all vehicles are properly maintained. In addition, any coverings on construction vehicles will be securely fastened before leaving site to avoid excessive ‘rattling’.

15.5.1.3 Construction Vibration

The vibration from construction activities will be limited to the values set out within Section 15.2.4.5. Limit values have been provided for the following building types:

- Residential and commercial properties of sound construction; and
- Protected structures and sensitive buildings such as those with no or minimal foundations.

It is understood that bored piling is to be used and this is a piling method which generates relatively low levels of vibration. Notwithstanding this, consideration should be given to the following methods to further mitigate the vibration levels:

- Minimise obstructions between the vibration source and the sensitive receiver, e.g. old basement floors, old foundations etc., which exacerbate the transmission of vibration; and
- Reduce the resistance to bored piles by “mudding in”. This technique involves lubricating the borehole with a small amount of bentonite slurry.

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

- A clear communication programme will be established by TII to inform adjacent building occupants in advance of any potential intrusive works which may give rise to vibration levels likely to result in significant effects as per Table 15-13. The nature and duration of the works will be clearly set out in all communication circulars as necessary;
- Activities capable of generating significant vibration effects with respect to human response (per Table 15-13) will be restricted to daytime hours only; and
- Appropriate vibration isolation shall be applied to plant (such as resilient mounts to pumps and generators), where required and where feasible.

15.5.2 Operational Phase

15.5.2.1 Rail Noise

Noise mitigation is required at St Helena's Childcare Centre. Mitigation measures will be included to reduce noise at the identified NSLs in this area.

A new solid sound boundary treatment is to be installed, with a minimum height of 2.25m and at the western edge of the St Helena's Childcare Centre, per Figure 15-10. The boundary treatment will be constructed from a suitable dense material such as masonry or solid timber fencing, offering suitable sound attenuation.

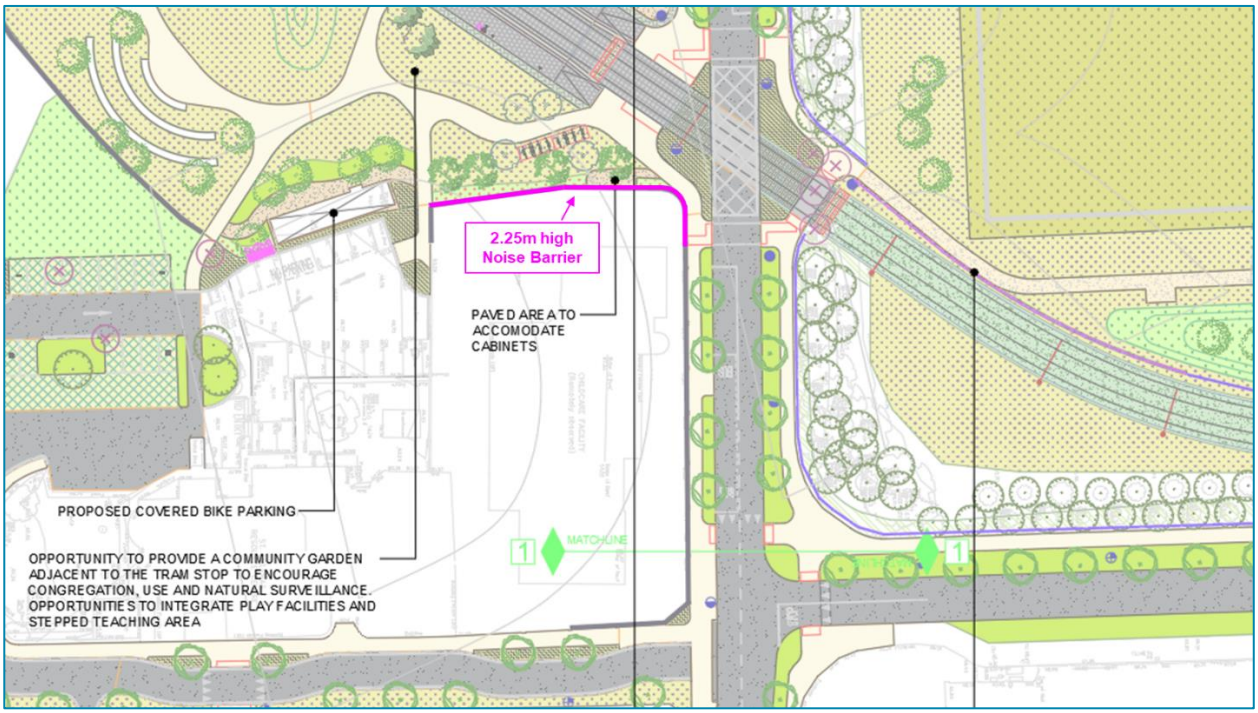


Figure 15-10: Extent of proposed Noise Barrier at St Helena's Childcare Centre

The range of allowable noise levels from each fixed source set will ensure that any impact will not be significant. The best practice measures outlined in the succeeding sections will be considered during the detailed design.

15.5.2.2 Rail Corrugation and Squeal

Noise mitigation in the form of barriers has been discussed in Section 15.5.2.1 for specific areas where noise thresholds were exceeded. However, there are other system-wide factors that influence the noise level generated during the operation. The majority of other factors are related to maintenance & operation criteria (LRV age, rail corrugation, LRV breaks) and engineering restrictions (track alignment, speed) etc.

A significant contribution to rail generated noise is from rail and wheel roughness. Once a rail has reached an unacceptable level of roughness, the remedy is to grind its surface. Grinding is carried out for a number of reasons by railway administrations. "Preventive grinding" delays corrugation initiation by removing

irregularities that could cause the problem. “Corrective grinding” removes discrete rail head damage, and corrugation, restores the transverse profile and improves the geometry of welds.

In addition, there are some sections of the track for the proposed Scheme where the radius of curvature of the track would present a risk of squeal noise and higher levels of vibration being generated. They are:

- Broombridge Stop to Broombridge Overbridge; and
- Approaches in both directions to Finglas Village Stop.

As part of the rail maintenance programme, rail lubrication at these locations is recommended to minimise the risk and magnitude of any squeal noise generated. This is provided by on-board lubrication systems aboard all Luas fleet, both existing and proposed.

A floating slab track detail is also being provided in the area approaching the Finglas Village Stop to mitigate the risk of vibration transfer to buildings in closest proximity to the track. The floating slab track reduces the transmission of vibration by incorporating a floating slab mat between the track slab and the surrounding structural slab. Figure 15-11 illustrates the principal of this mitigation and Figure 15-12 exhibits the extent of this measure on the proposed Scheme.

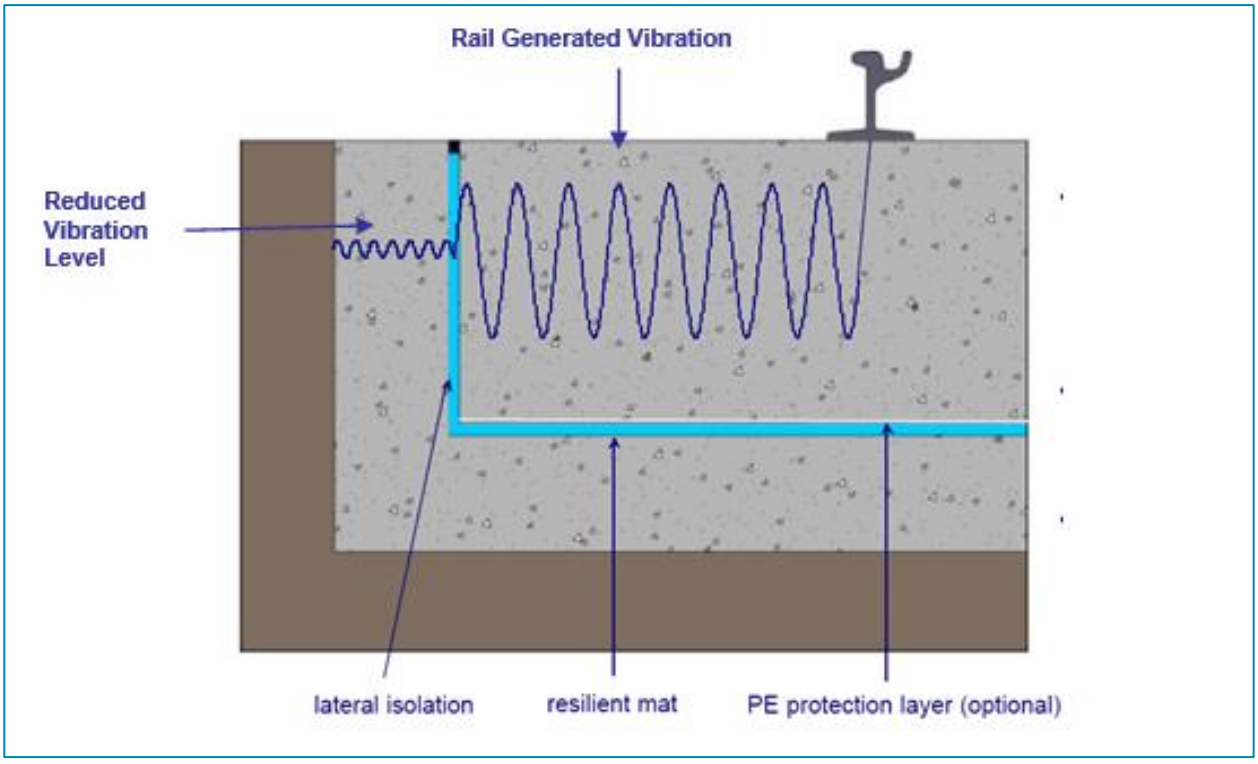


Figure 15-11: Floating Slab Principle

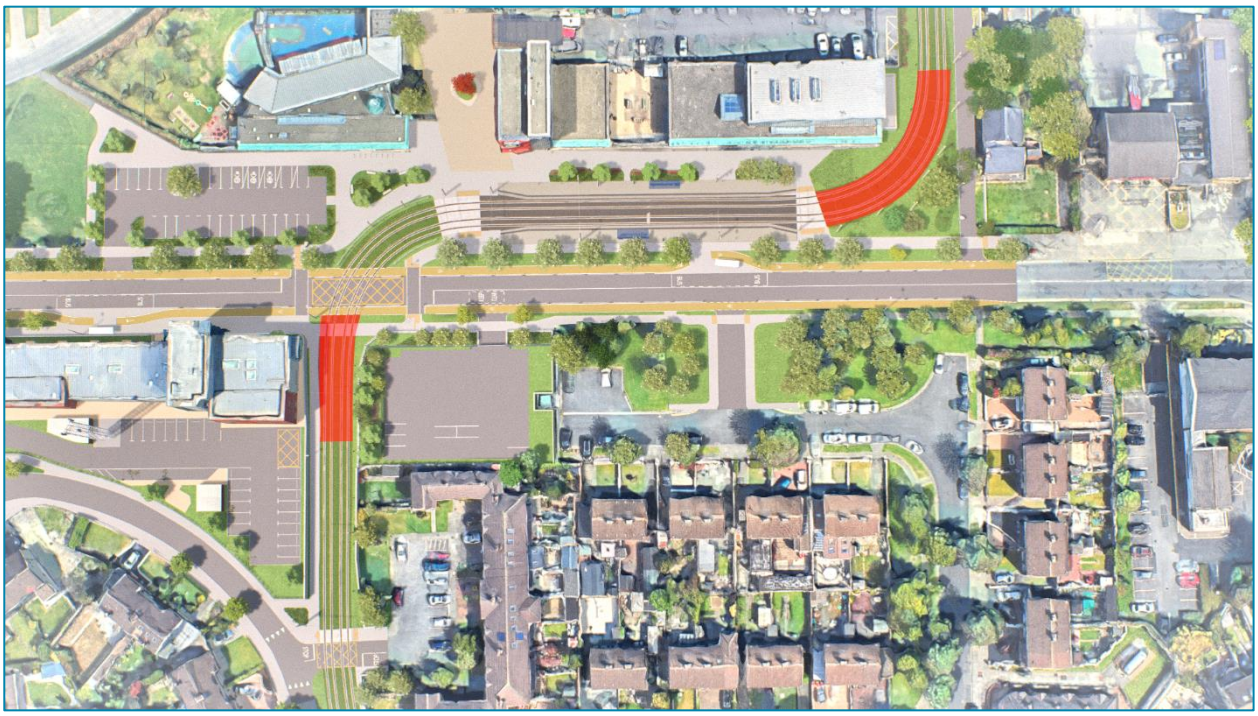


Figure 15-12: Extent of Floating Slab Track (in red)

Assuming the measures detailed above are taken into consideration during the track design and operation, the impact of rail noise corrugation, vibration and squeal can be minimised.

15.5.2.3 Railway Maintenance

Where rail maintenance activities are scheduled over night-time periods along the proposed Scheme alignment, advance notice will be provided to affected residents providing notification of the dates and durations of the planned works.

15.6 Residual Impacts

15.6.1 Introduction

The residual impacts are those which take account of the proposed mitigation measures. These are discussed in the following sections.

15.6.2 Construction Phase

15.6.2.1 Construction Noise

Construction Phase noise calculations have been updated to include for localised screening. Refer to Table 15-39 below. The measures included in the mitigated scenarios are those which are deemed practicable and can be defined as part of this assessment.

It is noted, the mitigated calculations do not take account of other various measures set out in BS 5228-1 (BS 5228-1, 2014) and summarised in section 15.5.1.1. They include selection of quieter plant, control of noise at source and ongoing day-to-day best practice mitigation measures which control overall noise emissions from construction sites.

A conservative assessment has applied a reduction of 5 dB to construction noise calculations to account for the level of noise reduction available by applying by the various noise mitigation measured outlined above. For the range of mitigation measures available and discussed in 15.5.1.1, construction noise levels can readily be reduced by 10dB for high noise activities. A higher level of mitigation is allowed for at St Helena's Childcare taking into account the construction of noise barrier boundary at that location as described in section 15.5.2.1.

Table 15-39: Calculated Residual Construction Noise Levels at Sensitive Locations Post Mitigation

Receiver Name	Location	Construction Noise Threshold	Predicted Residual Construction Noise Level Post Mitigation, dB $L_{Aeq,T}$											
			Demolition Works	Boundary Wall	Drainage and Utility Works	Earthworks	Road Construction	Principal Structure Works Royal Canal	Principal Structure Works Tolka Valley	Park & Ride	Substation Works	Track Works	OCS Works	Stops and Surface Works
CNR01	Broombridge Educate Together	70	63	57	61	59	60	58	--	--	--	60	55	58
CNR02	Hamilton Square	70	--	62	66	64	65	69	--	--	--	65	60	63
CNR03	Tolka Valley Park	65	--	58	61	60	61	--	55	--	--	61	56	59
CNR04	Carrigallen Drive	65	--	62	66	64	65	--	--	--	--	66	60	63
CNR05	Barnmore Grove	65	--	58	61	60	60	--	--	--	--	61	56	59
CNR06	St Helena's Court	65	--	65	68	67	67	--	--	--	--	68	63	66
CNR07	St Helena's Childcare Centre	65	--	71*	68	67	67	--	--	--	--	68	63	66
CNR08	Dunsink Road	70	--	50	54	52	53	--	--	--	--	54	48	51
CNR09	Erin's Isle	70	--	50	54	53	54	--	--	--	--	55	49	52
CNR10	Farnham Crescent	65	--	65	68	67	67	--	--	--	--	68	63	66
CNR11	Casement Road	65	--	61	65	63	64	--	--	--	--	65	59	62
CNR12	Wellmount Parade	65	--	64	67	66	67	--	--	--	--	67	62	65
CNR13	Assumption Convent	65	--	63	66	65	65	--	--	--	--	66	61	64

Receiver Name	Location	Construction Noise Threshold	Predicted Residual Construction Noise Level Post Mitigation, dB $L_{Aeq,T}$											
			Demolition Works	Boundary Wall	Drainage and Utility Works	Earthworks	Road Construction	Principal Structure Works Royal Canal	Principal Structure Works Tolka Valley	Park & Ride	Substation Works	Track Works	OCS Works	Stops and Surface Works
CNR14	Aylward Green	65	--	67	70	69	69	--	--	--	--	70	64	67
CNR15	Cardiff Castle Road	65	75	71	74	73	73	--	--	--	--	74	67	71
CNR16	Mellowes Court	65	61	64	67	66	67	--	--	--	--	67	62	65
CNR17	Ravens Court	65	67	68	70	68	69	--	--	--	--	69	64	67
CNR18	Finglas Garda Station	75	83	75	79	77	78	--	--	--	58	78	73	76
CNR19	Casement Road	65	--	58	62	60	61	--	--	64	--	62	56	59
CNR20	North Road	75	66	76	79	78	78	--	--	64	68	74	69	77
CNR21	St Margaret's Road	75	--	77	81	79	80	--	--	67	--	81	75	78
CNR22	Melville Lawn	70	--	63	66	65	65	--	--	--	--	66	60	63
Note * mitigation is limited to 5dB during the boundary wall construction. The duration of the works is temporary for this phase. Post boundary wall completion significant screening will be afforded to this location														

With the residual noise levels across the construction sites, noise levels are reduced to below the CNTs in most scenarios. However, there are a few phases that will result in potentially moderate to significant impacts for temporary periods when works are immediately adjacent to sensitive properties. The residual effect of noise and vibration during construction is negative, slight to significant and temporary to short term.

15.6.3 Operational Phase

15.6.3.1 Rail Noise

Table 15-40 presents the residual rail noise levels for the year 2057 at St Helena's Childcare location including the mitigation outlined in section 15.5.2.1.

Table 15-40: Calculated Mitigated Rail Noise Levels for Each NSL

Receptor ID	Northing	Easting	Description	Daytime, dB $L_{Aeq,16hr}$	Daytime Peak Hour, dB $L_{Aeq,1hr}$	Night-time, dB L_{night}	Night-time Peak Hour, dB $L_{Aeq,1hr}$	dB L_{den}
R042	713025	738317	Education	47	48	42	46	50
R044	713031	738326	Education	54	55	49	53	57

With the inclusion of the noise mitigation measures, the daytime $L_{Aeq,16hr}$ and daytime peak $L_{Aeq,1hr}$ values are less than or equal to the threshold of significance at all residential or educational receptors. The resultant residual impact is assessed to be negative, not significant and long term.

The assessment indicates that with mitigation rail noise impacts are reduced to negative, slight and long term at all residential locations when assessed over the full day and night periods as well as during peak hour periods.

A negative, slight to moderate but not significant and long-term impact is calculated at other non-residential locations adjacent to the proposed Scheme alignment, however, no mitigation is required as there are no significant impacts at these locations.

15.6.3.2 Commentary on Rail Noise Levels against WHO (2018) Guidance

In terms of potential health effects discussed in the WHO 2018 document, the potential for occupants of buildings to be highly annoyed (HA) or highly sleep disturbed (HSD) due to a noise source is outlined.

The residual impact assessment results discussed in Section 15.6.3.1 indicate that 50 assessment locations, of which only 20 are residential or educational NSLs, exceed the WHO recommended rail noise threshold of 54dB $L_{den.}$ For these most sensitive residential receptors, the pre-existing baseline levels are such that the rail noise level is not contributing any significant amount to the overall noise environment. As a result, it is concluded that the risk of there being a significant increase in those highly annoyed by noise is low.

Twenty-six (26) NSLs with night-time sensitivity exceed the WHO night-time recommended rail noise threshold of 44dB L_{night}. The calculated noise levels range between 45 and 54dB L_{night} at these locations. Those above 45dB L_{night} are discussed and confirmed that when added to the prevailing ambient noise environment, the impact is slight. Refer to Table 15-36.

The calculated rail noise levels across the proposed Scheme are therefore not significant in terms of any widespread community disturbance and results in a not significant to slight impact when added to the prevailing noise environment.

15.6.3.3 Noise from People Accessing Stops

Residual noise impacts at the closest NSLs to the Stops as a result of pedestrian activity are negative, slight but not significant and long term.

15.6.3.4 Park & Ride

Residual noise impacts at the closest NSLs to the Park & Ride are negative, slight but not significant and long term.

15.6.3.5 Operational Noise from Substations and LRT Stop Cubicles

The range of operational noise levels from each fixed source will be controlled in accordance with best practice guidance to control significant noise impacts. The residual impacts are negative, slight but not significant and long term.

15.6.3.6 Maintenance of Railway System

The range of operational noise levels from ongoing maintenance will be controlled in accordance with best practice guidance to control significant noise impacts. When impacts do occur the duration of the maintenance activity is expected to be measured in hours. The residual impacts are negative, slight to moderate but not significant and brief.

15.6.3.7 Noise from Additional Road Traffic on Surrounding Roads

Residual noise impacts due to changes to road traffic on the local road network are long-term, negative and not significant impact.

15.7 Cumulative Impacts

The cumulative assessment of relevant plans and projects has been undertaken separately in Chapter 24 of this EIAR.

15.8 Difficulties Encountered in Compiling Information

No difficulties were encountered during the preparation of this chapter.

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