Chapter 09
Noise & Vibration

Contents

9. Noise & Vibration

9.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has considered the potential noise and vibration impacts associated with the Construction and Operational Phases of the Kimmage to City Centre Core Bus Corridor Scheme (hereafter referred to as the Proposed Scheme).

During the Construction Phase, the potential noise and vibration impacts associated with the development of the Proposed Scheme are assessed. This included construction activities such as utility diversions, road resurfacing and road realignments as well as construction traffic construction access routes.

During the Operational Phase, the potential noise and vibration impacts associated with altered traffic flows along the Proposed Scheme, realigned traffic lanes and displaced traffic flows are assessed.

The assessment is carried out according to best practice standards and guidelines relating to environmental noise and vibration.

The aim of the Proposed Scheme, when in operation, is to provide enhanced walking, cycling and bus infrastructure on this key access corridor in the Dublin Region, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the corridor. The objectives of the Bus Connects Dublin – Core Bus Corridor Infrastructure Works (hereafter referred to as the CBC Infrastructure Works), applicable to the Proposed Scheme are described in Chapter 1 (Introduction). The Proposed Scheme, which is described in Chapter 4 (Proposed Scheme Description) has been designed to meet these objectives.

The design of the Proposed Scheme has evolved through comprehensive design iteration, with particular emphasis on minimising the potential for environmental impacts, where practicable, whilst ensuring the objectives of the Proposed Scheme are attained. In addition, feedback received from the comprehensive consultation programme undertaken throughout the option selection and design development process have been incorporated, where appropriate.

9.2 Methodology

The assessment has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out in the following sections of this Chapter.

An overview of the methodology undertaken for this noise and vibration impact assessment is outlined below:

- A detailed baseline noise study has been undertaken in order to characterise the baseline environment at areas most likely to be affected by noise associated with the Proposed Scheme. This has been undertaken through a review of available published data and site-specific noise monitoring at noise sensitive locations (NSLs) along the Proposed Scheme;
- Baseline vibration monitoring has been undertaken at representative locations along the existing road network to characterise baseline vibration levels associated with traffic flows;
- A review of the most applicable standards and guidelines has been undertaken in order to set a range of acceptable noise and vibration criteria for the Construction and Operational Phases of the Proposed Scheme;
- Predictive calculations and impact assessments relating to the likely Construction Phase noise and vibration impacts have been undertaken at the NSLs to the construction work areas associated with the Proposed Scheme;
- Predictive calculations have been performed to assess the potential noise impacts associated with traffic alterations associated with the operation of the Proposed Scheme at the most sensitive locations; and
- A schedule of mitigation measures has been incorporated to reduce, where necessary, the identified potential noise and vibration impacts associated with the Proposed Scheme.

9.2.1 Study Area

The study area for this assessment covers the length of the Proposed Scheme, approximately 3.7 kilometres (km) from Lower Kimmage Road at the junction with the R818 on Terenure Road West, Kimmage Road West and R817 Fortfield Road, continuing along R817 Kimmage Road Lower towards the City Centre, via the R137 on Harold's Cross Road, Clanbrassil Street Upper and Lower and New Street South until the junction of New Street South / Patrick Street / Kevin Street Upper, and the area either side of the Proposed Scheme (and other diverted routes) up to a maximum distance of 300m during the Construction Phase and extending out to 1km from the Proposed Scheme boundary during the Operational Phase. The study area for potential noise and vibration impacts during both Construction and Operational Phases relate to areas of potentially impacted NSLs, which include areas where people spend significant periods of time and where concentration, sleep and amenity are important considerations. Examples of these NSLs include residential dwellings, schools and other educational establishments, hospitals and nursing homes, hotels and other short-term accommodation buildings, buildings of religious sensitivity, recreational and noise sensitive amenity areas and offices. Vibration sensitive locations (VSLs) include buildings with vibration sensitive equipment (sensitive equipment within laboratories, highly sensitive medical equipment etc.) and structures that are structurally unsound.

For the Construction Phase, the assessment of the study area is focused on NSLs and VSLs adjacent to the works required to construct the Proposed Scheme, e.g., utility diversions, road widening works, road excavation works (where required), road reconfiguration and resurfacing works, construction of Bus Gates on Kimmage Road Lower to the North of the Ravensdale Park junction, on Kimmage Road Lower at the Harold's Cross Road Junction, on Harold's Cross Road North and on Kenilworth Square North at Harold's Cross Road Junction, and construction traffic access routes within the study area. The extent of the overall study area is typically up to 300m from a specific area of construction work with the key impacted study areas focused within 50m to 100m depending on the noise and vibration sources in question and the local area under consideration.

For the Operational Phase, the focus of the assessment is on NSLs and VSLs which bound the Proposed Scheme and those along diverted traffic routes. Potential noise impacts relate to alterations to traffic patterns (e.g. introduction of a new bus lane), with particular attention focused on those areas where the Proposed Scheme will be encroaching closer to NSLs, specifically where bus or traffic lanes are moving closer to noise sensitive areas in addition to roads where traffic is displaced onto, resulting in potential increased traffic noise levels.

The key impacted study areas for the Operational Phase will be focused within 50m to 100m of the Proposed Scheme and roads affected by redistributed traffic which captures those locations where potential significant impacts can occur. Roads modelled as part of the Transport Impact Assessment (TIA) within 1km of the Proposed Scheme have been included in the noise impact assessment study area for the Operational Phase assessment. The range of noise and vibration sensitive locations along the Proposed Scheme for the three geographic sections are discussed in Table 9.1.

Table 9.1: Description of NSLs Across the Study Area

Geographical Section	Description of Study Area
Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road	The key noise and vibration sensitive receptors are residential receptors lining the R817 Kimmage Road Lower, within 50m of the road edge. The study area also includes offices, B&B's, guesthouses and St. Gladys Private Nursing Home within 10m to 25m of the R817, amenity areas including Whelan Park and Mount Angus Park, within 100m of the R817. Religious receptors, Holy Apostles Peter and Paul Russian Orthodox Church and Mount Argus Church and Retreat between 10m and 150m to 200m of the R817 respectively.
Harold's Cross Road from Harold's Cross Park to the Grand Canal	Within this study area, the key noise and vibration sensitive areas are predominantly residential NSLs, which bound the east and west of R817 and R137 Harold's Cross Road, within 5m to 10m of the road edge. Educational receptors are within 10m to 100m of R137 Harold's Cross Road, including Leinster Park Montessori and St. Clare's Convent National School. Other noise and vibration sensitive receptors include Our Lady's Hospice and Care Services within 150m west of the R817 Kimmage Road Lower.
Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction	Within this study area, the key noise and vibration sensitive areas are predominately residential dwellings, which are located between 10m to 20m to the east and west of the Proposed Scheme. The Proposed Scheme passes within 10m of Maldron Hotel along New Street South eastern road edge.

9.2.2 Relevant Guidelines, Policy and Legislation

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

- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2022a).

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) 5228-1:2009 +A1:2014 Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise (hereafter referred to as BS 5228–1) (BSI 2014a);
- BS 5228-2:2009+A:2014 Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration (hereafter referred to as BS 5228–2) (BSI 2014b);
- BS 7385: 1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration (hereafter referred to as BS 7385–2) (BSI 1993);
- BS 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings, Part 1 Vibration sources other than blasting (hereafter referred to as BS 6472–1) (BSI 2008);
- BS 8233:2014 Guidance on sound insulation and noise reduction for buildings (hereafter referred to as BS 8233) (BSI 2014c);
- United Kingdom (UK) Highways Agency (UKHA) Design Manual for Roads and Bridges (DMRB) Sustainability and Environmental Appraisal - LA 111 Noise and Vibration, Revision 2 (hereafter referred to as DMRB Noise and Vibration) (UKHA 2020);
- Dublin Local Authorities including Dublin City Council (DCC), Fingal County Council (FCC), South Dublin County Council (SDCC) and Dún Laoghaire Rathdown County Council (DLRCC) Dublin Agglomeration Third Environmental Noise Action Plan December 2018 – July 2023 (hereafter referred to as the Dublin Agglomeration NAP 2018 – 2023) (DCC; FCC; SDCC; DLRCC 2018);
- S.I. No. 549/2018 – European Communities (Environmental Noise) Regulations 2018 (hereafter referred to as the Noise Regulations);
- S.I. No. 241/2006 - European Communities Noise Emission by Equipment for Use Outdoors (Amendment) Regulations 2006;
- International Organization for Standardization (ISO) 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (hereafter referred to as ISO 9613 – 2) (ISO 1996);
- ISO 1996-1:2016 Acoustics - Description, measurement and assessment of environmental noise. Part 1: Basic quantities and assessment procedures (hereafter referred to as ISO 1996 – 1) (ISO 2016);
- ISO 1996-2:2017 - Description, measurement and assessment of environmental noise - Part 2: Determination of sound pressure levels (hereafter referred to as ISO 1996 – 2) (ISO 2017);
- Transport Infrastructure Ireland (TII) (previously National Roads Authority (NRA)) Guidelines for the Treatment of Noise and Vibration in National Road Schemes (hereafter referred to as the TII Noise Guidelines 2004) (NRA 2004);
- Good Practice Guide for the Treatment of Noise during the Planning of National Road Schemes (hereafter referred to as the TII Noise Guidelines 2014) (NRA 2014);
- The UK Department of Transport Calculation of Road Traffic Noise (hereafter referred to as the CRTN) (UK Department of Transport 1998);
- World Health Organization (WHO) Environmental Noise Guidelines for the European Region (hereafter referred to as WHO Environmental Noise Guidelines)(WHO 2018);

- Institute of Acoustics (IOA) ProPG: Planning and Noise. Professional Practice Guidance on Planning and Noise. New Residential Development. 2017. (Hereafter referred to as ProPG) (IoA 2017); and
- European Commission (EC) Joint Research Centre Institute for Health and Consumer Protection. EUR 25379 EU. Publications office of the European Union, 2012. Common Noise Assessment Methods in Europe (CNOSSOS-EU) (hereafter referred to as CNOSSOS-EU) (EC 2012).

9.2.3 Data Collection and Collation

The baseline noise and vibration environment has been characterised through a desk study of publicly available published data sources and measured noise and vibration surveys.

9.2.3.1 Desk Study

The key sources of available baseline data comprise published noise mapping studies undertaken by Córas Iompair Éireann (CIE), TII and daa (formerly Dublin Airport Authority) which feed into the Dublin Agglomeration NAP 2018 – 2023 (DCC; FCC; SDCC; DLRCC 2018). The modelled noise maps are published on the EPA Geo Portal (EPA 2022b) and include existing sources of major rail, road and aircraft noise within the Dublin Agglomeration area. This information provides a useful strategic 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 5 decibel (dB) penalty) and the L_{night} (plus a 10 dB penalty). L_{den} is calculated using the following formula, as defined within the Noise Regulations:

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

Where:

- **L_{day}** is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the day periods of a year. The 12 hour daytime period is between 07:00hrs and 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 four-hour evening period is between 19:00hrs and 23:00hrs; and
- **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 eight-hour night-time period is between 23:00hrs and 07:00hrs.

The existing mapping available is based on noise modelled data from 2016.

The relevant published noise maps are presented in Figure 9.1.1 to Figure 9.1.2, in Volume 3 of this EIAR for road traffic noise. The range of noise sources within the published contour mapping associated with road traffic, are discussed in the Section 9.3.1.

9.2.3.2 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 of the Proposed Scheme. Baseline noise measurements were undertaken using attended surveys only to inform the assessment. Attended baseline noise surveys were undertaken at a total of nine locations along the length of the Proposed Scheme during July 2020. The selection, number and type of surveys undertaken are in line with those prescribed in the TII Noise Guidelines 2004 (NRA 2004) and TII Noise Guidelines 2014 (NRA 2014) survey methodology for linear (road) projects as far as practicable, taking account of the availability of secure locations along the length of the Proposed Scheme for equipment installation.

Due to the absence of secure locations to install equipment for unattended periods (i.e., front of properties which bound the road with no secure boundary fencing) all surveys were attended. The surveys were used to supplement the available published mapped road traffic noise data published on the EPA Geo Portal (EPA 2022b).

Full details of the baseline surveys, including methodologies, survey dates, terminology and glossary, and results are included in Appendix A9.1 in Volume 4 of this EIAR.

A summary of the baseline noise monitoring positions is provided in Section 9.2.3.2.1 to Section 9.2.3.2.3. Figure 9.2 in Volume 3 of this EIAR illustrates the baseline noise monitoring locations. The monitoring survey results are discussed in Section 9.3.2.

9.2.3.2.1 Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road

A total of five locations were surveyed within this study area. The location reference and a description of survey positions are included in Table 9.2.

Table 9.2: Noise Monitoring Locations – Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road

Location	Description of Survey Location
Monitoring Locations	
CBC0011ANML001	Green area in Poddle Park to northwest of R817 Fortfield Road / R818 Kimmage Road West junction, in line with Brookfield estate facades. Located approximately 40m from R817 Kimmage Road Lower and 10m from R818 Kimmage Road West road edges.
CBC0011ANML002	On footpath on Poddle Park Road, at 100m distance from Poddle Park Road / Ravensdale Park junction.
CBC0011ANML003	On footpath to southwest of R817 Kimmage Road Lower / Sundrive Road Junction, in line with facades on R817 Kimmage Road Lower. Located approximately 10m from R817 Kimmage Road Lower road edge.
CBC0011ANML004	On footpath located to east of Mount Argus Road / Mount Argus Grove junction, in line with facades of Mount Argus Grove estate. Located approximately 13m from Mount Argus Road edge.
CBC0011ANML005	On footpath to east of R817 Kimmage Road Lower. Located approximately 45m from R817 Kimmage Road Lower / R137 Harold's Cross Road Junction and 2m from R817 Kimmage Road Lower road edge.

9.2.3.2.2 Harold's Cross Road from Harold's Cross Park to the Grand Canal

A total of two locations were surveyed within this study area. The location reference and a description of survey positions are included in Table 9.3.

Table 9.3: Noise Monitoring Locations – Harold's Cross Road from Harold's Cross Park to the Grand Canal

Location	Description of Survey Location
Monitoring Locations	
CBC0011ANML006	On footpath to north of R137 Harold's Cross Road / St. Clare's Avenue Junction, in line with closest residential facades facing onto R137 Harold's Cross Road. Located approximately 8m from R817 road edge.
CBC0011ANML007	On footpath to south of R137 Harold's Cross Road / Mound Drummond Avenue Junction, in line with residential facades facing onto R137 Harold's Cross Road. Located approximately 6m from the road edge.

9.2.3.2.3 Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction

A total of two locations were surveyed within this study area. The location reference, and a description of survey locations are included in Table 9.4.

Table 9.4: Noise Monitoring Locations – Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction

Location	Description of Survey Location
Monitoring Locations	
CBC0011ANML008	On footpath to north-west of R137 Clanbrassil Street Upper / Clanbrassil Close Junction, in line with residential properties lining the road. Located approximately 12m from the road edge.
CBC0011ANML009	On footpath to northeast of R137 Clanbrassil Street Lower / St Vincent Street South Junction, in line with residential properties facing onto the road. Located approximately 4m from the road edge.

9.2.3.3 Baseline Vibration Surveys

Attended baseline vibration surveys have been conducted as part of the overall CBC Infrastructure Works at a number of locations adjacent to existing bus lanes within Dublin City. The surveys were undertaken to obtain typical baseline vibration levels along roads with both mixed vehicular traffic lanes and individual bus lanes. This information has been used to inform the operational vibration impact assessment for the Proposed Scheme and other Proposed Schemes under the CBC Infrastructure Works.

Surveys were also undertaken along an access road to the Harristown Bus Depot, Horizon Logistics Park, Swords, Co. Dublin, to obtain a measurement of vibration relating to specific bus drive bys in isolation at a controlled sampling location to characterise the specific vibration level associated with buses in the absence of other traffic.

Full details of the survey monitoring locations, methodologies, terminology and glossary, and results are included in Appendix A9.1 in Volume 4 of this EIAR. A summary of the baseline vibration monitoring positions is provided in Table 9.5.

Table 9.5: Vibration Monitoring Locations

Location	Description of Survey Location
Vibration Monitoring Locations	
AVML001	Harristown – Entrance Road to Bus Depot, midway along inbound road, 5m from road edge
AVML002	Harristown – Roundabout at Bus Depot entrance, buses entering depot, 5m from road edge
AVML003	Harristown – Roundabout at Bus Depot entrance, buses exiting depot, 5m from road edge
AVML004	Harristown – Entrance Road to Bus Depot, midway along outbound road, 5m from road edge
AVML005	Harristown – Entrance Road to Bus Depot, midway along inbound road, 7m from road edge
AVML006	Malahide Road / St. Johns Court – 5m from edge of Inbound Bus Lane
AVML007	Malahide Road / St. Johns Court – 10m from edge of Inbound Bus Lane
AVML008	Malahide Road / Donnycarney Church – 2.5m from edge of Inbound Bus Lane
AVML009	Malahide Road– 2.5m from edge of outbound Bus Lane

The monitoring survey results are discussed in Section 9.3.3.

9.2.4 Appraisal Method for the Assessment of Impacts

The significance of impacts has been assessed in accordance with the EPA Guidelines (EPA 2022a). The relevant definitions relating to quality, significance and duration of impacts are defined as per the EPA Guidelines and are set out in Chapter 1 (Introduction) this EIAR. These have been used to define the category of impacts throughout this Chapter. The assessment of impacts is discussed in terms of a range of acoustic parameters. A full glossary of terms used within the EIAR is included in Volume 2 of this EIAR and are further discussed in Appendix A9.1 in Volume 4 of this EIAR.

The key terms discussed in the following sections are summarised as follows:

- **$L_{Aeq,T}$** is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The time period T referred to in this section include the following:
  - $L_{Aeq,16hr}$: the daytime ambient noise level between 07:00hrs and 23:00hrs;
  - $L_{Aeq,18hr}$: the daytime ambient noise level between 06:00hrs and 00:00hrs; and
  - $L_{Aeq,12hr}$: the daytime ambient noise level between 07:00hrs and 19:00hrs, which is defined as the L_{day} parameter.
- **L_{ASmax}** is the maximum root mean squared (RMS) A-weighted sound pressure level occurring within a specified time period, measured using the 'Slow' time weighting;
- **Peak Particle Velocity (PPV)** is a measure of the velocity of vibration displacement in terms of millimetres per second (mm/s). It is defined as follows within BS 7385-2 (BSI 1993) as '*the maximum instantaneous velocity of a particle at a point during a given time interval'*; and
- **Vibration Dose Value (VDV)** is an evaluation of human exposure to vibration in buildings. It defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response. It is defined as follows within BS 6472-1 (BSI 2008), as:

  'The VDV is the fourth root of the integral of the fourth power of acceleration after it has been frequency-weighted (as defined in BS6472: 2008). The frequency-weighted acceleration is measured in m/s^2 and the time period over which the VDV is measured is in seconds. This yields VDVs in $m/s^{1.75}$.'

As the EPA Guidelines (EPA 2022a) 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 to further define significance ratings. These are discussed in the following sections.

9.2.4.1 Construction Phase Appraisal of Impacts

9.2.4.1.1 Criteria for Rating Construction Noise Impacts

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 are temporary to short term and are varied over the course of the work duration.

In the absence of specific statutory guidance, reference has been made to the TII Noise Guidelines 2004 (NRA 2004), TII Noise Guidelines 2014 (NRA 2014) and BS 5228–1 (BSI 2014a) in order to review and set appropriate noise construction criteria.

9.2.4.1.1.1 <u>TII Guidelines</u>

The TII Noise Guidelines 2004 (NRA 2004) and TII Noise Guidelines 2014 (NRA 2014) specify noise levels that are deemed acceptable in terms of construction noise for national road projects. These limits have been derived for the construction of new national road projects which predominately pass through rural environments with quieter ambient noise levels compared to those in urban setting. In this instance, these limits are typically lower than those typically used for urban infrastructural projects. These limits are set out in Table 9.6.

Table 9.6: TII Construction Noise Levels (CNLs) at the Facade of Dwellings during the Construction Phase

Days and Times	Noise Levels (dB re 2 x 10-5 Pa)	
	LAeq	LASmax
Monday to Friday 07:00hrs to 19:00hrs	70	80
Monday to Friday 19:00hrs to 22:00hrs	60*	65*
Saturdays 08:00hrs to 16:30hrs	65	75
Sundays and Bank Holidays 08:00hrs to 16:30hrs	60*	65*

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

9.2.4.1.1.2 British Standard BS 5228 – 1: 2009+A1:2014

Potential noise impacts during the construction stage of a project are often assessed in accordance with BS 5228–1 (BSI 2014a). Various mechanisms are presented as examples of recommended threshold values for determining if an impact is occurring, these are discussed in the following paragraphs.

Potential Significance Based on Noise Change - ABC Method

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on the existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a potential significant noise impact is associated with the construction activities, depending on context. Table 9.7 sets out the values which, when exceeded, signify a potential significant effect at the facades of residential receptors.

Table 9.7: BS 5228-1 Example of Thresholds of Potential Significant Effect

Assessment Category and Threshold Value Period (LAeq)	Threshold Value (dB)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and Weekends (19:00 – 23:00hrs weekdays) (13:00 - 23:00hrs Saturdays) (07:00 – 23:00hrs Sundays)	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75
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.

It should be noted that this assessment method is only valid for residential properties and if applied to commercial premises without consideration of other factors may result in an excessively onerous thresholds being set.

Potential Significance Based on Fixed Noise Limits

Section E.2 of BS 5228-1 (BSI 2014a) sets out recommended threshold levels using a fixed limit value set depending on the setting of the noise environment. 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 (CNLs) may be more appropriate.

9.2.4.1.1.3 Proposed Threshold Noise Levels for Proposed Scheme

Taking into account the documents outlined above, the linear and transient nature of construction works associated with the Proposed Scheme, and making reference to the baseline noise environment, Table 9.8 sets out the Construction Noise Threshold (CNT) levels proposed for the construction stage of this development.

Table 9.8: Construction Noise Threshold (CNT) Levels for Proposed Scheme

Period over Which Criterion Applies	Location	Construction Noise Threshold (CNT) (L_{Aeq}, period)
Monday to Friday: Daytime (07:00 – 19:00hrs)	Residential properties and sensitive commercial buildings (e.g. offices) in urban areas near main roads in heavy industrial areas Rural and suburban areas away from main roads	75 dB 70 dB
Monday to Friday: Evening: (19:00 – 23:00hrs)	Residential Properties Urban and Suburban	65 dB
Monday to Friday: Night-time (23:00 – 07:00hrs)	BS 5228-1: Category A locations BS 5228-1: Category B Locations BS 5228-1: Category C Locations	45 dB 50 dB 55 dB
Saturdays (08:00 – 16:30hrs)	Residential Properties Urban and Suburban	65 dB
Sundays and Bank holidays (08:00 – 13:00hrs)	Residential Properties Urban and Suburban	60 dB

In order to assist with interpretation of CNT's, Table 9.9 includes guidance as to the likely magnitude of impact associated with construction activities, relative to the CNT. This guidance is derived from Table 3.16 of DMRB: Noise and Vibration (UKHA 2020) and adapted to include the relevant significance effects from the EPA Guidelines (EPA 2022a).

In accordance with the DMRB Noise and Vibration (UKHA 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 night in any 15 consecutive day or nights; and
- A total number of days exceeding 40 in any six consecutive months.

Table 9.9: Construction Noise Signifiance Ratings

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

The adapted DMRB guidance outlined is used to assess the predicted CNLs at NSLs and comment on the likely impacts during the construction stages.

In order to determine the relevant construction noise significance ratings in line with Table 9.9 a daytime baseline noise level of 67 dB $L_{Aeq,12\ hr}$ and an evening baseline noise level of 65 dB $L_{Aeq,4hr}$ has been used when describing construction noise significance ratings in Section 9.4.3 at the closest properties affected by the works. This is based on the measured baseline noise environment for the Proposed Scheme as set out in Section 9.3 and Appendix A9.1 in Volume 4 of this EIAR. Review of all schemes associated with the CBC Infrastructure Works confirms the average evening noise level is 2 dB lower than the daytime noise level at these distances from the Proposed Scheme.

9.2.4.1.2 Criteria for Rating Construction Traffic Noise Impacts.

In order to assist with the interpretation of construction traffic noise, Table 9.10 includes guidance as to the likely magnitude of impact associated with changes in traffic noise levels along an existing road. This is taken from Table 3.17 of the DMRB Noise and Vibration (UKHA 2020).

Table 9.10: 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 day/nights; and >40 days over six 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. Further discussion relating to road traffic noise levels and overall significance rating tables are included in Section 9.2.4.2 dealing with operational traffic noise

9.2.4.1.3 Criteria for Rating Vibration Impacts

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 PPV for construction activities.

9.2.4.1.3.1 Building Response Criteria

BS 7385 - 2 (BSI 1993) gives guidance regarding acceptable vibration in order to avoid damage to buildings. BS 5228 – 2 (BSI 2014b) 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 of time 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 to 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 (BSI 2014b) 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 ground borne disturbance. The vibration limit range for protected and historical buildings are equal to or up to 50% of those for light framed buildings, depending on their structural integrity. Where no structural defects are noted, the same limit to those for light framed buildings apply. For other structures and buildings that are determined to be potentially vulnerable to vibration due to significant structural defects, a further stringent criteria has 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 9.11 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 (BSI 2014b) 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 is set out in Table 9.11.

Table 9.11: Recommended Construction Vibration Thresholds for Buildings

Vibration Limits for Buildings (PPV) at the Closest Part of the 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
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.

9.2.4.1.3.2 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 (BSI 20148b) notes that vibration typically becomes perceptible at around 0.15mm/s to 0.3mm/s and may become disturbing or annoying at higher magnitudes.

Higher levels of vibration are typically tolerated for single events or events of short-term 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 2.5 mm/s during the daytime and the evening if those affected are aware of the time-frame and origin of the vibration.

Table 9.12 presents the significance table relating to potential impacts to building occupants during construction based on guidance from BS 5228 – 2 (BSI 2014b), DMRB Noise and Vibration (UKHA 2020). and associated EPA significance ratings.

Table 9.12: Human Response Vibration Significance Ratings

Criteria	Likely Effect (DMRB)	Significance Rating
≥10 mm/s PPV	Major	Significant to Very Significant
≥1 to <10 mm/s PPV	Moderate	Moderate to Significant
≥0.3 to <1 mm/s PPV	Minor	Not Significant to Slight
≥0.14 to 0.3mm/s PPV	Negligible	Imperceptible to Not Significant
Less than 0.14 mm/s PPV		Imperceptible

9.2.4.1.3.3 Disturbance of Particularly 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 (BSI 2014b) provides a guide of vibration sensitivities of differing types of sensitive equipment from microscopes to microelectronic manufacturing equipment. However, these ranges are generic and relate to the sensitivity of the equipment as installed, not the external facade of the building. The most advisable approach for the control of potential vibration impacts at areas of vibration sensitive equipment or processes, was to review each location on its own merit in order to determine the site-specific vibration limits taking into account any building or machinery isolation already in place. In this instance, if a receptor was identified or made known within the study area for being potentially sensitive to vibration, this area would be highlighted as one for consideration.

9.2.4.2 Operational Phase Appraisal of Impacts

9.2.4.2.1 Changes in Traffic Noise

The Proposed Scheme will be located along the existing road network which will be reconfigured and widened at specific locations to facilitate the proposed layout. Once operational, the Proposed Scheme will include a realigned road corridor comprising dedicated footpaths, cycle lanes, bus lanes, and other vehicular lanes. Given that sections the existing road network already carries traffic volumes, it is appropriate to consider the change in traffic noise level that will arise as a result of changes in traffic flow (in terms of volume and fleet mix) and the realignment of traffic lanes, where relevant.

In the absence of any Irish guidelines or standards describing the effects associated with changes in road traffic noise levels, reference has been made to the DMRB Noise and Vibration (UKHA 2020). The DMRB Noise and Vibration (UKHA 2020) document provides magnitude rating tables relating to changes in road traffic noise. The document suggests that during the year of opening the magnitude of impacts between the Do Minimum and the Do Something scenarios are likely to be greater compared to the longer term period (fifteen years post opening) when people become more habituated to the noise level 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 these assessment years, a 1 dB change between the Do Minimum and Do Something scenarios (Refer to Chapter 6 (Traffic & Transport) for full description of these modelled traffic scenarios) is the smallest that is considered perceptible. Table 9.13 summarises the potential impact associated with defined changes in traffic noise level during the short to medium periods of the Proposed Schemes operation.

Table 9.13: Significance of Change Criteria – Short to Medium Term

Change in Noise Level, dB	Short to Medium 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 at NSLs along the Proposed Scheme in the short to medium term is 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 are determined for the long-term period (i.e. between the Opening Year (2028) Do Minimum and the Design Year (2043) Do Something). For this assessment year (Design Year (2043)), a 3 dB change is the smallest that is considered to pose any notable impact when considered over the life span of the Proposed Scheme (i.e. over a long-term 15 year period between the Opening Year (2028) and the Design Year (2043)) in accordance with the DMRB Noise and Vibration (UKHA 2020) guidance document. Table 9.14 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 9.14: Significance of Change Criteria – Long-Term

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

9.2.4.2.2 Absolute Noise Levels

The absolute noise level is an important consideration when determining the response to noise levels along affected roads within the study area. This is particularly valid for locations where a 'moderate' or 'major' magnitude of change rating applies against comparably low absolute noise levels.

There are no statutory guidelines associated with road traffic noise levels in Ireland. There are no new roads associated with the Proposed Scheme and therefore application of a road traffic noise design threshold is not appropriate in this instance. Notwithstanding, it is important to provide context for the range of traffic noise levels along the Proposed Scheme which includes an extensive existing road network with varying traffic volumes and associated varying levels of road traffic noise.

The most appropriate documentation for guidance on road traffic noise level ranges across the study area is the Dublin Agglomeration NAP 2018 – 2023 (DCC; FCC; SDCC; DLRCC 2018). This document proposes the following thresholds for defining Desirable Low and Undesirable High sound levels across the Agglomeration of Dublin:

- Desirable Low: <55 dB(A) L_{day} / < 50 dB(A) L_{night}; and
- Undesirable High: >70 dB(A) L_{day} / >55 dB(A) L_{night}.

The following thresholds are also used to define a Quiet Area:

- <55 dB(A) L_{day}; and
- <45 dB(A) L_{night}.

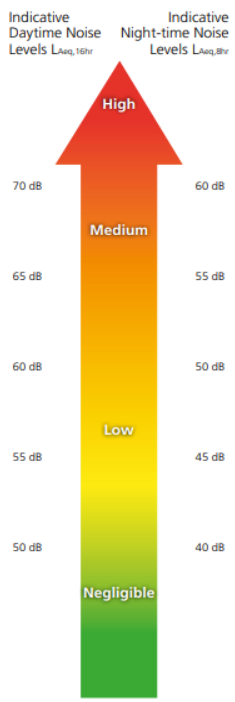
To further define noise levels between 'Desirable Low' and 'Undesirable High' reference is made to ProPG (IoA 2017). Whilst the scope of this document is used for the consideration of new residential development exposed to transport sources, the range of noise levels included provides a means of further categorising road traffic noise between the upper and lower threshold values described in the NAP with respect to noise sensitive properties.

This document categorises noise level ranges from Negligible (< 50 dB $L_{Aeq,16hr}$ /< 40 dB $L_{Aeq,8hr}$) to High (< 70 dB $L_{Aeq,16hr}$ /< 60 dB $L_{Aeq,8hr}$) in steps of 5 dB(A) to enable a site specific risk assessment for an area to be undertaken depending on its noise exposure ranges.

It is noted, the daytime period within the ProPG (IoA 2017) document is described using the $L_{Aeq,16hr}$ parameter. This is the L_{Aeq} noise level between 07:00hrs and 23:00hrs which encompasses the L_{day} (07:00hrs to 19:00hrs) and $L_{evening}$ (19:00hrs to 23:00hrs) periods as defined in Section 9.2.4. The night-time period is described using the $L_{Aeq,8hr}$ parameter, i.e. the L_{Aeq} noise level between 23:00 and 07:00hrs which is equivalent to the L_{night} in Section 9.2.3.1 and used in the Dublin Agglomeration NAP 2018 – 2023 (DCC; FCC; SDCC; DLRCC 2018).

Table 9.15 combines the threshold values from both documents to provide a combined range of noise level categories and their noise exposure levels. For the purposes of this assessment, the daytime period is defined as the $L_{Aeq,16hr}$ to capture both the L_{day} and $L_{evening}$ periods.

Table 9.15: Noise Level Ranges and Exposure Categorisation (ProPG (IoA 2017) and Dublin Agglomeration NAP 2018 - 2023 (DCC; FCC; SDCC; DLRCC 2018))



Daytime: dB $L_{Aeq,16hr}$	Night-time: dB $L_{Aeq,8hr}$	Pro PG - Noise Risk Assess Pro PG - Noise Risk Assessment	Dublin Agglomeration Noise Action Plan
>70dB	>60	High	Undesirable high day
65 – 70	55 - 60	Medium – High	Undesirable high night
60 – 65	50 - 55	Medium	
55 – 60	45 - 50	Low – Medium	Desirable Low night
<55	<45	Negligible – Low	Desirable low daytime/ Quiet area threshold day and night
<50	<40	Negligible	

Both documents define a daytime noise level below 55 dB(A) as being Low / Desirable Low, and both define daytime noise levels above 70 dB(A) as High / Undesirably High. For night-time periods, noise levels below 45 dB $L_{Aeq,8hr}$ are defined as being low with increasing magnitude of impact with higher noise levels. Night-time noise levels below 50 dB $L_{Aeq,8h}$ are defined as desirable low within the Dublin Agglomeration NAP 2018 – 2023 (DCC; FCC; SDCC; DLRCC 2018) with night-time noise levels greater than 55 dB $L_{Aeq,8h}$ as undesirable high.

As part of the noise impact assessment, consideration is given to the magnitude of change in traffic noise levels in addition to the noise level category in which a road is defined within.

WHO Environmental Noise Guidelines

The WHO Environmental Noise Guidelines (WHO 2018) provides recommendations for protecting human health from exposure to environmental noise originating from various sources. For road traffic, the WHO Environmental Noise Guidelines (WHO 2018) recommend limiting traffic noise to below 53 dB L_{den} and below 45 dB L_{night}. The recommended road traffic noise levels within the WHO Environmental Noise Guidelines are set on the basis of limiting annoyance and sleep disturbance.

The WHO Environmental Noise Guidelines, guideline values, are recommended to serve as the basis for a policy-making process, to allow public health orientated recommendations to control noise exposure within populations on a European and National level. The WHO Environmental Noise Guidelines state 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.'*

The WHO Environmental Noise Guidelines are to be considered, therefore, in the context of national policy making to adopt and / or propose alternative noise limits for use, should they be deemed feasible, based on a range of factors which must be considered. In making these decisions, economic, physical, and social considerations all need to be factored in. It is important, therefore, to highlight that the WHO Environmental Noise Guidelines should be considered across populations as a whole and used to review and manage health related noise exposure across National and European populations. They set a guideline as to what is desirable at a population level. They are not always achievable and are not intended to be applied as a level on an individual receptor or project basis.

It is important to put the WHO Environmental Noise Guidelines recommended traffic noise limits into context with respect to the existing noise levels within the Dublin Agglomeration. For the existing road network within the Dublin Agglomeration area, the most recent noise mapping prepared as part of the third round of the Dublin Agglomeration NAP 2018 – 2023 (DCC; FCC; SDCC; DLRCC 2018) notes that 72% of the population across the Dublin Agglomeration area are exposed to noise levels below 50 dB L_{night}. However, no further breakdown below this value is provided. The Dublin Agglomeration NAP 2018 – 2023 notes that 28% of the population are exposed to noise levels above 50 dB $L_{night.}$ In terms of the L_{den} parameter, the Dublin Agglomeration NAP 2018 – 2023 notes that 54% of the population are exposed to noise levels below 55 dB $L_{den.}$ However, no further breakdown below this value is provided. The document also notes that 46% of the population are exposed to noise levels above 55 dB $L_{den.}$ The range of existing road traffic noise at NSLs along the Proposed Scheme are all above WHO road traffic noise level recommendations in terms of both L_{den} and L_{night} (refer to Section 9.3) The existing road network, therefore, already contributes to road traffic noise above the recommended levels within the WHO Environmental Noise Guidelines for a large portion of the population.

An important part of the WHO Environmental Noise Guidelines relates to the recommended interventions or mitigation measure to be considered with respect to controlling and reducing road traffic noise exposure across populations. These include:

- Changes in infrastructure;
- Reduction in road traffic flows;
- Pathway interventions (barriers); and
- Quieter road surfaces.

The Dublin Agglomeration NAP 2018 – 2023 notes that overall, population and dwelling noise exposures have improved compared to the second round of noise mapping (2013 – 2018), in that more people and dwellings have moved from higher noise level bands to lower bands. This has been partially attributed to intervention measures within each of the local authorities through improved public transport and cycling facilities, limiting heavy goods vehicles (HGVs) to designated routes, the introduction of speed limits and limits on hours for deliveries within built up areas.

The Dublin Agglomeration NAP 2018 – 2023 includes further mitigation options to reduce traffic noise at exposed populations as part of the next 5 year plan. These include national and regional level strategies for improved public transport through increasing bus, train and bicycle journeys. At local authority level, key intervention

strategies include, but are not limited to, the replacement of diesel fleet to electric / natural gas vehicles, restrictions to HGV / truck routes, traffic re-routing and / or road closures, and road resurfacing.

The Proposed Scheme forms a key part of implementing the noise mitigation strategies discussed within the Dublin Agglomeration NAP 2018 – 2023 which also align with the recommended interventions and overall policies of the WHO Environmental Noise Guidelines to reduce population exposure to road traffic noise.

The absolute noise levels within the WHO Environmental Noise Guidelines are therefore not used to compare against at individual properties. However, changes in traffic noise levels are reviewed in the overall context of the Proposed Scheme to assess against the broad principles of the WHO Environmental Noise Guidelines.

9.2.4.2.3 Significance Ratings

The following overall significance ratings for the Operational Phase of the Proposed Scheme are applied along the road network taking account of both the calculated changes in road traffic noise levels (Table 9.13 and Table 9.14) and the noise level ranges (

Table 9.15) at a noise sensitive location. A daytime threshold value of 55 dB $L_{Aeq,16hr}$ and a night-time threshold value of 45 dB $L_{Aeq,8hr}$ has been applied for significance ratings, irrespective of the magnitude of change in noise levels. Operational traffic noise levels below these threshold levels during the Do Something scenarios are not considered to pose a significant noise impact such that overall significance ratings are not significant to slight depending on the change in noise levels.

Table 9.16: Significance Ratings for Operational Phase Traffic Noise Impacts

Noise Level Range (day/night)	Magnitude of Change in Noise Levels (Short Term and Long Term)				
	No Change / Reduction	**Negligible**	**Minor**	**Moderate**	**Major**
Negligible	Imperceptible / Positive	Not Significant	Not Significant	Not Significant	Not Significant - Slight
Negligible – Low	Imperceptible / Positive	Not Significant	Not Significant	Not Significant - Slight	Slight
Low – Medium	Imperceptible / Positive	Not Significant	Slight	Slight - Moderate	Moderate
Medium	Imperceptible / Positive	Not Significant	Slight	Moderate	Moderate - Significant
Medium - High	Imperceptible / Positive	Not Significant	Slight - Moderate	Moderate - Significant	Significant
High	Imperceptible / Positive	Not Significant - Slight	Slight - Moderate	Significant	Very Significant

9.2.4.2.4 Vibration

Magnitudes of vibration associated with road traffic are orders of magnitude below those associated with building or structural response to vibration. Operational Phase impacts are therefore limited to human response to vibration where much lower magnitudes of vibration apply.

In terms of human response, vibration associated with road traffic is negligible and generally do not result in perceptible levels of vibration within buildings along normal maintained roads with no significant defects. Notwithstanding, reference is made to BS 6472–1 (BSI 2008 which provides the following 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 to vibration in accordance with BS 6472–1 (BSI 2008). Specific vibration monitoring data and Operational Phase analysis are included in Section 9.3.3 and Section 9.4.4.2 respectively.

Table 9.17: BS 6472 -1 VDV Ranges and Associated Impact Probabilities for Building Occupants (BSI 2008)

Place and Time	Low Probability of Adverse Comment $m \cdot s^{-1.75}$ (Note 1)	Adverse Comment Possible $m \cdot s^{-1.75}$	Adverse Comment Probable $m \cdot s^{-1.75}$ (Note 2)
Residential buildings 16-hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8-hour night	0.1 to 0.2	0.2 to 0.4	to 0.8

Note 1: Below these ranges adverse comment is not expected.

Note 2: Above these ranges adverse comment is very likely.

9.3 Baseline Environment

The baseline noise environment has been characterised through a desk study of publicly available published data sources and measured noise levels through field studies. The following sections summarise the data sources and the results of the baseline noise surveys. Full details of the baseline surveys, including methodologies, survey dates, terminology and glossary, and results are included in Appendix A9.1 in Volume 4 of this EIAR.

9.3.1 Desk Study of Published Noise Data

The key sources of publicly available baseline data comprise published noise mapping studies undertaken by TII, which feed into the Dublin Agglomeration NAP 2018 – 2023 (DCC; FCC; SDCC; DLRCC 2018). The available noise mapping includes existing sources of major road noise sources within the Dublin Agglomeration area. Figure 9.1.1 to Figure 9.1.2 in Volume 3 of this EIAR present the published road traffic noise contours in terms of the L_{night} and L_{den} parameters respectively for the Proposed Scheme. Whilst there is no set rule of thumb conversion, for road traffic noise, the L_{den} parameter is typically 1 to 3 dB higher than the L_{day} value. Table 9.18 presents a summary of the traffic noise levels relevant to the closest NSLs along the Proposed Scheme.

Table 9.18: Summary of Road Traffic Noise Levels from EPA Mapping

Reference	Geographical Section	Nearest NSL to Road Centre Line	Noise Contour Noise Levels at NSLs	
			dB Lnight	dB Lden
Figure 9.1.1	Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road	Mount Argus Court	55 – 59	65 – 69
		Residential NSLs lining R817 Kimmage Road Lower (approximately 15m to 20m)	50 – 54	60 – 64
Figure 9.1.1 to Figure 9.1.2	Harold's Cross Road from Harold's Cross Park to Grand Canal	Residential NSLs lining R137 Harold's Cross Road, to west of Harold's Cross Park (<10m)	60 – 64	65 – 69
		Le Vere Terrace to west of R137 Harold's Cross Roads	55 – 59	65 – 69
Figure 9.1.2	Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction	Maldron Hotel (10m)	60 – 64	70 – 74
		Residential NSLs lining the road (10m to 20m)	55 – 59	65 – 69

The mapped road traffic noise levels for the geographical sections are discussed in the following sections.

9.3.1.1 Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road

Along the R817 Kimmage Road Lower, north of the junction with R818 Terenure Road West and Kimmage Road West, road traffic along the R817 Kimmage Road Lower is the dominant noise source. Closest residential NSLs lining the R817 Kimmage Road Lower are located in Mount Argus Court, north of Sundrive Road, at distances of 10m to the road centre line. At these small number of NSLs, the traffic noise maps L_{den} contours (hereafter referred to as L_{den} contours) are between 65 dB and 69 dB, reducing to within the 60 dB to 64 dB L_{den} contour at NSLs set back approximately 15m to 20m further from the road edge. The L_{den}, and the EPA road traffic night-time noise

map contours (hereafter referred to as L_{night} contours) are between 55 dB to 59 dB L_{night} depending on the distances from the road edge and the presence of boundary treatments.

A small number of religious NSLs are located within this Section of the study area. Those NSLs which lie within the noise mapped zones include Holy Apostles Peter and Paul Russian Orthodox Church (55 dB to 64 dB L_{den}), and Mount Argus Church and Retreat (55 dB to 64 dB L_{den}).

Other NSLs in this assessment zone include St. Gladys Private Nursing Home (55 dB to 64 dB L_{den}) and Whelan Park (≤55 dB L_{den}), Mount Argus Park (55 dB to 69 dB L_{den}),

9.3.1.2 Harold's Cross Road from Harold's Cross Park to Grand Canal

Between Harold's Cross Park and Grand Canal at Parnell Road junction, road traffic along R137 Harold's Cross Road is the dominant noise sources. Mapped road traffic noise contour levels are between 65 dB and 69 dB L_{den} and 60 dB to 64 dB L_{night} at distances extending approximately 15m from the road centre line. Closest NSLs to the road edge are located at residential NSLs lining the R817 Kimmage Road Lower, to west of Harold's Cross Park and Le Vere Terrace to the west of the R137 Harold's Cross Road, which are mapped within the 65 dB to 69 dB L_{den} noise contours. The L_{night} contour is between 60 dB and 64 dB L_{night} at NSLs within 15m of the road centre line and within the 55 dB to 59 dB L_{night} contour at Le Vere Terrace NSLs. The majority of other NSLs in the area are within the 50 dB to 54 dB L_{night} contour.

A number of other sensitive NSLs are located within this Section of the study area, including educational and care facilities. Those NSLs which lie within the noise mapped zones include Leinster Park Montessori (≤55 dB to 64 dB L_{den}), St. Clare's Convent National School (<55 dB L_{den}) and Our Lady's Hospice and Care Services (<55 dB L_{den}).

9.3.1.3 Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction

Between the Grand Canal at Parnell Road Junction and the New Street South at Patrick Street Junction, traffic along the R137 Clanbrassil Street and New Street South in addition to traffic along surrounding local roads are the dominant noise sources at the closest NSLs to the Proposed Scheme. The majority of NSLs are residential dwellings bounding either side of the R137 Harold's Cross Road. The mapped noise contours at the closest NSLs to the road edge are within the 65 dB to 69 dB L_{den} noise contour with a small number of NSLs mapped within the higher noise contour band between 70 dB and 74 dB $L_{den,}$ including the Maldron Hotel. Night-time noise levels at the closest residential NSLs are between 55 dB and 59 dB L_{night} for the majority, with a small number of NSLs mapped within the 60 dB to 64 dB L_{night} contour.

9.3.2 Baseline Noise Surveys

The measured baseline noise survey results are summarised in the following sections. Full survey details and results are included in Appendix A9.1 in Volume 4 of this EIAR, while Figure 9.2 in Volume 3 of this EIAR illustrates the locations of noise monitoring surveys carried out for this assessment.

The survey results are presented as the average daytime L_{Aeq} parameter, sampled over a three-hour daytime survey period and the calculated L_{den} parameter.

9.3.2.1 Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road

The noise survey results recorded during the baseline surveys in this study area are summarised in Table 9.19.

Table 9.19: Noise Survey Results for Kimmage Road Lower from Kimmage Cross Roads to Junction with Harold's Cross Road

Attended Location	Description	Average daytime, dB LAeq,T	dB Lden
CBC0011ANML001	R817 Fortfield Road / R818 Kimmage Road West junction	64	67
CBC0011ANML002	On footpath along Poddle Park Road fronting line of properties	63	67
CBC0011ANML003	R817 Kimmage Road Lower / Sundrive Road junction	68	71
CBC0011ANML004	Mount Argus Road / Mount Argus Grove junction	49	52
CBC0011ANML005	45m from R817 Kimmage Road Lower / Harold's Cross Road junction	71	73

The noise survey results within this study area are dominated by road traffic noise from R817 Kimmage Road Lower and Harold's Cross Road, in addition to traffic along the surrounding road network with a small contribution from local urban sources (e.g. pedestrian movements, car horns, dogs barking etc.).

Average daytime noise levels ranged between 49 dB to 71 dB $L_{Aeq,T}$. Lowest measured noise levels are those within Mount Argus Grove (CBC0011ANML004), a residential area set back from any significant passing through traffic. Highest measured noise levels are those measured along the footpath of the R187 (CBC0011ANML005).

L_{den} values calculated in this area ranged between 52 dB to 73 dB $L_{den.}$ The calculated L_{den} noise levels align closely with those discussed in Section 9.3.1.1 at similar distances from the road edge.

9.3.2.2 Harold's Cross Road from Harold's Cross Park to the Grand Canal

The noise survey results recorded during the baseline surveys in this study area are summarised in Table 9.20.

Table 9.20: Noise Survey Results for Harold's Cross Road from Harold's Cross Park to Grand Canal

Attended Location	Description	Average Daytime, dB LAeq,T	dB Lden
CBC0011ANML006	R817 Kimmage Road Lower / St. Clare's Avenue junction	62	66
CBC0011ANML007	R137 Harold's Cross Road / Mound Drummond Avenue junction	69	71

The noise survey results within this geographical section are dominated by road traffic noise from the R137 Harold's Cross Road, the R817 Kimmage Road Lower, in addition to traffic along the surrounding road network with a small contribution from local urban sources (e.g. pedestrian movements, car horns etc.).

During daytime periods, average ambient noise levels ranged between 62 dB to 69 dB $L_{Aeq,T}$. The higher value of being recorded due to the closer proximity to the road edge (CBC0011ANML007).

The measured L_{den} values calculated in this area ranged between 66 dB to 71 dB $L_{den.}$ The measured and calculated L_{den} noise levels align closely with those discussed in Section 9.3.1.2 at similar distances from the road edge.

9.3.2.3 Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction

The noise survey results recorded during the baseline surveys within this study area are summarised in Table 9.21.

Table 9.21: Noise Survey Results for Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction

Attended Location	Description	Average Daytime, LAeq,T	Lden
CBC0011ANML008	R137 Clanbrassil Street Upper / Clanbrassil Close junction	62	65
CBC0011ANML009	R137 Clanbrassil Street Lower / St Vincent Street South junction	66	69

The noise survey results within this geographical section are dominated by road traffic from R137 Clanbrassil Street Upper / Lower, in addition to traffic along the surrounding road network with a small contribution from local urban sources (e.g. pedestrian movements, commercial / retail activities and source etc.).

Average daytime noise levels ranged between 62 dB to 66 dB $L_{Aeq,T}$. The higher value of being recorded due to the closer proximity to the road edge (CBC0011ANML009).

L_{den} values calculated in this area ranged between 65 dB to 69 dB $L_{den.}$ The calculated L_{den} noise levels align closely with those discussed in Section 9.3.1.3 at similar distances from the road edge.

9.3.2.4 Comment on Baseline Traffic Noise Levels during COVID-19 Restrictions

From 13 March 2020 the Irish Government stated that all schools, colleges, and childcare facilities in Ireland would be closed due to the Covid-19 pandemic. People were also advised to work from home where possible. During April and May 2020 the restrictions were further extended with non-essential travel restricted nationwide. Restrictions were eased on 8 June in Phase 2 (i.e. non-essential retail reopened, employees were permitted to return to work in businesses if working from home was not an option). Baseline noise monitoring for the CBC Infrastructure Works was undertaken between 18 June 2020 and 4 October 2020 when Covid-19 restrictions were minimised (i.e. schools reopened during September and October). Baseline noise monitoring for the Proposed Scheme was undertaken during January, February and April 2019 and June to October 2020.

As the baseline noise monitoring was carried out during Level 2 and Level 3 of the Covid-19 restrictions, a review has been carried out on logged L_{Aeq} raw data, provided by DCC, for noise monitors between June to October in 2019 and 2020 to identify any changes in noise levels across the two years. The DCC long term noise monitoring locations were positioned at:

- Ballyfermot Library – 10m from road edge on R833 Ballyfermot Road;
- Ballymun Library – 20m from road edge on R108 Ballymun Road;
- Navan Road residential location – 60m from road edge on R147 Navan Road; and
- Dolphin's Barn residential location – 115m from road edge on R110 Crumlin Road.

A review of the DCC noise monitoring data has indicated that the overall difference in average noise levels between June and October of 2019 and 2020 are between 1 dB to 2 dB lower.

To further review the impact of Covid-19 travel restrictions on the baseline measured noise levels, an analysis of published TII traffic counters along national roads in the Dublin Region was undertaken to provide a comparison of traffic flows between June and October for the years 2019 and 2020 to inform the noise assessment. The traffic counts were taken from TII traffic counters at the two nearest locations to the Proposed Scheme (TMU R108 000.0 N and TMU M02 000.0 N) (TII 2022) which were averaged to provide a factor for each baseline noise survey date specific to the Proposed Scheme. The Annual Average Daily Traffic (AADT) traffic flows for each baseline noise survey date was corrected by the relevant factor to calculate any change in traffic during the baseline noise monitoring on specific survey dates.

The analysis has determined that noise levels are likely to be 0.4 dB to 1.5 dB lower during the 2020 survey periods when compared to the same months during 2019 due to Covid-19 travel restrictions.

Based on the review of DCC noise monitoring data and analysis of TII traffic counter data, the overall difference in baseline measured noise levels is typically <1 dB to 2 dB lower when compared to normal conditions (i.e. June to October 2019), when Covid-19 travel restrictions were not in place.

The difference in noise levels is not significant in the overall context of describing the prevailing baseline noise environment. The measured noise levels align with those mapped by the EPA and discussed in Section 9.3.1.

The baseline noise environment is used to provide an overall description of noise conditions along the Proposed Scheme. It is important to note that the baseline noise levels do not form the basis for noise calculations. Noise levels associated with Construction Phase works are calculated using construction plant information and relate to construction related activities specifically. The CNLs are compared against the relevant CNTs to assess the potential noise significance. Reference is made to the baseline noise environment, however, as part of the overall determination of construction noise impacts. For this assessment, a conservative approach has been adopted which uses the measured baseline noise levels which may be up to 1 dB to 2dB lower than normal conditions. In this instance, the magnitude of impact is robustly assessed.

Construction traffic noise impacts are assessed using future traffic flows for both the Do Minimum and Do Something scenarios for the Construction Year (2024) (i.e. they relate to future forecast flows not those in the current environment). The calculations do not therefore include measured baseline noise levels as is the standard approach for all traffic noise impact assessments. Similarly for the Operational Phase, calculated road traffic noise levels are based on future traffic flows for the Opening Year (2028) and Design Year (2043) assessment years for the Do Minimum and Do Something scenarios. The baseline noise levels are used to provide context of the normal range of traffic noise levels experienced across the study area, particularly where changes in traffic noise levels with potential significance effects are identified. As the variation in traffic noise levels between normal conditions and those during restricted movements as a result of Covid-19 are very small, the baseline noise environment as measured provides a sufficient and robust data range for the purpose of assessment.

In summary, whilst there is the potential for a small variation in baseline noise levels compared to normal conditions with no movement restrictions, this variation does not affect the impact assessment set out in the following sections.

9.3.3 Baseline Vibration Surveys

The measured vibration survey results are summarised in the following sections. Full survey details and results are included in Appendix A9.1 in Volume 4 of this EIAR.

The survey results are presented in terms of the PPV parameter in mm/s, and in terms of the VDV parameter in $m/s^{1.75}$.

9.3.3.1 Harristown Bus Depot

Vibration measurements were made along the access road to Harristown Bus Depot, Swords, Co. Dublin to capture specific vibration data relating to specific bus drive-bys / pass-bys in isolation at a controlled sampling location. This location was chosen due its location which is set back from adjacent trafficked roads and is predominately used by buses only. The survey data was obtained in order to inform the operational vibration assessments for the CBC Infrastructure Works and the Proposed Scheme under consideration here. Monitoring periods were approximately 15 minutes at each location. Measurements were undertaken at four monitoring positions described in Table 9.5. The survey results are summarised in Table 9.22.

Table 9.22: Vibration Monitoring Results at Harristown Bus Depot

Monitoring Location	Monitoring Scenario	Measured PPV, mm/s Associated with Bus Pass By	Measured, $VDV_{,b}$, $m/s^{1.75}$ Associated with Bus Pass By
AVML001	Entrance Road to Bus Depot, midway along inbound road, 5m from road edge. Moderate speed. 7 bus movements.	0.03 – 0.08	0.0008 – 0.0028
AVML002	Roundabout at Bus Depot entrance, buses entering depot, 5m from road edge. Buses decelerating at slow speed. 6 bus movements.	0.03 – 0.09	0.0012 – 0.0024
AVML003	Roundabout at Bus Depot entrance, buses exiting depot, 5m from road edge. Buses accelerating at slow speed. 7 bus movements.	0.03 – 0.09	0.0014 – 0.0032
AVML004	Entrance Road to Bus Depot, midway along outbound road, 5m from road edge. Moderate speed, accelerating. 9 bus movements.	0.1 – 0.15	0.0046 – 0.0072
	Entrance Road to Bus Depot, midway along inbound road, 7m from road edge. Moderate speed. 9 bus movements.	0.03 – 0.06	0.0012 – 0.0021

The results of the survey confirm vibration levels associated with a bus pass by result in negligible vibration levels at the edge of the road both in terms of human perception and building response. The low vibration levels measured correspond with the subjective observations made during the survey where vibration from passing buses was not perceptible.

9.3.3.2 Malahide Road

Vibration measurements were made at four locations along the Malahide Road to measure vibration associated with a mixed fleet of cars, large goods vehicles (LGVs), HGVs along the central carriageways and buses along a dedicated bus lane. Monitoring periods were 30 minutes at each location. Measurements were undertaken at four monitoring positions described in Table 9.5. The survey results are summarised in Table 9.23.

Table 9.23: Vibration Monitoring Results along Malahide Road

Monitoring Location	Monitoring Scenario	Measured PPV, mm/s	Measured, $VDV_{,b}$, $m/s^{1.75}$
AVML006	Malahide Road / St. Johns Court – 5m from edge of Inbound Bus Lane. Results for specific bus pass by events (4 No.).	0.04 – 0.1	0.0015 – 0.0033
	Malahide Road / St. Johns Court – 5m from edge of Inbound Bus Lane. Results for all traffic including 7 HGVs	0.03 – 0.17	0.0015 – 0.0056
AVML007	Malahide Road / St. Johns Court – 10m from edge of Inbound Bus Lane. Results for specific bus pass bys events (7 No.).	0.02 – 0.05	0.0005 – 0.0009
	Malahide Road / St. Johns Court – 10m from edge of Inbound Bus Lane. Results for all traffic including 1 HGV.	0.02 – 0.06	0.0003 – 0.0012
AVML008	Malahide Road / Donnycarney Church – 3m from edge of Inbound Bus Lane. Results for specific bus pass by events (7 No.).	0.02 – 0.06	0.0004 – 0.0017
	Malahide Road / Donnycarney Church – 3m from edge of Inbound Bus Lane. Results for all traffic including 4 HGVs.	0.02 – 0.23	0.0003 – 0.0057
AVML009	Malahide Road– 2.5m from edge of outbound Bus Lane. Results for specific bus pass by events (10 No.).	0.03 – 0.05	0.0008 – 0.0016
	Malahide Road– 2.5m from edge of outbound Bus Lane. Results for all traffic including 3 HGVs.	0.03 – 0.09	0.0008 – 0.0030

The results of the survey confirm vibration levels associated with a heavily trafficked urban / suburban road with a mix of fleet, inclusive of a dedicated bus lane, result in negligible vibration levels at the edge of the road, both

in terms of human perception and building response. The low vibration levels measured correspond with the subjective observations made during the survey where vibration from passing vehicles was not perceptible.

9.4 Potential Impacts

This Section presents potential impacts that may occur due to the Proposed Scheme, in the absence of mitigation. This informs the need for mitigation or monitoring to be proposed (refer to Section 9.5). Predicted 'residual' impacts taking into account any proposed mitigation is presented in Section 9.6.

9.4.1 Characteristics of the Proposed Scheme

The Proposed Scheme will involve the development of bus lanes, footpaths, cycle lanes and the implementation of traffic management measures over a defined construction period. When considering a development of this nature, the potential noise and vibration impact on the surroundings are considered for each of two distinct phases:

- Construction Phase; and
- Operational Phase.

9.4.1.1 Construction Phase

During the short-term Construction Phase of the Proposed Scheme, construction works will involve predominately general road works including road and junction reconfiguration and resurfacing works, and where required, road widening works, utility diversions, Bus Gate construction, quiet street treatment, urban realm improvements including landscaping, boundary wall construction, and construction traffic including movement of machinery and materials within and to and from Construction Compounds along the Proposed Scheme.

Other works specific to the Proposed Scheme will include the construction of:

- Stone Boat Boardwalk (45m) at Mount Argus View, requiring bored piles inserted into the river bank;
- A car park will be installed in front of Our Lady's Hospice;
- Footbridges on either side of the existing Robert Emmet Bridge, requiring bored piled foundations, and
- Road widening at Gordon's Fuel Merchants, requiring construction of a new retaining wall.

A variety of items of plant will be in use during these construction works all of which have the potential to generate high levels of noise and potential levels of perceptible vibration. These will include breakers, excavators dump trucks, road planers and generators in addition to general road surfacing, road marking and levelling equipment and additional works equipment including tracked cranes, Continuous Flight Auguring (CFA) or bored piling rigs and cement mixer trucks. In general, road construction works are transient in nature, as the works will progress along the length of the route of the Proposed Scheme.

Chapter 5 (Construction) provides an indicative programme and construction methodology for the Proposed Scheme.

The potential noise and vibration impacts associated with the Construction Phase are set out within Section 9.4.3.1.

9.4.1.2 Operational Phase

Once operational, potential noise impacts associated with the Proposed Scheme relate to changes in traffic noise levels along the affected road network. Traffic noise levels have the potential to be increased or decreased resulting from the following scenarios:

- Reduction in private vehicles along the Proposed Scheme resulting from the inclusion of bus lanes, bus priority signalling, reduced private vehicle lanes within core bus corridors, Bus Gates and modal shift to public transport;
- Increase in bus traffic along the core bus corridor;
- Location of bus lanes closer to the road edge / sensitive buildings; and

- Redistribution of private traffic off the Proposed Scheme onto the surrounding local road network.

In addition to traffic noise, potential impacts are associated with noise from bus activities at new or relocated bus stops. Commentary is also included on road maintenance once the Proposed Scheme is operational.

There are no expected perceptible changes to ambient vibration levels as a result of the Proposed Scheme. Potential impacts are, however, discussed within Section 9.4.4.2.

9.4.2 'Do Minimum' Scenario

The Do Minimum Scenario is a defined scenario within the traffic modelling exercise in Chapter 6 (Traffic & Transport). The output of this analysis has been used for traffic noise calculations. The Do Minimum scenario considers a range of committed developments and transport plans within the study area for the Opening Year (2028) and the Design Year (2043). Refer to Chapter 6 (Traffic & Transport) for a full description of the assumptions included within the Do Minimum scenario forecast years.

Traffic flows associated with the Do Minimum scenario have been assessed as part of the operational traffic noise impact assessment. This is set out in Section 9.3 are representative of the Do Nothing scenario.

9.4.3 Construction Phase

9.4.3.1 Construction Impact Assessment

The TII Noise Guidelines 2004 (NRA 2004) and TII Noise Guidelines 2014 (NRA 2014) specifically note that there is limited information available on specific construction methods, numbers and types of plant before the appointment of a contractor, which will normally happen after a scheme has been approved. The guidelines note that it is more appropriate to address the way in which potential construction impacts will be assessed and how they will be managed, including forms of mitigation and codes of practices that will be applied.

Whilst the phasing of works and location of activities and work sites have been progressed to detailed stages as part of the EIAR, the specifics in terms of plant items, plant numbers, their locations and operational duration will be subject to site conditions, work scheduling and appointed Contractor proposals. Notwithstanding, it is possible to determine indicative noise levels associated with typical construction activities associated with the various phases of works.

The TII Noise Guidelines 2004 and TII Noise Guidelines 2014 note that in the absence of an Irish or International standard relevant to construction noise, reference can be made to BS 5228 – 1 (BSI 2014a) and BS 5228 – 2 (BSI 2014b). These standards include recommended methodologies for calculating CNLs 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, BS 5228 – 1 (BSI 2014a) sets out sound pressure levels for a wide range of plant items normally encountered on construction sites, which in turn enables the prediction of indicative noise levels at distances from the works. BS 5228 – 2 (BSI 2014b) also includes empirical data on vibration levels measured at set distances from specific vibration generating activities in different ground and site conditions.

9.4.3.2 Construction Noise

Due to the nature of the activities undertaken on a construction site, there is the potential for the generation of high levels of noise. The flow of vehicular traffic to and from a construction site is also a potential source of relatively high noise levels, the impact at nearby NSLs will depend upon a number of variables, the most notable of which are:

- The amount of noise generated by plant and equipment being used at any one time generally expressed as a sound power level;
- The periods of operation of the plant at the development site, known as the 'on-time';
- The distance between the noise source and the NSLs;

- The attenuation due to ground absorption or barrier screening effects; and
- Reflections of noise due to the presence of hard vertical faces such as walls.

Using the typical noise levels for items of construction plant set out in BS 5228 – 1 (BSI 2014a), CNLs at specific distances have been calculated to determine a range of potential noise levels representative of the key Construction Phases of the Proposed Scheme. Section 9.4.3.2.1 to Section 9.4.3.2.9 set out the calculated CNLs associated with the key phases of construction representing the closest NSLs to the likely work phases.

Along the Proposed Scheme, the key Construction Phases activities are:

- General road works, where existing road surfacing is showing signs of deterioration and the existing cross section will be replaced;
- Road widening and road surface upgrade activities, where the quality of the existing road pavement is poor or where the existing road is being widened, full depth road foundation and pavement reconstruction will be carried out;
- Utility diversions, to account for likely service diversions where road widening works have taken place;
- Junctions, where excavation works will be completed for foundations for signs and traffic signal poles;
- Urban realm landscaping, where repaving is carried out and excavation for planting of trees;
- Construction Compounds, which will be used for storage of materials, plant and equipment, site offices, worker welfare facilities and limited car parking; and
- Boundary treatment works, where the relocation or rebuilding of replacement boundaries is required.

Items of plant and equipment that may be used during construction are identified in Chapter 5 (Construction) and typical operating 'on-times' have been developed for the purposes of construction noise calculation. The plant items along with their associated sound pressure levels taken from BS 5228 – 1 (BSI 2014a) are summarised in Table 9.24.

The calculations set out in the following sections do not include any attenuation from screening of site hoarding, buildings or structures, hence relate only to distance attenuation over hard ground. NSLs located beyond the road edge which are screened by intervening buildings and solid boundary treatments, therefore, will experience lower construction noise emissions than those presented at the varying distances set out in the following sections.

Table 9.24: Indicative Plant Noise Levels and Predicted CNL at Varying Distances

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,12hr}$ or $L_{Aeq,4hr}$)	% Plant On-Time	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time (dB $L_{Aeq,12hr}$ or $L_{Aeq,4hr}$)						
			10m	15m	20m	30m	50m	100m	150m
Lorry (Table C2.34)	80	40	76	72	70	66	62	56	52
Backhoe Mounted Hydraulic Breaker (Table C5.1)	88	20	81	77	75	71	67	61	57
Tracked Excavator 8t (Table C4.17)	71	100	71	67	65	61	57	51	47
Wheeled Excavator 14t (Table C4.56)	83	40	79	75	73	69	65	59	55
Wheeled Excavator 17t (Table C5.11)	73	100	73	69	67	63	59	53	49
Dumper (Table D3.98)	77	50	74	70	68	64	60	54	50
Road Planer (Table C5.7)	82	10	72	68	66	62	58	52	48
Road Sweeper (Table C4.90)	76	15	67	63	61	57	53	47	43
Asphalt Paver (Table C5.33)	75	15	66	62	60	56	52	46	42
Asphalt Roller (Table C5.20)	75	20	68	64	62	58	54	48	44
Roller 3t (Table C5.27)	67	50	64	60	58	54	50	44	40

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,12hr}$ or $L_{Aeq,4hr}$)	% Plant On-Time	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time (dB $L_{Aeq,12hr}$ or $L_{Aeq,4hr}$)						
			10m	15m	20m	30m	50m	100m	150m
Concrete Pump and Cement Mixer Truck (Table C4.28)	75	50	72	68	66	62	58	52	48
Tracked Crane (Table C3.29)	70	50	67	63	61	57	53	47	43
CFA Piling Rig (Table C3.22)	80	50	77	73	71	67	63	57	53

As the Construction Phase progresses along the length of the Proposed Scheme, a variety of plant items will be required for the varying phases noted above (e.g. road works, road widening, utility works etc.). When works are occurring immediately outside NSLs, they will be clearly audible and will generate high levels of construction noise. The specific noise level associated with individual items of plant at stated distances are included for reference in Table 9.24. The nature of the works associated with the Proposed Scheme are, however, transient in nature and each activity will occur for intermittent periods at any one time. For example, the use of breakers, excavators and planers, some of the highest noise generating plant items will operate outside a NSL for a limited period as it progresses along the length of a working area.

For indicative calculation purposes, an average plant noise level has been calculated for each phase of work making reference to the plant list and on-times' in Table 9.24.The average value is used to account of the mobile element of works assuming plant items associated with any activity are operating within a 50m linear work area at any one time. The average CNL for each phase of work has been used to assess CNLs at the closest NSLs. The following sections present a range of indicative construction noise calculations associated with the key construction activities associated with the Proposed Scheme.

9.4.3.2.1 General Road Works

This Section assesses the indicative noise levels generated from general road works, where existing road surfacing is showing signs of deterioration and the existing cross section will be replaced. This also includes for works at junctions for the installation of new signage and traffic signal poles (e.g. for proposed Bus Gate). As per Table 9.25, for construction plant typically associated with general road works, including lorries, dumpers, road planers, pavers and rollers etc., noise levels are typically in the range of 64 to 72 dB $L_{Aeq,T}$ at 10m, taking account of their typical 'on-time' in a working area. Table 9.25 outlines the typical CNL per period associated with typical road works, assuming six items of plant with an average noise level of 71 dB $L_{Aeq,T}$ at 10m. The average plant noise level has been calculated accounting for the fact that plant items will be operating at varying distances from a NSL at any one time.

Table 9.25: Indicative Road Works Construction Noise Calculations at Varying Distances

Average Plant Noise Level at 10m Distance, (dB)	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Six Plant Items Operating Simultaneously (dB LAeq,12hr or LAeq,4hr)								
	10m	15m	20m	30m	50m	75m	100m	150m	250m
71	79	76	73	69	65	61	59	55	51

During normal road works, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00hrs to 19:00hrs) is likely to be exceeded at distances of up to 15m from the works boundary in the absence of any noise mitigation. The evening and weekend CNT value of 65 dB $L_{Aeq,T}$ would be exceeded at distances up to 50m in the absence of any mitigation. The identified areas where this work will take place and calculated CNLs are presented in Table 9.26. The identified NSLs are those which bound the road edge and are not screened by intervening buildings. The identified NSL in Table 9.26 is not an exhaustive list of properties at varying distances.

Table 9.26: Road Works Construction Noise Calculations at Nearest NSLs

Geographical Section	Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Predicted Total CNL at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)
		Start	End		
Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road	Section 1a	A0+050	A0+310	Residential NSLs to north, east and west of R817 Kimmage Road Lower / R818 Kimmage Road West (<10m)	79
	Section 1b	A0+300	A0+340	Closest residential NSLs to the installation of signage poles to north, west and south of R817 Kimmage Road Lower (<10m)	79
		Offline to east of A0+520		Closest residential NSLs to the installation of signage poles to southwest and southeast of Derravaragh Road / Aideen Drive (15m)	76
		Offline to east of A0+610		Closest residential NSLs to the installation of signage poles to southeast of Derravaragh Road / Mount Tallant Avenue (15m)	76
		A1+900	A2+220	Closest residential NSLs to the installation of signage poles to west of R137 Harold's Cross Road West (<10m)	79
		A2+250	A2+260	Closest residential NSLs to the installation of signage poles to west of R817 Harold's Cross Road Lower (<10m)	79
		B10+050	B10+370	Residential NSLs to east of R137 Harold's Cross Road East (<10m)	79
		G60+000	H70+340	Closest residential NSLs to the installation of signage poles along Ravensdale Park, Poddle Park Road, Blarney Park Road, Sundrive Road onto Mount Argus Way (<10m)	79
	Section 1c	J90+050		Closest residential NSLs to the installation of signage poles to south of Kenilworth Square North (<10m)	79
Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction	Section 3b	A2+780	A3+460	Residential NSLs to west and east of R137 Clanbrassil Street Upper and Clanbrassil Street Lower (10m)	79
	Section 3c	A3+550	A3+650	Residential NSLs to west of R137 New Street South (<10m)	79

As summarised in Table 9.26, general road works including junction realignments, within the section of the Proposed Scheme along Lower Kimmage Road between Kimmage Cross Roads and the junction with Harold's Cross Road as well as the along Clanbrassil Street Upper and Lower and New Street South between the Grand Canal and the Patrick Street junction, will be between 10m to 15m of the nearest NSLs. The predicted noise levels for these works at the closest NSLs are between 76 to 79 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.26, the potential noise impacts at the closest NSLs range between Negative, Moderate to Significant, and Temporary during the daytime period and Negative, Significant to Very Significant, and Temporary during the evening and weekend periods in the absence of noise mitigation.

Reference to Table 9.24 indicates that highest noise levels will occur when road planers or excavators for signage foundations are operating at the closest distance to NSLs. During specific periods when these activities are operating outside NSLs, higher noise levels will occur compared to those discussed in Table 9.26. These activities will occur, however, for intermittent periods of time at any one location over the course of a working day.

9.4.3.2.2 Road Widening, Road Upgrade and Utility Diversion Construction Works

This Section assesses the indicative noise levels generated from road widening and utility diversion activities, where the quality of the existing road pavement is poor or where the existing road is being widened, full depth road foundation and pavement reconstruction will be carried out. This Section also included for activities associated with utility diversions where road widening works have taken place and for small elements of work associated with quiet street treatment which include installation of raised footpaths or raised paving. As per Table 9.24, construction plant typically associated with road widening and utility diversion works, include lorries, breakers, excavators, dumpers, road planers, sweepers, pavers and rollers etc., which will operate as required depending on the specific activity taking place at any one time. Noise levels associated with these activities are typically in the range of 64 to 81 dB $L_{Aeq,T}$ at 10m taking account of their typical 'on-time' in a working area. Table 9.27 outlines the typical CNL associated with the proposed works for this element of the Construction Phase, assuming six items of plant with an average noise level of 75 dB $L_{Aeq,T}$ at 10m.

The calculated levels relate to activities operating over a full day, full evening or Saturday period.

Table 9.27: Indicative Road Widening, Road Upgrade and Utility Diversion Construction Work Noise Calculations at Varying Distances

Average Plant Noise Level at 10m Distance (dB)	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Six Plant Items Operating Simultaneously (dB LAeq,12hr or LAeq,4hr)								
	10m	15m	20m	30m	50m	75m	100m	150m	250m
75	83	80	77	73	69	65	63	59	55

During road widening and utility diversion works, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00hrs to 19:00hrs) is likely to be exceeded at distances of up to 25m from the works boundary, in the absence of any noise mitigation. The evening and weekend CNT value of 65 dB $L_{Aeq,T}$ is likely to be exceeded at distances up to 75m in the absence of any mitigation. Noise mitigation will therefore be required to reduce CNLs from this type of activity, particularly during any scheduled evening and weekend works. The identified areas where this work will take place and calculated CNLs are presented in Table 9.28.

Table 9.28: Road Widening, Road Upgrade and Utility Diversion Construction Noise Calculations at Nearest NSLs

Geographical Section	Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Predicted Total CNL at Stated Distance from Edge of Works (dB LAeq,T)
		Start	End		
Lower Kimmage Road from Kimmage Cross	Section 1a	A0+050	A0+310	Residential NSLs to north, east and west of R817 Kimmage Road Lower / R818 Kimmage Road West (<10m)	83

Geographical Section	Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Predicted Total CNL at Stated Distance from Edge of Works (dB LAeq,T)
		Start	End		
Roads to the Junction with Harold's Cross Road	Section 1b	A0+340	A0+540	Residential NSLs to east and west R817 Kimmage Road Lower (<10m)	83
		G6+0000 (north)	A6+0025 (north)	Junction of Poddle Park and Ravensdale Park. Raised footpath. Residential NSLs at 10 – 15m	80 - 83
		N/A	N/A	Derravaragh Road / Corrib Road Junction – raised footpath. Residential NSLs at 15m	80
		N/A	N/A	Derravaragh Road / Aideen Drive Derravaragh Road / Mount Tallant Avenue Residential NSLs at 15m, cutting kerb and raising paving	80 - 83
		C20+000	C20+080	Residential NSLs to south of Harold's Cross Road (<10m)	83
Harold's Cross Road from Harold's Cross Park to Grand Canal	Section 2	A2+330	A2+360	Residential NSLs to north and south of Our Lady's Hospice (<10m)	83
		A2+360	A2+415	Residential NSLs to west of Harold's Cross Road (<10m)	83
		A2+360	A2+480	Residential NSLs to east of Harold's Cross Road (<10m)	83
		A2+630	A2+660	Residential NSLs to south of Harold's Cross Road (15m)	80
Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction	Section 3a	A2+680	A2+770	Residential NSLs to west of Clanbrassil Street Upper (<10m)	83
		A2+700	A2+780	Residential NSLs to east of Clanbrassil Street Upper (20m)	77

As summarised in Table 9.28, in the three geographical sections of the Proposed Scheme, road widening, and utility diversion works will be within 10m to 20m of the nearest NSLs. The indicative predicted noise levels for these works at the closest NSL facades are between 77 to 83 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.28, the potential noise impacts at the closest NSLs range between Negative, Moderate to Very Significant, and Temporary during the daytime period and Negative, Significant to Very Significant, and Temporary during the evening and weekend periods in the absence of noise mitigation.

Table 9.28 includes the proposed new car park on Harold's Cross Road, in the grounds of Our Lady's Hospice. The proposed works will include the provision of 22 car parking spaces, along with new boundary treatment and landscaping works. It is expected that the plant noise levels used for car park construction work will be no greater than for the road widening works outlined in Table 9.27. The car park works will be within 10m of the nearest NSLs. The indicative predicted cumulative noise level for these works will be in the order of 83 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.28, the predicted noise impact at the closest NSLs will be Negative, Significant to Very Significant, and Temporary during the daytime, evening and weekend periods, in the absence of noise mitigation.

Minor works associated with quiet street treatment will occur within Section 2b involving raising of footpaths or paved areas in confined areas at junctions. This activity will occur within 10 to 15m of the closest NSLs for brief to temporary periods with indicative calculated levels of the order of 80 to 83 dB L_{Aeq} which is a potentially significant effect depending on the duration over which it occurs.

A further summary of predicted impacts at NSLs located at varying distances from these activities is provided in Table 9.43.

The calculations are based on six plant items with an average noise level of 75 dB $L_{Aeq,T}$ at 10m operating simultaneously, in the absence of any noise mitigation, along a given section of road. The average plant noise level has been calculated on the basis that the plant will be operating at varying distances from a NSL at any one time. Reference to Table 9.24 indicates that the highest noise levels will occur when breaking, excavators and road planers are operating at the closest distance to NSLs. During specific periods, when these activities are operating outside NSLs, higher noise levels will occur compared to those discussed in Table 9.28. These activities will occur, however, for intermittent periods of time at any one location over the course of a working day.

9.4.3.2.3 Urban Realm Landscaping

This Section assesses the indicative noise levels generated from urban realm landscaping, where repaving is carried out and excavation for planting of trees. Plant items typically associated with urban realm landscaping, including lorries, excavators and pavers noise levels are typically in the range of 71 to 76 dB $L_{Aeq,T}$ at 10m taking account of their typical 'on-time' in a working area. Table 9.29 outlines the typical CNL associated with the proposed works for this element of construction, assuming three items of plant with an average noise level of 74 dB $L_{Aeq,T}$ at 10m.

Table 9.29: Indicative Urban Realm Landscaping Construction Noise Calculations at Varying Distances

Average Plant Noise Level at 10m Distance (dB)	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Three Plant Items Operating Simultaneously (dB LAeq,12hr or LAeq,4hr)								
	10m	15m	20m	30m	50m	75m	100m	150m	250m
74	79	76	73	69	65	61	59	55	51

During urban realm landscaping works, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00hrs to 19:00hrs) is likely to be exceeded at distances of up to 15m from the works boundary in the absence of any noise mitigation. The evening and weekend CNT value of 65 dB $L_{Aeq,T}$ would be exceeded at distances up to 50m, in the absence of any mitigation. The identified areas where this work will take place and calculated CNLs are presented in Table 9.30.

Table 9.30: Urban Realm Landscaping Construction Noise Calculations at Nearest NSLs

Geographical Section	Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Predicted Total CNL at Stated Distance from Edge of Works (dB LAeq,T)
		Start	End		
Lower Kimmage Road from Kimmage Cross Roads to the junction with Harold's Cross Road	Section 1b	A0+960	A1+070	Residential NSLs to west of R817 Kimmage Road Lower (<10m)	79

As summarised in Table 9.30, the provision of urban realm landscaping is proposed in the Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road geographical section. These public realm improvements will include repaving at shops, and commercial units, and the introduction of landscaping and parking bays. Public realm improvements will also be implemented on Sundrive Road at Sundrive Cross for 80m, including footpath repaving. During these particular works in this specific geographical section, the nearest NSLs will be within 10m of the proposed works. The indicative predicted cumulative noise level for these works will be in the order of 79 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.28, the potential noise impacts at the closest NSLs range between Negative, Moderate to Significant during the daytime period and Significant to Very Significant, and Temporary during the evening and weekend periods, in the absence of noise mitigation.

A further summary of predicted impacts at NSLs located at varying distances from these activities is provided in Table 9.43.

9.4.3.2.4 Construction Compounds

The Construction Compound areas will be used for storage, offices and welfare facilities. There is a potential for the use of temporary power requirements (generator) for site lighting etc., but there will be no expected on-going operational plant or works within the Construction Compound areas for the Proposed Scheme. A total CNL of 78 dB $L_{Aeq,T}$ at 10m has been used for the purposes of indicative calculations to allow for day-to-day activity and temporary power, where required. This would include, for example plant typically with noise levels in the range of 70 to 75 dB L_{Aeq} at 10m. Table 9.31 outlines the typical CNL associated with the proposed works for this element of the construction, assuming six items of plant with an average noise level of 70 dB $L_{Aeq,T}$ at 10m.

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

Table 9.31: Indicative Construction Compound Noise Calculations at Varying Distances

Average Plant Noise Level at 10m Distance (dB)	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Six Plant Items Operating Simultaneously (dB $L_{Aeq,12hr}$ or $L_{Aeq,4hr}$)								
	10m	15m	20m	30m	50m	75m	100m	150m	250m
70	78	75	72	68	64	60	58	54	50

The predicted values outlined in Table 9.31 indicate the daytime CNT value of 75 dB $L_{Aeq,\ 12hr}$ Monday through Friday (07:00hrs to 19:00hrs) is likely to be exceeded at distances of up to 15m from the works boundary in the absence of any noise mitigation. The evening and weekend CNT value of 65 dB $L_{Aeq,T}$ would be exceeded at distances within 50m, in the absence of noise mitigation.

There are three sites identified as potential Construction Compounds across the Proposed Scheme. The Construction Compounds are listed in Table 9.32 with approximate distance to NSLs and general comments on potential noise impacts included.

Table 9.32: Construction Compound Potential Noise Impacts

Construction Compound Ref.	Location	Chainage Reference		Predicted Works	Closest NSLs (m)	Predicted Total CNL at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)	Potential Impacts
		Start	End				
Construction Compound K1	Public Carpark to North of Sundrive Road	Offline		The main Construction Compounds will be used as the primary location for storage of materials, plant and equipment, site offices, worker welfare facilities and limited car parking.	Mount Argus Square residential NSLs (20m)	72 (day to day activity)	Potential exceedance of evening and weekend criteria without noise mitigation.
Construction Compound K2	Grounds of Our Lady's Hospice to West of Harold's Cross Road.	2+330	2+350		66 Harold's Cross Road residential NSL (5m)	⩾78 (day to day activity)	Potential exceedance of daytime, evening and weekend construction noise criteria to north and south of compound without noise mitigation.
					Greenmount Avenue residential NSLs (15m)	75 (day to day activity)	
Construction Compound K3	Green area at St.	3+170	3+210	Due to small area	Residential NSLs to west	69	Potential exceedance of evening and weekend

Construction Compound Ref.	Location	Chainage Reference		Predicted Works	Closest NSLs (m)	Predicted Total CNL at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)	Potential Impacts
		Start	End				
	Patrick's Court to west of R137 Clanbrassil Street Lower.			assumed Construction Compound likely to be used for storage and cabin, with total CNL of 60 dB L_{Aeq} at 10m.	of R137 Clanbrassil Street Lower (3m)		criteria without noise mitigation.

The indicative predicted cumulative noise levels associated with day to day material handing activities are between 75 to >78 dB $L_{Aeq,T}$ at NSLs adjacent to Construction Compound K2, to be located in the grounds of Our Lady's Hospice to west of R137 Harold's Cross Road. Making reference to the CNLs in Table 9.32, the predicted noise impacts at the closest NSLs will range between Negative, Moderate to Very Significant, and Temporary during the daytime period and Negative, Significant to Very Significant and Temporary during the evening and weekend periods in the absence of noise mitigation.

For Construction Compound K1, the indicative predicted cumulative noise level associated with day to day material handing activities will be in the order of 72 dB $L_{Aeq,T}$. Making reference to the CNLs in Table 9.32, the predicted noise impacts at the closest NSLs will range between Negative, Slight to Moderate, and Temporary during the daytime period and Negative, Significant to Very Significant, and Temporary during the evening and weekend periods, in the absence of noise mitigation.

While at Construction Compound K3, the indicative predicted cumulative noise level with day to day material handing activities will be in the order of 69 dB $L_{Aeq,T}$. Making reference to the CNLs in Table 9.32, the predicted noise impacts at the closest NSLs will range between Negative, Slight to Moderate, and Temporary during the daytime period and Negative, Moderate to Significant, and Temporary during the evening and weekend periods in the absence of noise mitigation.

A further summary of predicted impacts at NSLs located at varying distances from these activities is provided in Table 9.43.

9.4.3.2.5 Boundary Treatments

This Section assesses the indicative noise levels generated from boundary treatment works, where the relocation or rebuilding of replacement boundary walls is required. For boundary treatment works, where road widening works have already taken place and involve the removal of boundaries walls with excavators, dumpers, etc., the rebuilding works will require plant items such as excavation of new foundations, cement mixing and block laying. Table 9.33 outlines the typical CNL associated with the proposed works for this element of construction, assuming three items of plant with an average noise level of 75 dB L_{Aeq} at 10m.

Table 9.33: Indicative Boundary Wall Construction Noise Calculations at Varying Distances

Average Plant Noise Level at 10m Distance (dB)	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Three Plant Items Operating Simultaneously (dB LAeq,12hr or LAeq,4hr)								
	10m	15m	20m	30m	50m	75m	100m	150m	250m
75	80	77	74	70	66	62	60	56	49

During boundary wall construction work, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00hrs to 19:00hrs) is likely to be exceeded at distances within 20m from the works boundary, in the absence of any noise mitigation. The evening and weekend CNT value of 65 dB $L_{Aeq,T}$ would be exceeded at distances up to 50m, in the absence of any mitigation. Noise mitigation will therefore be required to reduce CNLs from this type of activity, particularly during any scheduled evening and weekend works.

The identified areas where this work will take place and calculated CNLs are presented in Table 9.34. For properties where boundary wall works are less than 10m from the property façade, the calculated noise level outlined in Table 9.34 is considered a valid representation of likely noise levels given the number of plant likely to operate simultaneously within this small working area will be limited at any one time.

Table 9.34: Boundary Walls Construction Noise Calculations at Nearest NSLs

Geographical Section	Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Predicted Total CNL at Stated Distance from Edge of Works (dB LAeq,T)
		Start	End		
Harold's Cross Road from Harold's Cross Park to Grand Canal	Section 2	A2+360	A2+415	Residential NSLs to west of R137 Harold's Cross Road (<10m)	80
				Our Lady's Hospice (100m)	60
		A2+370	A2+480	Residential NSLs to east of R137 Harold's Cross Road (<10m)	80
		A2+630	A2+665	Office NSLs to west of R137 Harold's Cross Road (<10m)	80
				Residential NSLs to south of works along R137 Harold's Cross Road (15m)	77

As summarised in Table 9.34, the provision of boundary wall treatment works is proposed in the Harold's Cross Road from Harold's Cross Park to Grand Canal geographical section. During boundary wall treatment works, the nearest NSLs will be within 10m to 100m of the proposed works. The indicative predicted cumulative noise levels for these works at the closest NSL facades will be between 60 to 80 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.34, the predicted noise impacts at the closest NSLs will range between Negative, Not Significant to Significant, and Temporary during the daytime period and Negative, Not Significant to Very Significant and Temporary during the evening and weekend periods, in the absence of noise mitigation.

The calculations are based on three plant items with an average noise level of 75 dB $L_{Aeq,T}$ at 10m operating simultaneously, in the absence of any noise mitigation. Reference to The calculations set out in the following sections do not include any attenuation from screening of site hoarding, buildings or structures, hence relate only to distance attenuation over hard ground. NSLs located beyond the road edge which are screened by intervening

buildings and solid boundary treatments, therefore, will experience lower construction noise emissions than those presented at the varying distances set out in the following sections.

Table 9.24 indicates that highest noise levels will occur when mobile plant is operating at the closest distance to NSLs.

9.4.3.2.6 Piling

The proposed Stone Boat Boardwalk will be independently supported and the foundations for the boardwalk will require the use of CFA bored piling rigs during the construction works. CFA bored piling rigs will also be used at the proposed cycle / pedestrian bridge to the west of Robert Emmet Bridge, pedestrian bridge to the east of Robert Emmet Bridge and the retaining wall on the western side of R137 Clanbrassil Street Upper. Plant typically associated with bored piling works, including a CFA piling rig, concrete trucks and tracked crane etc., noise levels are typically in the range of 67 to 77 dB $L_{Aeq,T}$ at 10m, taking account of their typical 'on-time' in a working area. Table 9.35 outlines the typical CNL associated with the proposed works for this element of construction, assuming four items of plant with an average noise level of 74 dB $L_{Aeq,T}$ at 10m.

Table 9.35: Indicative Bored / Auger Construction Noise Calculations at Varying Distances

Average Plant Noise Level at 10m Distance (dB)	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Four Plant Items Operating Simultaneously (dB LAeq,12hr or LAeq,T)								
	10m	15m	20m	30m	50m	75m	100m	150m	250m
74	80	77	74	70	66	62	60	56	52

During normal bored piling construction works, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00hrs to 19:00hrs) is likely to be exceeded at distances within 15m from the works boundary, in the absence of any noise mitigation. The evening and weekend CNT value of 65 dB $L_{Aeq,T}$ is likely to be exceeded at distances within 50m, in the absence of any mitigation. The identified areas where this work will take place and calculated CNLs are presented in Table 9.36.

Table 9.36: Piling Construction Noise Calculations at Nearest NSLs

Geographical Section	Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Predicted Total CNL at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)
		Start	End		
Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road	Section 1b	H70+080	H70+125	Residential NSLs to North of Mount Argus Square and south of Mount Argus Close (15m)	77
Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction	Section 3a	A2+680	A2+710	Residential NSLs to East of Clanbrassil Street Upper (20m)	74
				Office NSLs to South West of Clanbrassil Street Upper / Parnell Road junction (30m)	70
		A2+685	A2+710	Residential NSLs to East of Clanbrassil Street Upper (10m)	80
				Residential NSLs to South East of Clanbrassil Street Upper / Parnell Road junction (20m)	74
		A2+700	A2+780	Residential NSLs to east of Clanbrassil Street Upper (20m)	74

As summarised in Table 9.36, in the Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road geographical section, a parallel cycleway will be developed to the west, requiring a new boardwalk structure over the River Poddle. These works will require the use of bored piles along the length of the new structure. The nearest NSLs will be within 15m of the proposed bored piling works. The indicative predicted

cumulative noise level for these works at the closest NSL facades will be in the order of 77 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.36, the predicted noise impacts at the closest NSLs will range between Negative, Moderate to Significant and Temporary during the daytime period and in the absence of noise mitigation.

In the Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction geographical section, the provision of the footbridges to the west of Robert Emmet Bridge are proposed. The structure will be independently supported by two piers atop bored piles at the northern and southern end of the footbridge. The nearest NSLs will be within 20m to 30m of the proposed bored piling works. The indicative predicted cumulative noise level for these works at the closest NSL facades will be between 70 to 74 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.36, the predicted noise impacts at the closest NSLs will range between Negative, Slight to Moderate, and Temporary during the daytime period and Negative, Moderate to Very Significant, and Temporary during the evening and weekend periods in the absence of noise mitigation.

In the same geographical section, a pedestrian bridge to the east of Robert Emmet Bridge is proposed. These works will require installation of bored piles into the bank of the Grand Canal and bank seats at each end of the bridge. The nearest NSLs will be within 10m to 20m of the proposed bored piling works. The indicative predicted cumulative noise level for these works at the closest NSL facades will be between 74 to 80 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.36, the predicted noise impacts at the closest NSLs will range between Negative, Slight to Significant, and Temporary during the daytime period and Negative, Significant to Very Significant, and Temporary during the evening and weekend periods in the absence of noise mitigation.

The provision of a retaining wall on the western side of R137 Clanbrassil Street Upper is proposed. These works will require bored piles along the length of the structure. The nearest NSLs will be within 20m of the proposed bored piling works. The indicative predicted cumulative noise level for these works at the closest NSL facades will be in the order of 74 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.36, the predicted noise impacts at the closest NSLs will range between Negative, Slight to Moderate, and Temporary during the daytime period and Negative, Significant to Very Significant, and Temporary during the evening and weekend periods, in the absence of noise mitigation.

Reference to The calculations set out in the following sections do not include any attenuation from screening of site hoarding, buildings or structures, hence relate only to distance attenuation over hard ground. NSLs located beyond the road edge which are screened by intervening buildings and solid boundary treatments, therefore, will experience lower construction noise emissions than those presented at the varying distances set out in the following sections.

Table 9.24 indicates that the calculated noise levels will be dominated by the piling rig when in operation at this distance. These activities will occur for intermittent periods of time at any one location.

A further summary of predicted impacts at NSLs located at varying distances from these activities is provided in Table 9.43.

9.4.3.2.7 Retaining Walls

A retaining wall is proposed on the northern approach to the Robert Emmet Bridge. Plant typically associated with retaining walls works, including excavators and dumpers etc., noise levels will typically be in the range of 74 to 79 dB $L_{Aeq,T}$ at 10m, taking account of their typical ‘on-time’ in a working area. Table 9.37 outlines the typical CNL associated with the proposed works for this element of the construction, assuming three items of plant with an average noise level of 76 dB $L_{Aeq,T}$ at 10m.

Table 9.37: Indicative Retaining Walls Construction Noise Calculations at Varying Distances

Average Plant Noise Level at 10m Distance (dB)	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Three Plant Items Operating Simultaneously (dB $L_{Aeq,12hr}$ or $L_{Aeq,4hr}$)								
	10m	15m	20m	30m	50m	75m	100m	150m	250m
76	81	78	75	71	67	63	61	57	53

During retaining wall construction work, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00hrs to 19:00hrs) is likely to be exceeded at distances within 20m from the works boundary, in the absence of any noise mitigation. The evening and weekend CNT value of 65 dB $L_{Aeq,T}$ is likely to be exceeded at distances up to 60m, in the absence of any mitigation. The identified areas where this work will take place and calculated CNLs are presented in Table 9.38.

Table 9.38: Retaining Walls Construction Noise Calculations at Nearest NSLs

Geographical Section	Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Predicted Total CNL at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)
		Start	End		
Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction	Section 3a	A2+700	A2+780	Residential NSLs to east of Clanbrassil Street Upper (20m)	75

As summarised in Table 9.38, the provision of a retaining wall is proposed in the Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction geographical section at Gordon's Fuel Merchants and Mullen Scrap at Clanbrassil Street Upper. During retaining wall works in this specific geographical section, the nearest NSLs will be within 20m of the proposed works. The indicative predicted cumulative noise levels for these works at the closest NSL facades will be in the order of 75 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.36, the predicted noise impacts at the closest NSLs will range between Negative, Slight to Moderate, and Temporary during the daytime period and Negative, Significant to Very Significant, and Temporary during the evening and weekend periods, in the absence of noise mitigation.

9.4.3.2.8 Additional Structural Works

Construction of additional works related to the provision of a boardwalk, footbridges and ramp construction along the Proposed Scheme will require the use of different plant depending on the type of works involved. The more intrusive works (i.e. bored piling and retaining walls) with higher noise levels have already been assessed in Section 9.4.3.2.6 and Section 9.4.3.2.7. For the purpose of the less intrusive additional works related to the boardwalk, footbridges and ramp constructions, a total CNL of 72 dB $L_{Aeq,T}$ at 10m has been used for the purposes of indicative calculations. This would include, for example plant typically with noise levels in the range of 68 to 73 dB $L_{Aeq,T}$. Table 9.39 outlines the typical CNL associated with the proposed works for this element of the construction, assuming six items of plant with an average noise level of 72 dB $L_{Aeq,T}$ at 10m.

Table 9.39: Indicative Additional Works Construction Noise Calculations at Varying Distances

Average Plant Noise Level at 10m Distance (dB)	Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Six Plant Items Operating Simultaneously (dB $L_{Aeq,12hr}$ or $L_{Aeq,4hr}$)								
	10m	15m	20m	30m	50m	75m	100m	150m	250m
72	80	77	74	70	66	62	60	56	52

For the additional work activities, with cumulative site works up to 72 dB L_{Aeq} at 10m during the period, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00hrs to 19:00hrs) is likely to be exceeded at distances within 20m from the works boundary, in the absence of any noise mitigation. The evening and weekend CNT value of 65 dB $L_{Aeq,T}$ would be exceeded at distances up to 50m, in the absence of any mitigation. The identified areas where this work will take place and calculated CNLs are presented in Table 9.40.

Table 9.40: Additional Works Construction Noise Calculations at Nearest NSLs

Geographical Section	Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Predicted Total CNL at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)
		Start	End		
Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road	Section 1b	H70+080	H70+125	Residential NSLs to North of Mount Argus Square and south of Mount Argus Close (15m)	77
Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction	Section 3a	A2+680	A2+710	Residential NSLs to East of Clanbrassil Street Upper (20m)	74
				Office NSLs to South West of Clanbrassil Street Upper / Parnell Road junction (30m)	70
		A2+685	A2+710	Residential NSLs to East of Clanbrassil Street Upper (10m)	80
				Residential NSLs to South East of Clanbrassil Street Upper / Parnell Road junction (20m)	74
		A2+710	A2+715	Residential NSLs to north of Windsor Terrace (10m)	80

As summarised in Table 9.40, the provision of the Stone Boat Boardwalk is proposed offline in the Lower Kimmage Road from Kimmage Cross Roads to the Junction with Harold's Cross Road geographical section at Mount Argus View. During boardwalk construction works in this specific geographical section, the nearest NSLs will be within 15m of the proposed works. The highest predicted cumulative noise level for these works will be in the order of 77 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.40, the predicted noise impacts at the closest NSLs will range between Negative, Moderate to Significant, and Temporary during the daytime period and Negative, Significant to Very Significant, and Temporary during the evening and weekend periods, in the absence of noise mitigation.

The provision of a footbridge offline either side of the existing Robert Emmett Bridge, retaining wall and ramp construction are proposed in the Clanbrassil Street Upper and Lower and New Street South from the Grand Canal to the Patrick Street Junction geographical section at Gordon's Fuel Merchants. In addition, the existing bungalow to the west of the road will be demolished at Gordon's Fuel Merchants. During additional construction works in this specific geographical section, the nearest NSLs will be within 10m to 30m of the proposed works. The highest predicted cumulative noise levels for these works will be between 70 to 80 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9.40, the predicted noise impacts at the closest NSLs will range between Negative, Slight to Significant, and Temporary during the daytime period and Negative, Moderate to Very Significant, and Temporary during the evening and weekend periods, in the absence of noise mitigation.

A further summary of predicted impacts at NSLs located at varying distances from these activities is provided in Table 9.43.

9.4.3.2.9 Emergency Work

Emergency work may include the replacement of warning lights, signs and other safety items on public roads, the repair of water supplies and other services which have been interrupted, repair to any damaged temporary works and all repairs associated with working on public roads. These activities may be required to work outside of normal working hours. Where required, they will be subject to the same construction noise criteria outlined in Table 9.8.

9.4.3.3 Construction Vibration

The potential for elevated levels of vibration at sensitive locations during construction activities associated with the Proposed Scheme is typically associated with surface breaking activities used for road widening and utility diversions. Depending on the method and equipment used, there is the potential for some vibration relating to piling operations. In terms of piling, low vibration methods involving bored or augured piles are proposed for the Proposed Scheme. This piling method significantly minimises the levels of both noise and vibration generated as it is a non-percussive piling technique. For the purposes of this assessment, the expected vibration levels during piling have been determined through reference to published empirical data. BS 5228–2 (BSI 2014b) includes measured magnitude of vibration associated with rotary bored piling using a 600mm pile diameter for bored piling into soft ground over rock (Table D.6, Ref. No. 106). Table 9.41 reproduces those associated with rotary bored piling using a 600mm pile diameter during varying aspects of the operation.

Table 9.41:Vibration Magnitudes Associated with Rotary Bored Piling

Scenario	Distance (m)	PPV (mm/s)
Auguring	5	0.54
Twisting in casing	5	0.22
Spinning off	5	0.42
Boring with rock auger	5	0.43

The vibration magnitudes outlined in Table 9.41 indicate that at distances of 5m, vibration magnitudes are orders of magnitude below those associated with any form of cosmetic damage to structurally sound and protected and historic buildings or structures (refer to Table 9.11). The vibration magnitudes will also be Imperceptible to Not Significant in terms of human response to vibration at these distances. Referring to the vibration magnitudes above and to Table 9.12, the impact is determined to be Negative, Imperceptible to Not Significant and Temporary.

During surface breaking activities, there is the potential for vibration to be generated through the ground. Empirical data for this activity is not provided in BS 5228–2 (BSI 2014b). However, the likely levels of vibration from this activity will be significantly below the vibration criteria for building damage based on monitoring data and experience from other sites. AWN Consulting has previously conducted vibration measurements under controlled conditions, during trial construction works on a sample site where concrete slab breaking was carried out. The trial construction works consisted of the use of the following plant and equipment when measured at various distances:

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

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

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

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

Widening and upgrading of existing footpaths and kerbs will involve careful deconstruction using controlled techniques. Vibration levels associated with this activity will be of similar or lower magnitude to breaking activities discussed above.

Referring to the vibration magnitudes above and in Table 9.12, vibration impacts during ground breaking activities using heavy breakers have the potential to generate a Negative, Slight to Moderate and Temporary effects at distances of 10m from the activity. Beyond 50m from this type of activity, impacts are reduced to Negative, Not Significant to Slight and Temporary. For all other works, vibration impacts will be below those associated with perceptible vibration and will be Negative, Imperceptible to Not Significant and Temporary. All construction works are orders of magnitude below limits values associated with any form or cosmetic or structural damage for

structurally sound or protected or historical buildings or structures referred to in Table 9.11. Notwithstanding the above, any construction activities undertaken on the site will be required to operate below the recommended vibration criteria, as set out in Table 9.11.

No vibration sensitive processes have been identified along the Proposed Scheme.

9.4.3.4 Construction Traffic

In addition to direct impacts from the construction works including activity at Construction Compounds, there is also the potential for noise impacts from construction traffic along public roads. A detailed analysis of construction traffic volumes has been conducted to determine the potential noise impacts associated with this phase of the Proposed Scheme.

Traffic flows have been modelled over an extensive study area across the Dublin Region as part of the traffic assessment for the Proposed Scheme. The output of the traffic modelling has been used to undertake a detailed analysis of traffic noise level changes. The noise impact assessment has focused on all modelled roads within 1km of the Proposed Scheme boundary to assess the potential noise impacts on the surrounding road network.

The Proposed Scheme will be constructed over several separate work stages and work fronts which will progressively move along the route, with different sections under construction at any given time during the construction programme. The works in some sections may only last for a number of weeks with others having longer durations. For the purpose of traffic modelling, a worst-case scenario has been determined for assessment purposes (that is a representation of the worst-case situation for construction and road network impacts, at both local and strategic levels, respectively), in order to capture the reasonable worst-case environmental impacts. Traffic flows associated with the Construction Phase represent a 'worst-case day' over a two-year construction period, assuming multiple sections are under construction simultaneously during the Construction Year (2024). This includes required traffic management measures associated with the works (e.g. road closures, one way systems, diverted routes etc.) In addition, HGV movements associated with the construction works have been added to the proposed construction access routes. For this Proposed Scheme, peak haulage activities are expected to take place during the period of Year 2. This has been used to determine a conservative value of 360 HGV movements (180 vehicles) over a peak construction day. Further information relating to construction traffic, construction sections and the construction working sequences is set out in Chapter 6 (Traffic & Transport).

Given the assessed traffic flows represent a 'worst-case day' peak scenario over the overall two-year construction period for the Proposed Scheme, the duration over which the calculated impacts will occur will be less than one year and are categorised as Temporary.

The approach adopted for construction noise traffic analysis involves calculation of noise emission levels associated with the Do Minimum and Do Something traffic scenarios and determining the related increase in noise level as a result of the additional traffic on the road network. Calculations have been undertaken for each of the roads modelled within a 1km zone of the Proposed Scheme boundary using a breakdown of the fleet types along each (i.e. buses, cars, LGVs and HGVs). The calculated noise levels are then summed to obtain a total daytime ($L_{Aeq,16hr}$) value along each road within the study area.

Noise levels associated with a passing event such as road traffic may be expressed in terms of its Sound Exposure Level (L_{AX}). The Sound Exposure Level can be used to calculate the contribution of an event or series of events to the overall noise level in a given period using the following formulae:

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

where:

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

The following Sound Exposure Level (L_{AX}) reference values have been used for the assessment. The specific data has been obtained from specific source measurements undertaken for the Proposed Scheme EIAR and from

AWN's in-house data base of road vehicle sound exposure levels measured under controlled conditions for other applications. The L_{AX} values relate to vehicles traveling at a low to moderate speed in an urban environment. The reference noise values are also comparable with those within the CNOSSOS-EU (EU 2012) document for road traffic noise for light, medium and heavy vehicles at urban speeds.

Table 9.42: Reference Sound Exposure Levels for Noise Calculations

Vehicle Type	L_{AX} at 5m from Road Edge, dB
Car	72
LGV	75
Bus	78
HGV	85

For each modelled road within study area, the associated daytime $L_{Aeq,16hr}$ traffic noise level was calculated for the Do Minimum and the Do Something scenarios (Construction Phase) for the Construction Year (2024). For all roads, calculations are made at a reference distance of 5m from the road edge.

The assessment of potential traffic noise impacts has been undertaken using the following approach:

- Traffic noise levels have been calculated along the modelled roads within a 1km study area of the Proposed Scheme;
- Noise levels have been calculated for the Do Minimum scenario for the assessed Construction Year (2024);
- Noise levels have been calculated for the Do Something scenario for the assessed Construction Year (2024); and
- The change in traffic noise levels between the Do Minimum and Do Something scenarios for the Construction Year (2024) have been calculated and the associated magnitude of change (Table 9.13) and noise level range defined (
- Table 9.15).

In the 1km study area, traffic noise impacts for all roads are determined to be Positive, Slight and Temporary to Negative, Slight to Moderate and Temporary due to the negligible to low volume of additional traffic along the road network during the Construction Phase scenario.

There are no roads in the overall study area where there are potential for significant impacts as a result of traffic redistribution onto the surrounding road network and / or as a result of construction vehicles travelling along the construction access routes. These are defined as roads with a traffic noise level above a daytime noise level of 55 dB $L_{Aeq,16hr}$ and an increase in noise level greater than 3 dB (Table 9.16). All traffic noise level changes will be below 3 dB along the assessed road network.

The overall construction traffic noise impacts across the full study area are presented in Figure 9.3 in Volume 3 of this EIAR.

9.4.3.5 Summary of Potential Construction Noise Impacts

It should be noted that the calculations set out in Section 9.4.3.2 are indicative and are used for the purposes of comparison only with the adopted criteria. Where exceedance of the recommended criteria is expected, the use of noise mitigation measures will be used as part of the construction works. Further details of the noise mitigation measures are set out in Section 9.5.1.1.

The pre-mitigation construction noise significance ratings across the Proposed Scheme are summarised in Table 9.43. In line with Table 9.9, the significance ratings are defined taking account of the prevailing baseline noise environment and the calculated CNL. The specific duration of a significant impact at a NSL also influences the overall significance determination. In accordance with the DMRB Noise and Vibration (UKHA 2020), a significant effect occurs where a moderate or major magnitude of impact occurs for periods equal to or greater than 10 or more days in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months. Given this level of detail cannot be accurately determined at EIAR stage for construction activities at any one

location, the pre-mitigation construction noise significance ratings discussed in Table 9.43 assume all activities will occur over periods equal to or greater than the durations discussed above.

For ease of reference, where activities have comparable average plant noise levels (e.g. road works and urban realm landscaping), their impacts are discussed under one heading to reflect that the range of noise levels are comparable at the same distances.

Table 9.43: Summary of Potential Construction Phase Noise Impacts

Assessment Topic	Period over which Criterion Applies	Potential Impacts
General Road Works and Urban Realm Landscaping	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, Moderate to Significant and Temporary in the absence of noise mitigation at NSLs within 15m distance from the proposed works; and • Negative, Slight to Moderate and Temporary at NSLs at distances between 20m to 30m from the proposed works; and • Negative, Not Significant and Temporary at NSLs at distances greater than 30m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5.1.1 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 25m distance from the proposed works; • Negative, Moderate to Significant and Temporary at NSLs at distances between 25m and 50m from the proposed works; and • Negative, Not Significant and Temporary at NSLs at distances greater than 50m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5.1.1 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs.
Road Widening / quiet street road works, and Utility Diversion Works	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 10m of the proposed works; • Negative, Moderate to Significant and Temporary at NSLs between 15m to 25m of the proposed works; • Negative, Slight to Moderate and Temporary at NSLs at distances between 25m to 50m from the proposed works; and • Negative, Not Significant and Temporary at NSLs at distances greater than 50m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5.1.1 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 40m of the proposed works; • Negative, Moderate to Significant and Temporary at NSLs within 40m to 75m of the proposed works; and • Negative, Not Significant and Temporary at NSLs at distances greater than 75m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5.1.1 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs.
Boundary Treatment, Bored Piling and Additional Construction Works	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, Moderate to Significant and Temporary at NSLs within 15m of the proposed works; • Negative, Slight to Moderate and Temporary at NSLs between 20m to 40m of the proposed works; and • Negative, Not Significant and Temporary at distances greater than 40m from the proposed works. All impacts noted above are in the absence of noise mitigation.

Assessment Topic	Period over which Criterion Applies	Potential Impacts
		As outlined in Section 9.5.1.1 a range of control measures will be required at specific working areas to suitably reduce noise impacts at NSLs.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary to Short-Term at NSLs within 25m of the proposed works; • Negative, Moderate to Significant and Temporary at NSLs between 30m to 50m of the proposed works; and • Negative, Not Significant and Temporary at distances greater than 50m from the proposed works. All impacts noted above are in the absence of noise mitigation.
Construction Compounds	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, Significant to Very Significant and Temporary at one NSL within 5m of Construction Compound K2; • Negative, Slight to Moderate and Temporary at NSLs between 15m to 30m distance from the three Construction Compounds; and • Negative, Not Significant and Temporary at NSLs at distances greater than 30m Construction Compounds. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5.1.1 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs. Particular emphasis will be given to positioning of high noise level plant items at a suitable set back distance from NSLs and localised screening around high noise level plant items.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 20m of the proposed Construction Compounds; • Negative, Moderate to Significant and Temporary at NSLs between 20m and 40m from the proposed Construction Compounds; and • Negative, Not Significant and Temporary at NSLs at distances greater than 40m from the Construction Compounds. All impacts noted above are in the absence of noise mitigation.
Retaining Wall Construction Works	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, moderate to significant and temporary at NSLs between 10m to 15m of the proposed works. • Slight to moderate and temporary at NSLs within 20m to 40m of the proposed works. • Not significant at distances greater than 40m from the proposed works. All impacts noted above are in the absence of noise mitigation • Not significant at distances greater than 40m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5.1.1 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary to Short-Term at NSLs within 30m of the proposed works; • Negative, Moderate to Significant and Temporary at NSLs between 30m to 50m of the proposed works; • Negative, Slight to Moderate and Temporary at NSLs between 50m to 60m of the proposed works; and • Negative, Not Significant and Temporary at NSLs at distances greater than 60m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5.1.1 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs.
Construction vibration from general road works and construction activities including bored piling and	All construction work periods	• Negative, Imperceptible to Not Significant and Temporary.

Assessment Topic	Period over which Criterion Applies	Potential Impacts
ground breaking beyond 50m		
Construction vibration from ground breaking activities within 10m of occupied residential buildings	Ground breaking during road widening and utility diversion works	• Negative, Slight to Moderate and Temporary.
Construction Traffic – within 1km study area	Peak construction periods	• Positive, Slight and Temporary to Negative, Slight to Moderate and Temporary

9.4.4 Operational Phase

9.4.4.1 Operational Noise Impact Assessment

9.4.4.1.1 Calculation of Road Traffic Noise Levels.

The key principle of the operational noise impact assessment associated with the Proposed Scheme is to determine and categorise potential changes in road traffic noise between the Do Minimum and Do Something Scenarios.

Traffic flows have been modelled over an extensive study area across the Dublin Region as part of the traffic assessment for the Proposed Scheme. The output of the traffic modelling has been used to undertake a detailed analysis of traffic noise levels changes. The noise impact assessment has focused on all modelled roads within 1km of the Proposed Scheme red line boundary to assess the potential noise impacts on the surrounding road network. Review of the traffic modelling outputs confirmed that a 1km zone was sufficient to capture all roads with potential noise impacts resulting from the operation of the Proposed Scheme.

There are two key assessment zones within the 1km study area, the specific core bus corridor (i.e. the Proposed Scheme) and the surrounding road network extending out to a 1km zone. In both instances, changes in traffic volumes and changes in fleet composition (i.e. car, bus, LGV, HGV etc.) is a key consideration when determining the change to the traffic noise environment.

9.4.4.1.1.1 Traffic Flow Data

Detailed traffic data have been provided for each modelled road within the 1km study area for the Proposed Scheme. For each road, traffic flows are provided in terms of AADT with a percentage breakdown of cars, buses, LGVs and HGVs for each road.

Traffic flow data was provided for the Opening Year (2028) and the Design Year (2043). Review of traffic volumes associated with the Opening Year (2028) are determined to be higher than those associated with Design Year (2043) for the majority of roads within the study area. This is predominately due to the modal shift towards public transport through the introduction of other committed public transport projects along with supporting transport demand management measures within the Greater Dublin Area Transport Strategy, 2022 - 2042 (NTA 2022) under the future design year scenario.

A diurnal profile for the study area was prepared for two key road types, those roads within the inner city cordon and those within the outer city cordon. This information was used to calculate traffic noise levels over the 16 hour daytime period (07:00hrs to 23:00hrs) and 8 hour night-time period (23:00hrs to 07:00hrs) for each road depending on the area in which it is located (i.e. inner or outer city cordon).

Further analysis of traffic flows during night-time periods was undertaken to understand the level of congestion or over-capacity queuing during this period on the road network in the study area (refer to Chapter 6 (Traffic & Transport). Traffic in the night-time periods is approximately 10% of the total daily (24hr) flow and represents a fraction of the peak daytime hours where congestion is modelled to occur. The analysis concluded that due to the significantly lower traffic volumes during this period, compared to those during the day, in tandem with the higher

levels of junction capacity for vehicle movements, the effects of traffic redistribution due to the Proposed Scheme will be Imperceptible or Negligible during the night-time period. Further comment on this analysis is included in Chapter 6 (Traffic & Transport). On this basis, traffic noise analysis has focused on the daytime period where the greatest potential impacts will occur in terms of overall traffic volumes along the Proposed Scheme and traffic redistribution off the Proposed Scheme due to congestion.

A summary of the key potential noise impacts associated with the Proposed Scheme is provided in the following sections.

9.4.4.1.1.2 Potential Noise Impacts Along Proposed Scheme

Along the Proposed Scheme the key changes affecting the noise environment relate to:

- Reduction in private vehicles along the Proposed Scheme resulting from the inclusion of bus lanes, bus priority signalling, Bus Gates, and modal shift to public and sustainable transport;
- Increased bus fleet and an associated reduction in private traffic;
- Alternations to the cross section of the road to include footpaths, cycle and bus lanes, and a Bus Gate where none presently exist; and
- Addition or relocation of bus stops.

9.4.4.1.1.3 Potential Noise Impacts Along Surrounding Road Network

Along the surrounding road network, potential changes to road traffic noise are associated with traffic redistribution onto local roads due to the introduction of bus priority measures, a Bus Gate, restricted turning movements, and bus lanes along the Proposed Scheme, where relevant. As noted in Section 9.4.4.1.1.1, redistributed traffic onto the surrounding road network is determined to occur during daytime periods only. During night-time periods, scheme related traffic redistribution is Negligible.

9.4.4.1.1.4 Source Noise Levels

The approach adopted for both study areas involves the calculation of noise emission levels associated with the key fleet composition types along the road (i.e., buses, cars, LGVs and HGVs). The calculated noise levels are then summed to obtain a total daytime ($L_{Aeq,16hr}$) value along each road within the study area. This approach allows for a sufficient sensitive analysis of fleet and road alignment changes which is specifically relevant along the Proposed Scheme including along individual bus lanes.

Noise levels associated with a passing event such as road traffic may be expressed in terms of its Sound Exposure Level (L_{AX}). The Sound Exposure Level can be used to calculate the contribution of an event or series of events to the overall noise level in a given period using the following formulae:

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

where:

- $L_{Aeq,T}$ is the equivalent continuous sound level over the time period T (in seconds);
- L_{AX} is the 'A-weighted' Sound Exposure Level of the event considered (dB); and
- N is the number of events over the course of time period T.

The Sound Exposure Level (L_{AX}) reference values used for the assessment are those discussed in Section 9.4.3.4 and Table 9.42

The L_{AX} values relate to fleet with internal combustion engines (ICEs). The source noise levels therefore take account of the combustion noise associated with the vehicle engine noise and rolling noise from the tyre and road interface, both of which make up the total noise associated with road traffic vehicles. At speeds of up to approximately 30km/hr (kilometres per hour), noise from light ICE vehicles is dominated by engine noise. The contribution from engine noise for light ICE vehicles reduces above this speed and rolling noise becomes the dominant contributor to overall noise levels. For heavy vehicles including buses, the contribution of the engine

noise remains a significant contributor to overall noise levels at speeds typically encountered in an urban environment (between 30km/hr to 60km/hr).

During the proposed Opening Year (2028), the percentage of vehicles with combustion engines will be reduced compared to the existing scenario. The NTA forecast for the year 2028 is for 94% of the city bus fleet to be electric vehicles (EVs) or hybrid electric vehicles (HEVs). For the Design Year (2043), the city bus fleet is forecast to be 100% electric.

The reference noise levels included within this study are therefore worst-case and reflect a full fleet of ICE vehicles. Due to the absence of reliable published sound emission data relating to EVs and HEVs, the approach for this EIAR is to assume a full fleet of ICE. Given the same fleet type is assumed for both the Do Minimum and Do Something scenarios, the relevant change in noise levels between these scenarios will remain unchanged irrespective of the fleet type used. Further comment on specific noise levels is discussed in Section 9.4.4.1.2.1.

Proposed Scheme

Using the calculation approach discussed above, the daytime $L_{Aeq,16hr}$ traffic noise level was calculated along each road modelled as part of the traffic impact assessment (refer to Chapter 6 (Traffic & Transport)) within the Proposed Scheme boundary for the Do Minimum and Do Something scenarios. All calculations are made at a reference distance of 5m from the road edge. Where relevant, the calculations have taken account of changes to the alignment of bus lanes and general traffic lanes during the Do Something scenario, specifically where these were identified to be located closer to NSLs compared to the existing cross section (i.e. the Do Minimum scenario). In these identified scenarios, the reference distance of the traffic source is accounted for in the calculations. The calculations also account for potential speed increase of buses using the dedicated bus lanes.

Surrounding Road Network

For each modelled road within the surrounding road network outside of the Proposed Scheme red line boundary, the associated daytime $L_{Aeq,16hr}$ traffic noise level was calculated for the Do Minimum and Do Something scenarios. For all roads, calculations are made at a reference distance of 5m from the road edge. No changes to the alignment cross section occurs outside of the Proposed Scheme boundary.

9.4.4.1.2 Traffic Noise Impacts

Opening Year (2028)

As noted above, traffic volumes associated with the Design Year (2043) of the Proposed Scheme are determined to be lower than those associated with the Opening Year (2028) for the majority of modelled roads within the study area. Traffic noise levels and associated impacts are therefore largely worst-case for the Opening Year (2028). For the purposes of assessing and describing potential noise impacts, opening year traffic is assumed to be representative from the Opening Year (2028) to the Design Year (2043) (i.e. for a 15 year period). The 'short-term' magnitude of change ratings from the DMRB (UKHA 2020) (Table 9.13) are therefore used to assess potential noise impacts associated with the Opening Year (2028) up to the Design Year (2043). In this instance, these impacts are described as Short to Medium-Term in duration in accordance the EPA Guidelines (EPA 2022a).

The assessment of potential traffic noise impacts has been undertaken using the following approach:

- Traffic noise levels have been calculated along each road within a 1km study area of the Proposed Scheme;
- Noise levels have been calculated for the Do Minimum scenario for the Opening Year (2028);
- Noise levels have been calculated for the Do Something scenario for the Opening Year (2028); and
- The change in traffic noise levels between the Do Minimum and Do Something scenarios for the Opening Year (2028) has been calculated, and the associated magnitude of change (Table 9.13) and noise level range (
- Table 9.15).

Along the Proposed Scheme, a direct, Positive, Moderate and Short to Medium-Term impact to a direct, Neutral and Short to Medium-Term impact is calculated (Table 9.16). This is as a result of a reduction in overall traffic volumes through the incorporation of bus priority signals and junctions, a Bus Gate, restricted turning movements for private vehicles and the incorporation of dedicated bus lanes, cycle lanes and footpaths.

Along the majority of roads off the Proposed Scheme within the 1km study area, impacts as a result of traffic redistribution are determined to be indirect, Positive, Moderate and Short to Medium-Term impact to indirect, Negative, Slight to Moderate and Short to Medium-Term impact (Table 9.16) is determined for the majority of roads due to the negligible to low volume of additional traffic added once the Proposed Scheme becomes operational.

There are a small number of roads in the overall study area where there are potential initial significant impacts. These are defined as roads with a daytime traffic noise level above 55 dB $L_{Aeq,16hr}$ and an increase in noise level greater than 3 dB. All roads with potential initial significant impacts are located off the Proposed Scheme and are indirectly impacted by redistributed traffic during daytime periods.

Further analysis of these roads was undertaken which involved the following:

- For each identified road above the potential initial significance threshold, the location or presence of noise sensitive buildings was identified and the distance from the road confirmed;
- The corrected traffic noise level at the closest NSL was calculated; and
- The overall significance rating was determined, taking account of the change in noise level during the short-term period, and the noise level range, taking account of any distance corrections.

The specific operational noise impacts during the daytime period for these roads are summarised in Table 9.45.

Table 9.44: Summary of Potential Daytime Operational Phase Impacts – Opening Year (2028)

Road	Increase above Do Minimum Scenario, dB	DMRB Short term magnitude of Impact	Calculated Road Traffic Noise at Closest NSL, dB $L_{Aeq,16hr}$	Noise Level Category	Overall Significance Rating	Potential Impact
Cashel Road	+4.4	Moderate	56	Low to Medium	Slight to Moderate	Indirect, Negative, Slight to Moderate and Short to Medium-Term
Ravensdale Park	+3.1	Moderate	59	Low to Medium	Slight to Moderate	Indirect, Negative, Slight to Moderate and Short to Medium-Term
Clonard Road	+3.6	Moderate	54	Negligible to Low	Not Significant to Slight	Indirect, Negative, Not Significant to Slight and Short to Medium-Term
Kenilworth Park	+3.0	Moderate	55	Low to Medium	Slight to Moderate	Indirect, Negative, Slight to Moderate, Short to Medium-Term

In the Opening Year (2028), along Cashel Road and Ravensdale Park, the short-term change in traffic noise is defined as moderate with a traffic noise level calculated at the closest NSLs along these roads categorised as low to medium. The overall impact is determined to be Negative, Slight to Moderate and Short to Medium-Term.

Along Clonard Road, the short-term change in traffic noise is defined as moderate with the traffic noise level calculated at the closest NSLs along this road categorised as negligible to low. Overall a Negative, Not Significant to Slight and Short to Medium-Term impact is calculated along this road.

Along Kenilworth Park, the short-term change in traffic noise is defined as moderate with the traffic noise level calculated at the closest NSLs along this road categorised as low to medium. Overall a Negative, Slight to Moderate and Short to Medium-Term impact is calculated at NSLs along this road.

The traffic noise levels of 54 to 59 dB $L_{Aeq, 16hr}$ at the closest NSLs along the roads discussed in Table 9.44 are typical of the semi-urban to urban environments in which they are located, and are also in line with road traffic noise levels in the surrounding environment, as discussed in Section 9.3. The operational noise levels will be within and up to 4 dB of the desirable low noise threshold values set within the Dublin Agglomeration NAP 2018 – 2023 (DCC; FCC; SDCC; DLRCC 2018) and is significantly below the Undesirable High noise threshold.

For all other roads off the Proposed Scheme, impacts are determined to be Indirect, Positive, Slight and Short to Medium-Term to Negative, Slight to Moderate, and Short to Medium-Term. Similar to the daytime $L_{Aeq,16hr}$ parameter, the difference in the L_{den} parameter between the Do Minimum and Do Something scenario is Positive or Not Significant along the Proposed Scheme and the surrounding road network (a change in L_{den} of less than or equal to 1 dB). Highest increases are along the roads discussed in Table 9.45 which have a calculated increase in the L_{den} parameter of 2 dB. The residual noise level along these roads are in the range of 61 and 63 dB L_{den}, in line with similar traffic noise levels along the surrounding adjacent roads and is typical for an urban environment. No increase in night-time noise levels is calculated along these roads.

A full suite of calculated noise levels along roads within the study area is included in Appendix A9.2 in Volume 4 of this EIAR.

The 2028 operational traffic noise impacts across the full study area are presented in Figure 9.4 in Volume 3 of this EIAR.

Design Year (2043)

For the Design Year (2043), the assessment of potential traffic noise impacts has been undertaken using the following approach:

- Traffic noise levels have been calculated along each road within a 1km study area of the Proposed Scheme;
- Noise levels have been calculated for the Do Minimum scenario for the Opening Year (2028);
- Noise levels have been calculated for the Do Something scenario for the Design Year (2043);
- The non-project noise change has been calculated between the Do Minimum Design Year (2043) and the Do Minimum Opening Year (2028), to account for other projects and transport strategies between these assessment years; and
- The change in traffic noise levels between the 2028 Do Minimum and the Do Something scenario for the Design Year (2043) has been calculated, accounting for any variation in Do Minimum traffic flows between the Opening Year (2028) and the Design Year (2043). The associated magnitude of change (Table 9.14) and noise level range (
- Table 9.15) has been defined.

Along the Proposed Scheme, a direct, Positive, Moderate and Long-Term to Direct, Neutral and Long-Term impact is calculated. Along the remaining roads outside of the Proposed Scheme, an indirect, Positive, Moderate and Long-Term to indirect, Negative, Not Significant to Slight and Long-Term impact is calculated due to the negligible to low volume of additional traffic added once the Proposed Scheme becomes operational.

There are no roads in the overall study area where potential significant impacts in the long-term are identified. These are defined as roads with a traffic noise level above a daytime noise level of 55 dB $L_{Aeq,16hr}$, representing an increase in noise level greater than or equal to 5 dB. The highest change in traffic noise between the Do Minimum and Do Something scenario is less than 3 dB, which is defined as a negligible magnitude of change in

the long-term period. There are therefore no roads associated with the proposed development with potential for significant effects during the design year.

The overall significance ratings are lower for the Design Year (2043) compared to the Opening Year (2028) due to the following reasons:

- The magnitude of change ratings for the long-term period are less significant compared to the Opening Year (2028) due to the recognised habituation to traffic noise environment over time; and
- Overall traffic volumes forecast along the Proposed Scheme and surrounding road network are for the majority reduced or are not increased during the Design Year (2043) compared to the Opening Year (2028) due to modal shift to public transport.

Similar to the daytime $L_{Aeq,16hr}$ parameter, the difference in the L_{den} parameter between the Do Minimum and Do Something scenario will be Positive or Not Significant along the Proposed Scheme and the surrounding road network (a change in L_{den} of less than or equal to 2 dB). No increase in night-time noise levels is calculated along these roads.

The overall operational noise impacts across the full study area for the Design Year (2043) are presented in Figure 9.5 in Volume 3 of this EIAR.

9.4.4.1.2.1 Comment on Future EV Fleet

For the roads assessed in Table 9.44, the majority of the fleet type is comprised of cars and LGVs. Given the same power type (ICE) has been assumed for both the Do Minimum and Do Something scenarios, the relative change in traffic noise remains the same for these roads, irrespective of the vehicle power.

The range of traffic noise levels calculated along these roads have the potential to be lower during the future year scenarios as a result of the conversion from ICE to EVs and HEVs, particularly along residential roads with speeds lower than 30km/hr. In addition, an overall reduction in engine noise will occur at junctions and roundabouts. The calculated traffic noise level for these roads is therefore considered a robust analysis and to be worst-case.

Along the Proposed Scheme the fleet type is a mixture of buses, cars, LGVs with a portion of HGVs. The change in noise levels is determined to be Neutral to Positive and Moderate along the Proposed Scheme for both the Opening Year (2028) and the Design Year (2043) due to reduced overall traffic volumes. Given the same fleet type (ICE) has been assumed for both the Do Minimum and Do Something scenarios, the relative change in traffic noise remains the same for these roads irrespective of the vehicle power type.

Notwithstanding, it is likely that a further reduction in overall noise level will occur along the Proposed Scheme due to the transition towards a full EV and HEV bus fleet. This reduction will occur irrespective of the Proposed Scheme. An overall reduction in engine noise from buses will occur at junctions, roundabouts and bus stops. The calculated traffic noise level assuming ICEs for all fleet is therefore considered a robust analysis and to be worst-case.

9.4.4.2 Operational Vibration Impact Assessment

Once operational, buses will use the dedicated bus lanes for the Proposed Scheme. Analysis of traffic data for the Proposed Scheme, however, indicates a reduction in overall AADT traffic flows along the Proposed Scheme.

Reference to the monitoring results in Table 9.22 and Table 9.23, confirms that vibration levels associated with passing buses and other vehicular traffic at distances of 2.5m to 10m from the road edge are negligible in terms of human perception and building response. Vibration levels associated with a passing bus were recorded at 0.1mm/s PPV or less under the monitored scenarios. These values are below the normal range of perceptible human response to vibration and would not pose any significant impact.

A review of the traffic data for the Proposed Scheme indicates that the maximum number of buses travelling in-bound or outbound will be 280 over the 16 hour daytime period. Using this number and the highest VDV event measured during a bus pass at a reference distance of 5m from the road edge (0.0033 $m/s^{1.75}$), the daytime $VDV_{,b,day}$ value is calculated as 0.014 $m/s^{1.75}$. Reference to Table 9.17 confirms this value is orders of magnitude

below those associated with a low probability of adverse comment. The overall impact is Neutral, Negligible and Long-Term.

9.4.4.3 Bus Stops

Noise sources associated with bus stops relate to idling engines, acceleration and deceleration from the stop and air brakes. At close distances to a stop, these activities are perceptible over normal passing road traffic. However, the level of perceptibly is masked to a greater extent along heavily trafficked routes with higher road traffic noise levels.

The majority of bus stops will be retained in their current position as part of the Proposed Scheme with no change in the noise environment as a result. Whilst a small number of bus stops will be removed or relocated, a small number of new bus stops will be installed as part of the Proposed Scheme. All new bus stops will be along the Proposed Scheme and the prevailing noise environment will be dominated by road traffic from cars, buses, LGVs and HGVs.

Review of the proposed new bus stop locations indicates that those adjacent to retail and commercial areas which are not noise sensitive areas will not pose any significant noise impacts. There are five locations identified where new bus stops are proposed with noise sensitive locations in proximity and where minimal screening will be in place. These are located at the following locations:

- Chainage A+140, R817 Kimmage Road Lower (east);
- Chainage A+1010, R817 Kimmage Road Lower (east);
- Chainage A+1365, R817 Kimmage Road Lower (east);
- Chainage A+3250, R137 Clanbrassil Street lower (west); and
- Chainage A+3350, R137 Clanbrassil Street lower (east).

It is not feasible to install physical barriers along these bus stop locations due to their positions along a traffic lane.

The closest noise sensitive locations (residential dwellings) to these new bus stop locations are close to the existing road edge and are exposed to passing road traffic noise levels typically between 65 and 69dB $L_{Aeq,16hr}$ which will dominate noise levels at these locations.

As discussed in Section 9.4.4.1.2.1, during the proposed Opening Year (2028), the NTA forecast is for 94% of the city bus fleet to be EVs or HEVs. For the Design Year (2043), the city bus fleet is forecast to be 100% electric. The operation of electric and hybrid buses will eliminate ICE noise from buses accelerating, decelerating and idling at bus stops which is the dominant noise source. In addition, the characteristic of noise from EVs is subjectively less intrusive compared to those with ICEs and is masked to a much greater extent by surrounding road traffic.

It is noted the bus stops along the Proposed Scheme will be used by other bus operators which may not transition to EV and HEVs over the same period as the city bus fleet. The volume of these buses along the Proposed Scheme will, however, be significantly less than the city bus fleet and hence, noise levels associated with these areas will not generate significant noise levels over the prevailing noise environment. The overall impact is Negative, Not Significant and Long-Term.

9.4.4.4 Road Maintenance

The Proposed Scheme is expected to have an operational life span of 60 years. Once operational, the Proposed Scheme will be subject to the same maintenance programme as the existing road infrastructure. This will involve upgrade and / or replacement of road surfaces over the life span of the Proposed Scheme). These activities will occur along sections of the Proposed Scheme as required. Noise impacts associated with these activities will be of similar magnitude to those described in Section 9.4.3.2.1.

9.4.4.5 Assessment Summary

The Operational Phase noise impacts associated with the Proposed Scheme are summarised in Table 9.45.

Table 9.45: Summary of Potential Operational Phase Impacts

Assessment Topic	Potential Impact
Opening Year (2028) traffic noise – Proposed Scheme	Direct, Positive, Moderate and Short to Medium-Term to Direct, Neutral, and Short to Medium-Term
Opening Year (2028) traffic noise – Surrounding road network	Indirect, Positive, Moderate and Short to Medium-Term to Indirect, Negative, Slight to Moderate and Short to Medium-Term
Design Year (2043) traffic noise – Proposed Scheme	Direct, Positive, Moderate and Long-Term to Direct, Neutral and Long-Term
Design Year (2043) traffic noise – Surrounding road network	Indirect, Positive, Moderate and Long-Term to Indirect, Negative, Not Significant to Slight and Long-Term
Operational Phase Vibration	Neutral, Negligible and Short to Long-Term
Bus stops – new locations	Negative, Not Significant and Long-Term

9.5 Mitigation and Monitoring Measures

9.5.1 Construction Phase

9.5.1.1 Noise

The appointed Contractor will be required to take specific noise abatement measures to the extent required and comply with the recommendations of BS 5228–1 (BSI 2014a) and S.I. No. 241/2006 - European Communities (Noise Emissions by Equipment for Use Outdoors) (Amendment) Regulations 2006. The mitigation measures outlined below for the Construction Phase have also been included in the Construction and Environmental Management Plan (CEMP) in Appendix A5.1 in Volume 4 of this EIAR.

These measures will ensure that:

- During the Construction Phase, the appointed Contractor will be required to manage the works to comply with the limits detailed in Section 9.2.4.1 using methods outlined in BS 5228–1 (BSI 2014a); and
- The best means practicable, including proper maintenance of plant and equipment, will be employed to minimise the noise produced by on-site operations.

BS 5228–1 includes guidance on several aspects of construction site practices, which include, but are not limited to:

- Selection of quiet plant;
- Control of noise sources;
- Screening;
- Hours of work;
- Liaison with the public; and
- Monitoring.

The appointed Contractor will put in place the most appropriate noise control measures depending on the level of noise reduction required at individual working areas (i.e. based on the construction threshold values for noise and vibration set out in Table 9.8 and Table 9.11). Reference to Table 9.43 indicates that intrusive works occurring within 75m of NSLs will need specific noise control measures to reduce impacts depending on time period over which they will occur (i.e. daytime or evening).

9.5.1.1.1 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 on the site 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 appointed Contractor will evaluate the choice of excavation, breaking or other working method taking into account various ground conditions and site constraints. Where alternative lower noise generating equipment are available that will provide equivalent structural / excavation / breaking results, these will be selected to control noise within the relevant thresholds, where it is practicable to do so.

The decision regarding the type of excavation technique or other construction activity to be used on a site will normally be governed by a range of engineering and environmental constraints. In these instances, it may not be possible for technical reasons to replace an item of plant with a quieter alternative. In some instances, the adoption of a quieter method may prolong the overall process, with the net result being that the overall disturbance to the community will not necessarily be reduced.

9.5.1.1.2 Noise Control at Source

The following measures will be implemented, if required, by the appointed Contractor to control noise at source in order to remain below the threshold values for noise set out in Table 9.8, which relate to specific site considerations:

- For mobile plant items such as dump trucks, planers, excavators and loaders, the installation of an acoustic exhaust, utilising an acoustic canopy to replace the normal engine cover and / or maintaining enclosure panels closed during operation can reduce noise levels by up to 10 dB;
- For percussive tools such as pneumatic concrete breakers and tools 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;
- The Construction Compounds are in close proximity to NSLs (refer to Table 9.32) will incorporate a strict noise control policy relating to materials handling will be applied. Noisy items of plant will be sited away from noise sensitive boundaries.
- Where compressors, generators and pumps are located in proximity to NSLs and have the potential to exceed the construction noise thresholds, these will be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation; and
- Resonance effects in panel work or cover plates can be reduced through stiffening or the application of damping compounds, while other noise nuisance can be controlled by fixing resilient materials in between the surfaces in contact.

9.5.1.1.3 Screening

Screening is an effective method of reducing CNLs at a receiver location and can be used successfully as an additional measure to other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen, its mass, and its position relative to both the source and receiver. BS 5228–1 (BSI 2014a) 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.

Erection of localised demountable enclosures or screens will be used around breakers or drill bits, as required, when in operation in proximity to NSL boundaries with the potential to exceed the construction noise thresholds. Annex B of BS 5228–1 (Figures B1, B2 and B3) provide typical details for temporary and mobile acoustic screens, sheds and enclosures that can be constructed on-site from standard materials. A well placed and designed mobile temporary screen around a breaker or excavation can effectively reduce noise emissions by 10 dB(A).

The appointed Contractor will provide a site hoarding of 2.4m height along noise sensitive boundaries, at a minimum, at the Construction Compounds. The length of the screen should in practice be at least five times the height. However, if shorter sections are necessary, then the ends of the screen will be wrapped around the source.

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 (kilogrammes per metre squared) will give adequate sound

insulation performance. The use of a standard 2.4m high construction site hoarding will provide a sufficient level of noise screening once it is installed at a suitable position between the source and receiver.

In addition, careful planning of the construction site layout will also be considered. Within the Construction Compounds, the placement of site buildings such as offices and stores between the site and sensitive locations can provide a good level of noise screening.

9.5.1.1.4 Hours of Work

It is envisaged that generally construction working hours will be between 07:00hrs and 23:00hrs on weekdays, and between 08:00hrs and 16.30hrs on Saturdays. Night-time and Sunday working will be required during certain periods to facilitate street works that cannot be undertaken under daytime / evening time conditions. The planning of such works will take consideration of sensitive receptors, in particular any nearby residential areas.

Construction activities will be scheduled in a manner that reflects the location of the site and the nature of neighbouring properties. Construction activities / plant items will be considered with respect to their potential to exceed construction noise thresholds at NSLs and will be scheduled according to their noise level, proximity to sensitive locations and possible options for noise control. In situations where an activity with potential for exceedance of construction noise thresholds is scheduled (e.g. road widening and utility diversions or activities with similar noise levels identified in Table 9.43), other construction activities will be scheduled to not result in significant cumulative noise levels.

9.5.1.1.5 Liaison with the Public

For the Proposed Scheme, the major sources of noise are essentially mobile and the noise received at any NSL will therefore vary from day to day as the work proceeds. The duration of excavation, breaking and other high noise or vibration activities is usually short in relation to the length of construction work as a whole, and the amount of time spent working near to sensitive areas can represent only a part of the overall period.

The NTA will establish clear forms of communication that will involve the appointed Contractor and NSLs in proximity to the works, so that residents or building occupants are aware of the likely duration of activities likely to generate noise or vibration that are potentially significant, as set out in Table 9.8 and Table 9.11.

9.5.1.1.6 Monitoring

During the Construction Phase the appointed Contractor will carry out noise monitoring at representative NSLs to evaluate and inform the requirement and / or implementation of noise management measures. Noise monitoring will be conducted in accordance with ISO 1996–1 (ISO 2016) and ISO 1996–2 (ISO 2017). The selection of monitoring locations will be based on the nearest representative NSLs to the working area which will progress along the length of the Proposed Scheme.

9.5.1.2 Vibration

On review of the likely vibration levels associated with construction activities, it is considered that the construction of the Proposed Scheme is not expected to give rise to vibration that is either significantly intrusive or capable of giving rise to structural or cosmetic damage to buildings.

Vibration from construction activities will be limited to the values set out in Table 9.11 to avoid any form of potential cosmetic damage to buildings and structures. Monitoring will be undertaken at identified sensitive buildings, where proposed works have the potential to be at or exceed the vibration limit values in Table 9.11.

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

- A clear communication programme will be established by the NTA 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 9.12. 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 (as per Table 9.12) will be restricted to daytime hours only, as far as practicable; and
- Appropriate vibration isolation shall be applied to plant (such as resilient mounts to pumps and generators), where required and where feasible.

9.5.1.3 Summary of Impacts

A reduction of 10 dB has been applied to construction noise calculations to account for the level of noise reduction available by applying by the various noise mitigation measured outlined above.

At the closest properties impacted by the works (typically between 10m to 30m), the prevailing daytime baseline noise level is assumed as 67 dB $L_{Aeq,12\ hr}$ and the evening baseline noise level as 65 dB $L_{Aeq,4hr}$. As discussed in Section 9.3.2.4, baseline noise levels measured as part of the baseline study are potentially 1 dB to 2 dB lower than those under normal conditions without restricted movements due to COVID-19. To allow for a conservative assessment, however no correction has been made to these values when discussing the CNLs against the baseline noise environment.

Following mitigation, the highest predicted CNLs are between 67 to 73 dB $L_{Aeq,T}$ at the closest properties impacted by the most intrusive works. The higher impacts will be at those properties where the prevailing baseline is below the specific predicted construction works noise levels. Table 9.46 presents the predicted Construction Phase impacts following the implementation of mitigation and monitoring measures and assumes that the construction activities have the potential to operate for periods equal to or greater than 10 or more days in any 15 consecutive days, or for a total number of days exceeding 40 in any six consecutive months at impacted NSLs.

The results are summarised based on the distance of a NSL to a working area. The closest identified NSL to the edge of the works, unscreened by intervening buildings are identified in the relevant impact tables in Section 9.4.3.2.

Table 9.46: Summary of Predicted Construction Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Period over which Criterion Applies	Potential Impacts (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
General Road Works, and Urban Realm Landscaping	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, Moderate to Significant and Temporary in the absence of noise mitigation at NSLs within 15m distance from the proposed works; • Negative, Slight to Moderate and Temporary at NSLs at distances between 20m to 40m from the proposed works; and • Negative, Not Significant and Temporary at NSLs at distances greater than 30m from the proposed works.	• Negative, slight to moderate and temporary at NSLs within 10m distance from the proposed works. • Negative, not significant and temporary at NSLs at distances greater than 10m from the proposed works.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 25m distance from the proposed works; • Negative, Moderate to Significant and Temporary at NSLs at distances between 25m and 50m from the proposed works; • Negative, Sight to Moderate and Temporary at NSLs at distances greater than 50m from the proposed works; and • Negative, Not Significant and Temporary at NSLs at	• Negative, moderate to significant and temporary at NSLs within 15m from the proposed works. • Negative, not significant and temporary at NSLs at distances greater than 15m from the proposed works.

Assessment Topic	Period over which Criterion Applies	Potential Impacts (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
		distances greater than 50m from the proposed works.	
Road Widening / quiet street road works and Utility Diversion Works	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 10m of the proposed works; • Negative, Moderate to Significant and Temporary at NSLs between 15m to 25m of the proposed works; • Negative, Slight to Moderate and Temporary at NSLs at distances between 25m to 50m from the proposed works; and • Negative, Not Significant and Temporary at NSLs at distances greater than 50m from the proposed works.	• Negative, slight to moderate and temporary at NSLs within 15m distance from the proposed works. • Negative, not significant and temporary at NSLs at distances greater than 15m from the proposed works.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 40m of the proposed works. • Negative, Moderate to Significant and Temporary at NSLs within 40m to 75m of the proposed works; • Negative, Not Significant and Temporary at NSLs at distances greater than 75m from the proposed works.	• Negative, significant to very significant and temporary at NSLs within 10m from the proposed works. • Negative, moderate to significant and temporary at NSLs within 15m to 20m from the proposed works. • Negative, not significant and temporary at NSLs at distances greater than 20m from the proposed works.
Boundary Treatments Works, Additional Works and Bored Piling	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, Moderate to Significant and Temporary at NSLs within 15m of the proposed works; • Negative,Slight to Moderate and Temporary at NSLs within 20m to 40m of the proposed works; and • Negative, Not Significant and Temporary at distances greater than 40m from the proposed works.	• Negative, slight to moderate and temporary at NSLs within 10m distance from the proposed works. • Negative, not significant and temporary at NSLs at distances greater than 10m from the proposed works.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary to Short-Term at NSLs within 25m of the proposed works; • Negative,Moderate to Significant and Temporary at NSLs between 25m and 50m of the proposed works; • Negative, Not Significant and Temporary at distances greater than 50m from the proposed works.	• Negative, moderate to significant and temporary at NSLs within 15m from the proposed works. • Negative, not significant and temporary at NSLs at distances greater than 15m from the proposed works.
Construction Compounds	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, Significant to Very Significant and Temporary at NSL's within 5m of Construction Compound K2 • Negative, Slight to Moderate and Temporary at NSL's between 15 to 30m distance from the three Construction Compounds during daytime	• Negative, Slight to Moderate and Temporary at NSLs within 10m of the Construction Compound boundaries; and • Negative, Not Significant and Temporary at all other distances. • Refer to Table 9.32 for identified NSLs and distances from Construction Compounds

Assessment Topic	Period over which Criterion Applies	Potential Impacts (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 20m of the proposed Construction Compounds during evening or weekend periods. • Moderate to Significant and Temporary at NSLs between 20m and 40m from the proposed Construction Compounds during evening or weekend periods.	• Negative, Moderate to Significant at NSLs within 10m of the Construction Compound boundaries; • Negative, Slight to Moderate and Temporary between 10m to 15m distance. Refer to Table 9.32 for identified NSLs and distances from Construction Compounds • Negative, Not Significant and Temporary at NSLs at a distance greater than 15m.
Retaining Wall Construction Works	Monday to Friday: Daytime (07:00hrs – 19:00hrs)	• Negative, moderate to significant and temporary at NSLs between 10m to 15m of the proposed works. • Slight to moderate and temporary at NSLs within 20m to 40m of the proposed works. • Not significant at distances greater than 40m from the proposed works. All impacts noted above are in the absence of noise mitigation	• Negative, Slight to Moderate and Temporary at NSLs within 15m distance from the proposed works; and • Negative, Not Significant and Temporary at NSLs at distances greater than 15m from the proposed works.
	Monday to Friday: Evening: (19:00hrs – 23:00hrs) or Saturdays (08:00hrs – 16:30hrs)	• Negative, Significant to Very Significant and Temporary at NSLs within 30m distance from the proposed works; • Negative, Moderate to Significant and Temporary at NSLs between 30m to 50m of the proposed works; • Negative, Slight to Moderate and Temporary at NSLs between 50m to 60m of the proposed works; and • Negative, Not Significant and Temporary at distances greater than 60m from the proposed works.	• Negative, Moderate to Significant and Temporary at NSLs between 10m to 15m from the proposed works; • Negative, not significant and temporary at NSLs at distances greater than 15m from the proposed works
Construction vibration from general road works and construction activities including bored piling and ground breaking beyond 50m	All Construction work periods	• Negative, Imperceptible to Not Significant and Temporary	• Negative, Imperceptible to Not Significant and Temporary
Construction vibration from ground breaking activities within 10m of occupied residential buildings	Ground breaking during road widening and utility diversion works	• Negative, Slight to Moderate and Temporary	• Negative, Slight and Temporary
Construction Traffic – within 1km study area	Peak construction work periods	• Positive, Slight and Temporary to Negative, Slight to Moderate and Temporary	• Positive, Slight and Temporary to Negative, Slight to Moderate and Temporary

9.5.2 Operational Phase

9.5.2.1 Change in Road Traffic Noise

The impact assessment has determined that there are no calculated significant direct or indirect traffic noise impacts across the study area for the Proposed Scheme. The range of noise level changes and overall noise levels calculated do not require any specific noise mitigation measures to be incorporated into the Proposed Scheme.

9.5.2.2 Bus Stops

The impact assessment has determined that noise impacts associated with the provision of relocated or new bus stop locations will be Negative, Not Significant and Long-Term, taking account of the prevailing noise environment dominated by road traffic and the proposed transition to electric and hybrid for the city bus fleet between the Opening Year (2028) and the Design Year (2043). No further noise mitigation measures are proposed.

9.5.2.3 Road Maintenance

Impacts associated with this activity will be controlled in line with best practice measures in line with regular road maintenance works across DCC and FCC.

9.5.2.4 Impact Overview

The predicted Operational Phase impacts associated within the Proposed Scheme are summarised in Table 9.47.

Table 9.47: Summary of Predicted Operational Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Predicted Impact (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
Opening Year (2028) traffic noise – Proposed Scheme	Direct, Positive, Moderate and Short to Medium-Term to Direct, Neutral, and Short to Medium-Term	Direct, Positive, Moderate and Short to Medium-Term to Direct, Neutral, and Short to Medium-Term
Opening Year (2028) traffic noise – Surrounding road network	Indirect, Positive, Moderate and Short to Medium-Term to Indirect, Negative, Slight to Moderate and Short to Medium-Term	Indirect, Positive, Moderate and Short to Medium-Term to Indirect, Negative, Slight to Moderate and Short to Medium-Term
Design Year (2043) traffic noise – Proposed Scheme	Direct, Positive, Moderate and Long-Term to Direct, Neutral and Long-Term	Direct, Positive, Moderate and Long-Term to Direct, Neutral and Long-Term
Design Year (2043) traffic noise – Surrounding road network	Indirect, Positive, Moderate and Long-Term to Indirect, Negative, Not Significant to Slight and Long-Term	Indirect, Positive, Moderate and Long-Term to Indirect, Negative, Not Significant to Slight and Long-Term
Operational Phase Vibration	Neutral, Imperceptible and Short to Long-Term	Neutral, Imperceptible and Short to Long-Term
Bus stops – new locations	Negative, Not Significant and Long-Term	Negative, Not Significant and Long-Term

9.6 Residual Impacts

9.6.1 Construction Phase

Given the linear nature of the works, noise emissions related to construction works will be of temporary impact at any one area as the works progress along the length of the Proposed Scheme. The application of the proposed noise thresholds and restricted hours of operation, along with the implementation of appropriate noise control measures, will ensure that noise impact is controlled within acceptable limit values.

During the Construction Phase of the Proposed Scheme, noise levels at properties closest to working areas will be temporarily increased. The most appropriate noise mitigation measures for each work area will be determined taking account of the various control measures included within Section 9.5.1.1, and the CEMP in Appendix A5.1

in Volume 4 of the EIAR and Chapter 5 (Construction). The various mitigation measures will be selected in order to control CNLs to within the limit values included in Table 9.8 as far as practicable.

Once the various mitigation measures are put in place, noise impacts associated with the Construction Phase will be Negative, Not Significant to Moderate and Temporary during all key Construction Phases during daytime periods.

During evening periods, noise impacts associated with the Construction Phase will be Negative, Moderate to Significant and Temporary for the majority of scheduled works within 20m of the works. As per DMRB Noise and Vibration (UKHA 2020), in cases of moderate to major magnitude of impacts, the duration of works determines the overall significance rating. As part of the mitigation measures, the durations advised in the DMRB Noise and Vibration will be followed, where feasible, to reduce overall significance effects (i.e. scheduling works to occur for periods of less than 10 days / nights over 15 consecutive day / night periods and less than 40 days over six consecutive months where significant effects are identified). Once the CNL and duration of works is considered in line with the DMRB Noise and Vibration, all key Construction Phase residual noise levels will be Not Significant, whilst meeting the scheme objectives set out in Chapter 1 (Introduction).

The assessment has indicated that the use of standard construction activities can operate comfortably within the recommended vibration limits for standard residential and other light-framed buildings. With the adoption of best practice methodologies, vibration impacts at the most sensitive premises can be adequately mitigated to within acceptable levels relating to disturbance, whilst meeting the scheme objectives set out in Chapter 1 (Introduction).

9.6.2 Operational Phase

Once operational, there will be a Positive to Neutral direct impact along the Proposed Scheme due to a reduction in traffic volumes during both the Opening Year (2028) and the Design Year (2043).

During the year of opening, 2028, increased traffic noise levels will occur along a small number of roads adjacent to the Proposed Scheme as a result of traffic re-distribution during daytime periods. During this initial short to medium term phase, the highest noise impacts will be Negative, Slight to Moderate and Short to Medium-Term along a small number of roads discussed in Table 9.42. Along the remaining road network within the 1km study area, resultant noise impacts are determined to be Positive, Moderate and Short to Medium-Term to Negative, Slight and Short to Medium-Term.

During the Design Year (2043), increased traffic noise levels will occur along a small number of roads adjacent to the Proposed Scheme as a result of traffic re-distribution during daytime periods. During the long-term phase, noise impacts are calculated as Positive, Moderate and Long-Term impact to Negative, Not Significant to Slight and Long-Term impact along the surrounding road network off the Proposed Scheme.

The Proposed Scheme aligns with the policy objectives of The Dublin Agglomeration NAP 2018 – 2023 (DCC; FCC; SDCC; DLRCC 2018) to reduce traffic noise exposure to populations across the city through the incorporation of improved public transport, increasing bus, train and bicycle journeys and the replacement of diesel fleet to electric and natural gas fleet. The results of the noise assessment for the Operational Phase confirms that with the introduction of the various measures included as part of the Proposed Scheme, a reduction in traffic noise can be achieved along the Proposed Scheme where highest existing traffic noise levels are experienced. The various design measures associated with the Proposed Scheme also align with the various intervention measures recommended within the WHO Environmental Noise Guidelines (WHO 2018) to reduce traffic noise exposure across populations.

There are no significant residual Operational Phase noise or vibration impacts associated with the Proposed Scheme, whilst meeting the scheme objectives set out in Chapter 1 (Introduction).

9.7 References

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

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