Chapter 07
Air Quality

Contents

7. Air Quality

7.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has considered the potential air quality impacts associated with the Construction and Operational Phases of the Clongriffin to City Centre Scheme (hereafter referred to as the Proposed Scheme).

During the Construction Phase, the potential air quality impacts associated with the development of the Proposed Scheme have been assessed. This included construction activities such as utility diversions, road carriageway / cycleway / footway resurfacing and kerb road realignments. Construction traffic construction access routes are also assessed as part of the study area for this phase of the works.

During the Operational Phase, the potential air quality impacts associated with altered traffic flows along the Proposed Scheme, reallocated traffic lanes and displaced traffic flows have been assessed.

The assessment has been carried out according to best practice and guidelines relating to air quality.

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 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.

7.2 Methodology

The assessment has been undertaken with reference to the most applicable guidance documents relating to air quality which are set out in the following sections of this Chapter.

An overview of the methodology undertaken for the air quality impact assessment is outlined below:

- A detailed baseline air monitoring study has been undertaken in order to characterise the existing ambient environment in areas along the Proposed Scheme. This has been undertaken through a review of available published ambient air monitoring data and site-specific ambient air monitoring at sensitive locations along the Proposed Scheme;
- A review of the most applicable standards and guidelines has been reviewed in order to define the air quality significance criteria for the Construction and Operational Phases of the Proposed Scheme;
- Predictive calculations and impact assessments relating to the likely Construction Phase air quality impacts have been undertaken at the nearest sensitive locations to the construction work areas associated with the Proposed Scheme;
- Predictive calculations have been performed to assess the potential air quality 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 where required, to reduce, where necessary, the identified potential air quality impacts associated with the Proposed Scheme.

7.2.1 Study Area

The study area for this assessment covers the length of the Proposed Scheme, approximately 5.7 kilometres (km) from the Mayne River Avenue – R107 Malahide Road Junction to the Marino Mart / Fairview – Malahide Road Junction, and the area either side of the Proposed Scheme up to a maximum distance of 350 metres (m) during the Construction Phase, and 200m during the Operational Phase. For the Construction Phase assessment, the focus is on air quality sensitive receptors adjacent to the proposed works (e.g. utility diversions, road widening works, road excavation works (where required), road reconfiguration and resurfacing works) that are susceptible to air quality impacts but also those receptors along construction traffic access routes or routes along which traffic is redistributed within the study area (please see Chapter 5 (Construction) in Volume 2 of this EIAR for more information on construction traffic access routes). The extent of the overall study area is typically up to a maximum of 350m from a specific area of construction work, as per the Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction (hereafter referred to as the IAQM Guidance) (IAQM, 2014), with the key impacted study areas focused up to a maximum of 100m depending on the air emission sources in question and the local area under consideration. For the Operational Phase, assessment of the dust impacts from maintenance of the route has been scoped out on the basis that these activities have low potential for dust release and are likely to have a negligible impact on air quality sensitive receptors.

For the Construction Phase and Operational Phase traffic assessment, the focus is on air quality sensitive receptors which bound the Proposed Scheme and those along diverted traffic routes within the study area. Highly sensitive air quality receptors during the construction phase include residential properties, hospitals, schools and residential care homes, whilst commercial and workplace properties are generally viewed as being of medium sensitivity (IAQM 2014). Sensitive receptor locations include residential housing, schools, hospitals, places of worship, sports centres and shopping areas, i.e. locations where members of the public are likely to be regularly present (TII 2011). Designated areas of conservation (either Irish or European designation) are also considered sensitive air quality receptors (TII 2011). Potential impacts to air quality relate to alterations to traffic patterns (e.g. introduction of a new bus lane or due to redistributed traffic), with particular attention focused on those areas where the Proposed Scheme will be encroaching closer to air quality receptors, specifically where bus or traffic lanes are moving closer to air quality receptors.

For the Construction Phase and Operational Phase traffic assessment, the focus is on air quality receptors within an overall study area of 200m from the Proposed Scheme, as per the Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (hereafter referred to as the TII Air Quality Guidelines) (TII 2011) or diverted routes within the key impacted study areas focused within 50m to 100m. The range of air quality sensitive receptors for the two geographical sections are discussed in Table 7.1. The locations of sensitive receptors are provided initially in Table 7.19 and also in Figures 7.3 to 7.8 in Volume 3 of this EIAR.

Table 7.1: Description of Air Quality Receptors within the Study Area

Geographical Section	Description of Study Area
Mayne River Avenue to Gracefield Road – Malahide Road	Within this study area, the key air quality sensitive receptors are predominately residential dwellings which bound the east and west of the Proposed Scheme. There are some Sections of less sensitive industrial receptors between Priorswood Road and the Oscar Traynor Road to the west of the Proposed Scheme. There are two secondary schools (Chanel Catholic College and Mercy College) and a church (St. Brendan's Catholic Church) within 200m of the Proposed Scheme at the junction of the Malahide Road and Main Street, Coolock.
Gracefield Road to Marino Mart / Fairview – Malahide Road	Within this study area, the key air quality sensitive receptors are predominately residential dwellings which are located in close proximity to the east and west of the Proposed Scheme. The Proposed Scheme passes within 50m of Donnycarney Church (Our Lady of Consolation) and Nazareth House nursing home, which is considered a highly sensitive receptor to air quality impacts. The Proposed Scheme will help to further reduce through traffic on Brian Road, Carleton Road and Haverty Road. These roads are within high sensitivity residential area with residential receptors within 20m of the road.

7.2.2 Relevant Guidelines, Policy and Legislation

The following 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 Statements (EPA 2002);
- Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (EPA 2003);
- Draft Advice Notes for Preparing Environmental Impact Statements (EPA 2015); and
- Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2017).

The statutory ambient air quality standards in Ireland are outlined in S.I. No. 180 of 2011 Air Quality Standards Regulations 2011 (hereafter referred to as the Air Quality Regulations), which incorporate the ambient air quality limits set out in Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (hereafter referred to as the CAFE Directive), for a range of air pollutants. The statutory ambient air quality guidelines are discussed in greater detail in Section 7.2.2.1.

In addition to the specific statutory air quality standards, the assessment has made reference to national guidelines, where available, in addition to international standards and guidelines relating to the assessment of ambient air quality impact from road schemes. These are summarised below:

- Institute of Air Quality Management Guidance (IAQM 2014 2020);
- The Transport Infrastructure Ireland Air Quality Guidelines (TII 2011);
- Guidelines for Assessment of Ecological Impacts of National Roads Schemes (hereafter referred to as the TII Ecological Guidelines) (TII 2009);
- Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (European Commission 2013);
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report (European Commission 2017);
- United Kingdom (UK) Department of Environment Food and Rural Affairs (DEFRA) Part IV of the Environment Act 1995: Local Air Quality Management Policy Guidance (PG16) (hereafter referred to as LAQM (PG16)) (DEFRA 2016);
- Part IV of the Environment Act 1995: Local Air Quality Management Technical Guidance (TG16) (hereafter referred to as LAQM (TG16)) (DEFRA 2018);
- UK Highways Agency (UKHA) Design Manual for Roads and Bridges (DMRB) – LA 105 Air Quality (hereafter referred to as LA 105 Air Quality) (UKHA 2019); and

- World Health Organization (WHO) Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide Global Update 2005 (hereafter referred to as the WHO Air Quality Guidelines) (WHO 2006).

7.2.2.1 Ambient Air Quality Standards / Limit Values

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. The applicable legal standards in Ireland are outlined in the Air Quality Regulations, which incorporate the CAFE Directive. The Air Quality Regulations set limit values for the relevant pollutants nitrogen dioxide (NO_2) and nitrogen oxides (NO_X), particulate matter (PM) with an aerodynamic diameter of less than 10 microns (PM_{10}), PM with an aerodynamic diameter of less than 2.5 microns ($PM_{2.5}$), lead (Pb), sulphur dioxide (SO_2), benzene and carbon monoxide (CO) (Table 7.2).

Table 7.2: Air Quality Regulations (based on the CAFE Directive)

Pollutant	Regulation*	Limit Type	Value**
NO_2	S.I. 180 of 2011	Hourly limit for protection of human health - not to be exceeded more than 18 times / year	200µg/m^3 NO_2
		Annual limit for protection of human health	40µg/m^3 NO_2
Nitrogen Oxides (NO + NO_2)		Critical limit for the protection of vegetation and natural ecosystems	30µg/m^3 NO + NO_2
Lead	S.I. 180 of 2011	Annual limit for protection of human health	0.5µg/m^3
SO_2	S.I. 180 of 2011	Hourly limit for protection of human health - not to be exceeded more than 24 times / year	350µg/m^3
		Daily limit for protection of human health - not to be exceeded more than three times / year	125µg/m^3
		Critical limit for the protection of vegetation and natural ecosystems (calendar year and winter)	20µg/m^3
PM (as PM_{10})	S.I. 180 of 2011	24-hour limit for protection of human health - not to be exceeded more than 35 times / year	50µg/m^3
		Annual limit for protection of human health	40µg/m^3
PM (as $PM_{2.5}$)	S.I. 180 of 2011	Annual limit for protection of human health	25µg/m^3
Benzene	S.I. 180 of 2011	Annual limit for protection of human health	5µg/m^3
CO	S.I. 180 of 2011	8-hour limit (on a rolling basis) for protection of human health	10mg/m^3

* CAFE Directive replaces the previous Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management and daughter directives, Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air and Directive 2000/69/EC of the European Parliament and of the Council of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air.

** µg/m3 (micrograms per cubic metre); mg/m3 (milligrams per cubic metre)

The WHO Air Quality Guidelines (WHO 2006) values relating to NO_2, PM_{10} and $PM_{2.5}$ are shown in Table 7.3. The WHO Air Quality Guidelines values are more stringent than the European Union (EU) statutory limit values for PM_{10} and $PM_{2.5}$. In relation to NO_2, the compliance limit values are equivalent. However, the WHO one hour guideline value is an absolute value while the EU standards allows this limit to be exceeded for 18 hours / annum without breaching the statutory limit value.

In May 2020, as part of the joint WHO / United Nations Environment Program (UNEP) / World Bank *BreatheLife* campaign, the four Dublin local authorities signed a commitment to achieve the WHO Air Quality Guidelines by a target date of 2030.

The appropriate compliance limit values for the assessment of air quality impacts of the Proposed Scheme are those outlined in the Air Quality Regulations, which incorporate the CAFE Directive. Both the compliance limit value and WHO guideline value for NO_2, the pollutant most likely to exceed either, are 40µg/m^3. The assessment therefore considers both compliance with the EU limit and meeting the WHO guideline value.

Table 7.3: WHO Air Quality Guidelines (WHO 2006)

Pollutant	Regulation	Limit Type	Value
NO_2	WHO Air Quality Guidelines	Hourly limit for protection of human health	200µg/m³ NO_2
		Annual limit for protection of human health	40µg/m³ NO_2
PM (as PM_{10})		24-hour limit for protection of human health	50µg/m³ PM_{10}
		Annual limit for protection of human health	20µg/m³ PM_{10}
PM (as $PM_{2.5}$)		24-hour limit for protection of human health	25µg/m³ $PM_{2.5}$
		Annual limit for protection of human health	10µg/m³ $PM_{2.5}$

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the Construction Phase of a development in Ireland. Dublin City Council (DCC) has published a guidance document titled Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition (DCC 2018). However, this guidance does not specify a guideline value.

The Verein Deutscher Ingenieure (VDI) German Technical Instructions on Air Quality Control - TA-Luft standard for dust deposition (VDI 2002) (non-hazardous dust) sets a maximum permissible emission level for dust deposition of 350mg/(m^2*day) averaged over a one year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Health and Local Government (DEHLG) Quarries and Ancillary Activities, Guidelines for Planning Authorities (DEHLG 2004) apply the Bergerhoff limit of 350mg/(m^2*day) measured over monitoring periods of between 28 to 32 days which are then averaged over a one-year period to the site boundary of quarries. This guidance value is applied to dust impacts from the construction of the Proposed Scheme.

7.2.2.2 National Air Emission Targets

Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC (hereafter referred to as the National Emissions Reduction Directive) was published in December 2016. This National Emissions Reduction Directive applied the limits set out in Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants (hereafter referred to as the 2010 National Emission Ceiling Directive) until 2020 and establish new national emission reduction commitments which are applicable from 2020 and 2030 for SO_2, NO_X, non-methane volatile organic compounds (NMVOC), ammonia (NH_3), $PM_{2.5}$ and methane (CH_4). In relation to Ireland, the 2020 to 2029 emission targets are 25kt (kilotonnes) for SO_2 (65% on 2005 levels), 65kt for NO_X (49% reduction on 2005 levels), 43kt for NMVOCs (25% reduction on 2005 levels), 108kt for NH_3 (1% reduction on 2005 levels) and 10kt for $PM_{2.5}$ (18% reduction on 2005 levels) as shown in Table 7.4. In relation to 2030, Ireland's emission targets are 85% below 2005 levels for SO_2, 69% reduction for NO_x, 32% reduction for VOCs, 5% reduction for NH_3 and 41% reduction for $PM_{2.5}$, also shown in Table 7.4.

Table 7.4: National Air Emission Targets (Ireland's Air Pollutant Emissions 2020 to 2030)

Pollutant	2020 to 2029 Reduction Commitments (kilotonnes) (and % Reduction Compared to 2005 Levels)	2030 Reduction Commitments (kilotonnes) (and % Reduction Compared to 2005 Levels)
SO_2	25.6	11.0
	-65%	-85%
NO_X	66.8	40.6
	-49%	-69%
NMVOC	56.3	51.1
	-25%	-32%
NH_3	112.1	107.5
	-1%	-5%
$PM_{2.5}$	15.6	11.2
	-18%	-41%

7.2.2.3 Regional Policy

In 2009, the Dublin Regional Air Quality Management Plan 2009 - 2012 (DCC 2009) was published and a range strategies defined to improve air quality in the Dublin region. The strategies included an improvement in co-ordination to build on the good work to date, to mainstream air quality management into all major policy areas, strengthen the decision-making by improving sharing of information on air quality, introduce measures related to local authority activities that will reduce air emissions and identify and prioritise the main potential threats to air quality.

In relation to specific policies, Policy 6 states that the local authorities shall:

> '*support and encourage the rapid implementation of Quality Bus Corridors and other bus priority measures along the routes identified in the Dublin Transportation Initiative strategy within their functional areas.*'

The Dublin Regional Air Quality Management Plan for Improvements in Levels of Nitrogen Dioxide in Ambient Air Quality (DCC 2011) was a companion document to the Dublin Regional Air Quality Management Plan 2009 - 2012. The document reviewed the measured levels of NO_2 in Dublin City. The document defined the current strategic planning approach as the promotion of '*consolidated urban development based on enhanced public transport*' and outlines a range of measures and policies which will help to improve ambient levels of NO_2.

As a result of an exceedance of the annual mean NO_2 ambient air quality limit value at the St John's Road West monitoring station in 2019 (EPA 2020a), an Air Quality Action Plan by Dublin Local Authorities in conjunction with the EPA is now legally required by the end of 2021. Once prepared, the action plan will be submitted to the European Commission for analysis and approval. The plan will examine the causes of the exceedance and provide solutions in the affected areas. This location of exceedance is outside the study area of the Proposed Scheme.

7.2.3 Data Collection and Collation

The baseline ambient air quality environment has been characterised through a desk study of publicly available published data sources and site-specific baseline ambient monitoring surveys.

7.2.3.1 Desk Study

A desk-based air quality assessment was carried out following guidelines described in the publication by TII (TII 2011). TII states that wherever possible use should be made of existing certified air quality data such as that undertaken by the EPA. Air quality monitoring programmes have been undertaken in recent years by the EPA and Local Authorities in the Dublin region. The most recent annual report, Air Quality in Ireland 2019 (EPA 2020a), details the range and scope of monitoring undertaken throughout Ireland. The Urban Environmental Indicators:

Nitrogen dioxide levels in Dublin report (EPA 2020b) assessed spatial variations in ambient air quality in Dublin using diffusion tube sampling and detailed air dispersion modelling. The study found that there were potential exceedances of the ambient air quality standards for NO_2 close to busy City Centre road junctions, near the Dublin Port Tunnel entrance and exit and along the M50 Motorway. The baseline air quality data collected through the desk study is detailed in Section 7.3.2.1.

A review of potentially sensitive ecological areas has also been conducted using the National Parks and Wildlife Services (NPWS) online mapping services. This review is discussed in Section 7.2.4.3.

7.2.3.2 Site-Specific Baseline Surveys

A site-specific baseline monitoring study was undertaken at monthly intervals from November 2019 to June 2020 as part of the air quality assessment for NO_2 using diffusion tube monitoring at 10 locations as detailed in Section 7.3.2.2 and as shown in Figure 7.1 in Volume 3 of this EIAR. Passive sampling of NO_2 involves the molecular diffusion of NO_2 molecules through a polycarbonate tube and their subsequent adsorption onto a stainless steel disc coated with triethanolamine. Following a month of sampling, the tubes were analysed using ultraviolet (UV) spectrophotometry, at a United Kingdom Accreditation Service (UKAS) accredited laboratory (SOCOTEC Laboratories in Burton-on-Trent, UK).

The TII Air Quality Guidelines (TII 2011) note that NO_2 diffusion tube monitoring provides a simple, cost-effective means of monitoring at a number of locations across an area and can provide useful information on spatial distributions. The baseline study overlapped in time with traffic surveys being conducted as part of the Traffic Impact Assessment (TIA). Details of the baseline data collected is discussed in Section 7.3.2.

7.2.4 Appraisal Method for the Assessment of Impacts

7.2.4.1 Air Quality Impact Assessment from Traffic Emissions

The air quality assessment has been carried out following procedures described in the Environmental Impact Assessment (EIA) guidance publications by the EPA (EPA 2002; EPA 2003; EPA 2015; EPA 2017) and using the methodology outlined in LA 105 Air Quality (UKHA 2019), LAQM (PG16) (DEFRA 2016) and LAQM (TG16) (DEFRA 2018). The general approach outlined in the LA 105 Air Quality, LAQM (PG16) and LAQM (TG16) guidance documents and the methodology outlined within has been recommended for use in assessing Irish road schemes by the TII Air Quality Guidelines (TII 2011) as discussed in Section 7.2.4.1.1 below.

The potential changes in regional air emissions due to the Construction Phase and Operational Phase traffic impacts of the Proposed Scheme have been assessed using the National Transport Authority (NTA) Environmental Appraisal Tool (2015), which is based on the Environmental Evaluation Model (hereafter referred to as ENEVAL). The data also takes into account the modal shift from private car to bus (walk or cycle).

A validation study of ENEVAL was undertaken by Jacobs Systra in 2016 (Jacobs Systra 2016) which involved running the module on all the Regional Modelling System (RMS) base models to produce a national emission figure for CO_2 production against the national figure provided by the Department of Transport, Tourism and Sport (DTTAS) of 12 megatonnes. The resultant figure was 8.1 megatonnes for ENEVAL. The DTTAS figure included non-transport related fuel (agricultural and industrial use) and in addition the ENEVAL modelled year was 2012 whilst the DTTAS figures were based on 2015 which would be expected to have higher flows. Therefore, ENEVAL is deemed to be valid for the purposes of calculating regional emissions.

7.2.4.1.1 Local Air Quality Screening Assessment

In 2019 the UKHA DMRB air quality guidance was revised with the publication of LA 105 Air Quality (UKHA 2019) replacing a number of historical guidance documents (HA 207/07, IAN 170/12, IAN 174/13, IAN 175/13, part of IAN 185/15). The revised document outlines a number of changes of approach when assessing the air quality impact of road schemes.

LA 105 Air Quality states that modelling should be conducted for NO_2 for the base, construction and opening years for both the Do Minimum and Do Something scenarios (please see Chapter 6 (Traffic & Transport) for the definition of these terms). Modelling of PM_{10} is only required for the base year to demonstrate that the air quality limit values in relation to PM_{10} are not breached. Where the air quality modelling indicates exceedances of the PM_{10} air quality limits in the base year then PM_{10} should be included in the air quality model in the Do-Minimum and Do-Something scenarios. LA 105 Air Quality guidance states that modelling of $PM_{2.5}$ is not required, as modelling of PM_{10} can be used to show that the project does not impact on the $PM_{2.5}$ limit value. However, as outlined in Section 7.2.2.1, the four Dublin local authorities have signed up for the *BreatheLife* campaign (https://breathelife2030.org/) to work towards achieving the goal of compliance with the WHO Air Quality Guidelines (WHO 2006) by 2030. Modelling of PM_{10} and $PM_{2.5}$ was undertaken to consider the impact of the Proposed Scheme on these concentrations.

Historically modelling of CO, lead and benzene was required by UK HA Guidance (UKHA 2007) and TII Guidance. However, guidance has now been updated by the UK HA (LA 105 Air Quality). As concentrations of these pollutants have been monitored to be significantly below their air quality limit values in recent years, even in urban centres (see Section 7.3.2.1) CO, lead and benzene have been scoped out of detailed assessment (EPA 2020a).

LA 105 Air Quality states that the following scoping criteria shall be used to determine whether the air quality impacts of a project can be scoped out or require an assessment based on the changes between the Do Something traffic (with the Proposed Scheme) compared to the Do Minimum traffic (without the Proposed Scheme):

- Annual average daily traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV – includes goods vehicles, buses and other heavy vehicles) AADT changes by 200 or more;
- A change in speed band; and
- A change in carriageway alignment by 5m or greater.

The above scoping criteria have been used in the current assessment to determine the road links required for inclusion in the modelling assessment. Sensitive receptors within 200m of impacted road links were included within the modelling assessment as detailed in LA 105 Air Quality.

7.2.4.1.2 ADMS-Roads Dispersion Model

The TII Air Quality Guidelines (TII 2011) state that the assessment must progress to detailed modelling if:

- Concentrations exceed 90% of the air quality limit values when assessed by the screening method; or
- Sensitive receptors exist within 50m of a complex road layout (e.g. grade separated junctions, hills etc).

Guidance from LA 105 Air Quality states that a detailed assessment must be conducted where the sensitivity of the environment is medium or above when combined with a high-risk project, due to a risk of exceeding air quality thresholds.

Considering the scale of the Proposed Scheme, its risk should be considered high as it has the potential to have an impact on ambient air quality over a large geographical area.

Guidance from LA 105 Air Quality states that a medium sensitivity environment includes areas that have annual mean NO_2 concentrations of 36µg/m^3 or above combined with sensitive receptors within 50m of the impacted roads. NO_2 concentrations (Section 7.3.2.1 and Section 7.2.3.2) were found to be generally below 36µg/m^3 along the suburban areas along the Proposed Scheme. However, towards the City Centre, ambient NO_2 concentrations were measured in excess of 36µg/m^3. The LA 105 Air Quality guidance states a detailed assessment should consider a representative number of receptors and all receptors with the likelihood of exceeding the air quality limit values.

Vehicle-derived air emissions for areas impacted by significant changes in AADT were modelled using the detailed ADMS-Roads dispersion model (Version 5.1) which has been developed by Cambridge Environmental Research Consultants (CERC) (CERC 2020). The model is a steady-state Gaussian plume model used to assess ambient pollutant concentrations associated with road sources.

The ADMS-Roads dispersion model (Version 5.1) has been used to predict the ground level concentrations (GLC) of NO_2 and PM_{10} / $PM_{2.5}$ in the vicinity of the impacted areas for the baseline year of 2019, the peak construction year of 2024 and the opening and design years of 2028 and 2043 respectively.

The modelling incorporated the following features:

- Hourly-sequenced meteorological information for Casement Aerodrome in 2019 has been used in the model (see Diagram 7.2) (Met Éireann 2020). The selection of the appropriate meteorological data has followed the guidance issued by the LAQM (TG16) (DEFRA 2018). A primary requirement is that the data used should have a data capture of greater than 90% for all parameters; and
- Specific air sensitive receptors (ASRs) were also mapped into the model. Receptor heights were input at 1.5m to represent breathing height. Concentrations were reported for each ASR modelled for all modelling scenarios.

It is intended that the Proposed Scheme will have a peak construction year of 2024 and an opening year of 2028. Road traffic emission rates are derived using traffic data for the peak construction year of 2024 and the Opening Year of 2028 and Design Year of 2043 provided in Chapter 6 (Traffic & Transport) and using emission factors from the COPERT V database (EMISIA 2020) which has been incorporated into the UK DEFRA Emission Factor Toolkit (EFT) Version 10.1 (DEFRA 2020).

The EFT Version 10.1 has been incorporated into the ADMS-Roads model. The toolkit provides emission rates from 2017 to 2030 and traffic emissions for the Proposed Scheme were based on the following assumptions:

- EFT Version 10.1 is based on eight vehicle categories including petrol cars, diesel cars, diesel Light Goods Vehicles (LGV), rigid Heavy Goods Vehicles (HGVs) and buses;
- Systra (ENEVAL) fleet composition data for Ireland (2016 base year) were selected to input car, LGV and HGV proportions (Table 7.5). 2019 projections were used for detailed modelling of the 2020 base year, 2022 projections and 2024 projections were used as conservatively representative of the 2024 peak construction year and 2028 opening year respectively;
- National Transport Model (NTM) fleet projections provided in UK Technical Advisory Group (TAG) (UK Department for Transport 2020) have been used to estimate the proportions of cars, LGV and HGV in 2043. No fleet projection tools currently exist, Irish or UK based, that accurately predict the proportion of electric vehicles in 2043, or which take the 2021 Climate Action Plan measures into account. A conservative approach is therefore inevitable, and is based on the use of the UK NTM as the most up to date and robust alternative to the older 2016 base year Systra fleet;
- Predicted bus fleet composition data was developed for 2019, 2028 and 2043 (Table 7.5). The 2019 bus fleet was also applied to the 2024 construction year;
- Emissions have been calculated using predicted emissions factors for 2019 (to represent the Base Year 2020), 2022 (to represent the peak construction year 2024), 2024 (to represent the Opening Year 2028) and 2030 (to represent the Design Year 2043). A conservative approach to emission years has been taken, similarly to the fleet projections, to counteract some of the uncertainty associated with improved vehicle standards;
- EFT Version 10.1 incorporates updated NO_X (defined as NO and NO_2) and PM speed emission coefficient equations for Euro 5 and 6 vehicles, taken from the European Environment Agency (EEA) COPERT V emission calculation tool which reflects the most recent evidence on the real-world emission performance of these vehicles;
- Fleet composition based on European emission standards from pre-Euro 1 to Euro 6/VI. Systra fleet data was used to estimate Euro class proportions for cars, LGV and HGV. The NTA provided Euro class proportions for the bus fleet; and
- Improvements in the quality of fuel and some degree of retrofitting; technology conversion in the national fleet.

Table 7.5:Summary of Fleet Proportions

Vehicle Type		Base Year 2019	Construction Year 2024	Operational Year 2028	Design Year 2043
Car	Petrol Car	41%	38%	36%	38%
	Diesel Car	57%	60%	63%	25%
	Electric Car	2%	2%	2%	37%
LGV	LGV	99.9%	99.9%	99.9%	81.5%
	Electric LGV	0.1%	0.1%	0.1%	18.5%
HGV	Rigid HGV	86%	86%	86%	86%
	Artic HGV	14%	14%	14%	14%
Bus	Plug-in Hybrid Bus	0%	0%	24%	0%
	Fuel Cell Electric Bus	0%	0%	70%	100%
	Diesel Bus	100%	100%	6%	0%

Advancements in engine technology and the addition of a higher percentage of electric vehicles to the fleet will assist in significantly reducing emissions between 2028 and 2043, even in circumstances where the number of vehicles using a road link increases. Emissions per road link using the EFT Version 10.1 were calculated for the 2043 Do Something scenario and compared to the 2028 Do Something scenario. Conservative assumptions were made for future fleet and uptake of electric vehicles. Across the Proposed Scheme, emissions decreased in 2043, therefore 2028 modelled impacts can be considered worst case. As a result, detailed modelling of the design year 2043 was scoped out for all pollutants on the basis that emissions will be lower compared to 2028 emissions.

7.2.4.1.3 Verification Study – Year 2019 Traffic Data

Model verification investigates the level of agreement between modelled and measured concentrations. Difference between modelled and measured pollutant concentrations can arise due to uncertainties in or limitations to the model input data (such as traffic data and meteorological data), uncertainties in monitoring data and inherent modelling limitations. As outlined in LAQM.TG16 (DEFRA 2018), an adjustment to the modelled results is usually required in order to ensure that the final concentrations presented are representative of monitoring information in the area.

A verification study was undertaken using the traffic data for the study area which was received from the NTA Eastern Regional Model (ERM) traffic model (See Section 7.2.4.1.2 and Chapter 6 (Traffic & Transport)) for year 2020. The study compared the ambient NO_2 monitored concentration at a range of diffusion tube locations with the ADMS-Roads model output at these locations. DCC has undertaken a diffusion tube monitoring program at a range of locations in the study area for both 2018 and 2019. This data has been used to compare model predictions of NO_2 to monitored NO_2 concentrations.

Background data was based on NO_2 levels from Ballyfermot for 2019. Ballyfermot was selected as a suitable suburban background station as it is an ambient air monitoring station suitably removed from Dublin City Centre and at a distance of over 200m from a main roadway. The backgrounds were also utilised in the 2024 and 2028 modelling.

The emission data for the ADMS-Roads model was based on EFT Version 10.1 and the ADMS-Roads model input parameters selected is summarised in Table 7.6.

Table 7.6:Summary of the ADMS-Roads Model Input Parameters

Parameter	Description	Input Value
Coordinate System	Spatial data in ADMS-Roads is linked to a Cartesian coordinate system, measured in meters.	Irish Transverse Mercator (ITM) Coordinate system was used.
Pollutants	A range of preset pollutants can be selected in ADMS-Roads for modelling.	NO_X, NO_2 and PM_{10} were specifically modelled.

Parameter	Description	Input Value
Road Source Emissions	Road sources emissions can be entered manually or calculated from traffic flow data.	Road emissions have been calculated from traffic flow data.
Street Canyons	ADMS-Roads has to the ability to model street canyon effects either by using the Basic Street Canyon module or the Advance Street Canyon Module to simulate turbulent flow patterns along streets with relatively tall buildings.	Basic Street Canyon module has been used where canyons have been identified.
Road Emission Factors	ADMS-Roads has a range of emission factors including the recent UK Emission Factor Tool (EFT) v.9.0 dataset.	UK Emission Factor Tool (EFT) v.10.1 (8 VC) dataset has been used based on Northern Ireland (Urban)
Traffic Speed	ADMS-Roads can adjust pollutant emission factors to take account of traffic speed.	Average traffic speed specific to each link, as advised by traffic consultant, has been used in the model.
Meteorological Data	ADMS-Roads requires hourly meteorological data from a suitable meteorological station for a full year.	2019 data from Casement Aerodrome has been used in the model.
Surface Roughness	The model requires a representative surface roughness value for both the modelling domain and the meteorological station.	A value of 1.0m has been selected for the modelling domain with a value of 0.1m selected for Casement Aerodrome
Time-varied Emissions	The model can accept a range of profiles including 3-day and 7-day diurnal profiles	3-day diurnal profile (Weekdays, Saturday, Sunday) has been used in the model.
Primary NO_2	Model will assume that a certain percentage of NO_X emissions are NO_2 when modelling chemistry	Primary NO_2 fractions (%) were calculated using the EFT for each modelled scenario: 2020 Base – 28.2% 2024 Do Minimum – 28.9% 2024 Do Something – 28.9% 2028 Do Minimum – 29.6% 2028 Do Something – 29.6%
Complex Terrain	Where terrain exceeds 1;10, terrain effects may be modelled	Flat terrain has been used in the modelling domain

The first step of model verification, in line with LAQM.TG16, is to consider the performance of the model, prior to any adjustment, by comparing modelled and measured road NO_X contribution at each of the site-specific survey and DCC diffusion tube locations. Some of the monitoring locations were not considered suitable for model verification, due to missing traffic or monitoring data, or other spatial considerations. A total of ten monitoring sites were included in the verification exercise. The comparison is shown in Diagram 7.1, as the red points and trendline, and also in Table 7.7. This shows that on average, the unadjusted model under predicts total NO_2 concentrations by around 3%.

Table 7.7: Diffusion Tube Monitoring Data Used for Model Verification

Diffusion Tube	Modelled NO_X concentration ($\mu g/m^3$)	Modelled NO_2 concentration ($\mu g/m^3$)	Monitored NO_X concentration ($\mu g/m^3$)	Monitored NO_2 concentration ($\mu g/m^3$)	Difference [(modelled – monitored)/(monitored) *100]	Adjustment Factor
Coolock, Newtown (DCC)	3.9	21.8	2.2	20.9	4.2%	1.27
1.2	3.0	21.3	3.3	21.4	-0.6%	
1.3	7.8	23.8	7.9	23.9	-0.4%	
1.4	10.3	25.1	8.3	24.1	4.1%	
1.5	11.4	25.6	7.6	23.7	8%	
1.6	23.6	31.6	22.9	31.4	0.6%	

Diffusion Tube	Modelled NO_X concentration ($\mu g/m^3$)	Modelled NO_2 concentration ($\mu g/m^3$)	Monitored NO_X concentration ($\mu g/m^3$)	Monitored NO_2 concentration ($\mu g/m^3$)	Difference [(modelled – monitored)/(monitored) *100]	Adjustment Factor
1.7	6.7	23.2	4.3	22.0	5.6%	
1.8	6.4	23.1	14.5	27.3	-15.4%	
1.9	26.0	32.8	34.8	37.1	-11.6%	
1.10	17.1	28.5	37.3	38.2	-25.5%	

In line with LAQM.TG16, the model adjustment was based on NO_X rather than NO_2 with the NO_2 diffusion tube data first converted to NO_X using the NO_X to NO_2 Calculator (DEFRA 2020). A background NO_2 concentration of 19 $\mu g/m^3$ was applied to all conversions. Additionally, the adjustment was applied to the road source contribution only rather than total NO_X, again in line with LAQM.TG16. This process identified that the model performed better at some locations than others, and the adjustment of model bias took this into account. The comparison of road NO_X contributions provided a bias adjustment factor of 1.27 across the study area, which was then applied to the modelled road contributions at all air quality sensitive receptors, before being converted into total NO_2 concentrations.

Following the application of the model bias adjustment factor, the modelled and measured values at these locations included in the verification exercise were compared again. This comparison is shown in Diagram 7.1 as the blue points and trendline. This shows that on average, the adjusted model is within the target 10% of the air quality standard, with a root mean square error (RMSE) of 3.22$\mu g/m^3$. In the absence of measured PM_{10} and $PM_{2.5}$ at roadside locations in the study area, the same factors calculated for the modelled road NO_X contribution were applied to the road PM_{10} and road $PM_{2.5}$ contributions.

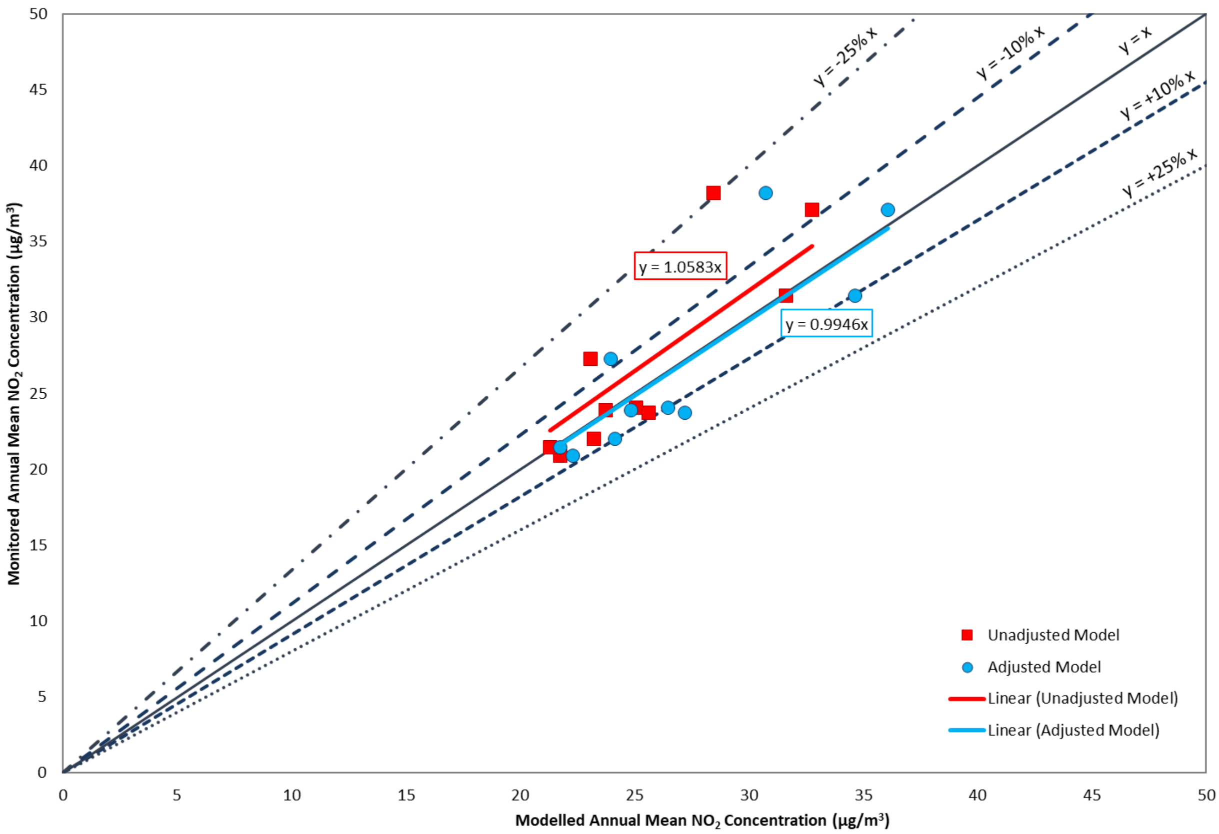

Diagram 7.1: Dispersion Model Verification - Comparison of Monitored and Modelled NO_2 Concentrations (µg/m³)

7.2.4.1.4 Air Quality Impact Significance Criteria

The TII Air Quality Guidelines (TII 2011) detail the methodology for determining air quality impact significance criteria for road schemes in Ireland. The degree of impact is determined based on both the absolute and relative impact of the Proposed Scheme. The significance criteria have been adopted for the Proposed Scheme and are detailed in Table 7.8, Table 7.9 and Table 7.10. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40µg/m³). However, the criteria have also been applied to the predicted annual $PM_{2.5}$ concentrations for the purpose of this assessment.

Table 7.8: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations (TII 2011)

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. Days with PM_{10} Concentration > 50µg/m³	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥ 4µg/m³	Increase / decrease >4 days	Increase / decrease ≥ 2.5µg/m³
Medium	Increase / decrease 2µg/m³ to < 4µg/m³	Increase / decrease 3 or 4 days	Increase / decrease 1.25µg/m³ to <2.5µg/m³
Small	Increase / decrease 0.4µg/m³ to < 2µg/m³	Increase / decrease 1 or 2 days	Increase / decrease 0.25µg/m³ to <1.25µg/m³
Imperceptible	Increase / decrease < 0.4µg/m³	Increase / decrease <1 day	Increase / decrease < 0.25µg/m³

Table 7.9: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations (TII 2011)

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration		
	Small	Moderate	Large
Increase with Proposed Scheme			
Above Objective / Limit Value with Proposed Scheme (≥40μg/m^3 of NO_2 or PM_{10}) (≥25μg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Substantial adverse
Just Below Objective / Limit Value with Proposed Scheme (36μg/m^3 to <40μg/m^3 of NO_2 or PM_{10}) (22.5μg/m^3 to <25μg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Moderate adverse
Below Objective / Limit Value with Proposed Scheme (30μg/m^3 to <36μg/m^3 of NO_2 or PM_{10}) (18.75μg/m^3 to <22.5μg/m^3 of $PM_{2.5}$)	Negligible	Slight adverse	Slight adverse
Well Below Objective / Limit Value with Proposed Scheme (<30μg/m^3 of NO_2 or PM_{10}) (<18.75μg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight adverse
Decrease with Proposed Scheme			
Above Objective / Limit Value with Proposed Scheme (≥40μg/m^3 of NO_2 or PM_{10}) (≥25μg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Substantial beneficial
Just Below Objective / Limit Value with Proposed Scheme (36μg/m^3 to <40μg/m^3 of NO_2 or PM_{10}) (22.5μg/m^3 to <25μg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Moderate beneficial
Below Objective / Limit Value with Proposed Scheme (30μg/m^3 to <36μg/m^3 of NO_2 or PM_{10}) (18.75μg/m^3 to <22.5μg/m^3 of $PM_{2.5}$)	Negligible	Slight beneficial	Slight beneficial
Well Below Objective / Limit Value with Proposed Scheme (<30μg/m^3 of NO_2 or PM_{10}) (<18.75μg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight beneficial

* Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible

Table 7.10: Air Quality Impact Significance Criteria (TII 2011)

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration		
	Small	Medium	Large
Increase with Proposed Scheme			
Above Objective / Limit Value with Proposed Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective / Limit Value with Proposed Scheme (32 days to <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective / Limit Value with Proposed Scheme (26 days to <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective / Limit Value with Proposed Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Proposed Scheme			
Above Objective / Limit Value with Proposed Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective / Limit Value with Proposed Scheme (32 days to <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective / Limit Value with Proposed Scheme (26 days to <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective / Limit Value with Proposed Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

*Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible

7.2.4.2 Regional Air Quality Assessment

The change in regional air quality emissions due to Operational Phase traffic impacts of the Proposed Scheme have been assessed using the NTA Environmental Appraisal Module. Emissions from the zonal level ENEVAL tool can provide information on the emissions of pollutants including NO_2, PM_{10}, CO_2 and VOCs for the different traffic scenarios on a regional basis. The ENEVAL software is recommended by Codema in the publication Developing CO_2 Baselines – A Step-by-Step Guide for Your Local Authority (Codema 2017). The ENEVAL tool is discussed in more detail in Section 7.2.4.1.

7.2.4.3 Ecology

For routes which pass within 2km of a designated area of conservation (either Irish or European designation) the TII Air Quality Guidelines (TII 2011) requires the air quality specialist to consult with the project ecologist. However, in practice the potential for impact on an ecological site is highest within 200m of the Proposed Scheme and within 200m of roads where significant changes in AADT (Section 7.2.4.1) occur. Sites identified within these parameters are considered Key Ecological Receptors.

The TII Ecological Guidelines (TII 2009) and the Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities (DEHLG 2010) provide details regarding the legal protection of designated conservation areas. Further guidance can also be found in the IAQM document A Guide to The Assessment Of Air Quality Impacts On Designated Nature Conservation Sites (IAQM 2020) and in the DMRB guidance LA105 Air Quality (UKHA 2019), both of which describe N deposition as the most likely source of significant impacts from road traffic. Pollutants such as CO_2, CO, SO_2, ammonia, particulate matter and volatile organic compounds have been scoped out of detailed assessment.

The following assessment criteria, in accordance with TII guidance, is used to determine whether an assessment for nitrogen deposition should be conducted:

- There is a designated area of conservation within 200m of the Proposed Scheme; and
- There is a significant change in AADT flows (see Section 7.2.4.1).

In circumstances where the above criteria are met, there is the potential for impacts on ecology as a result of nitrogen deposition and thus an assessment should be undertaken. For road transport sources within 200m of a designated habitat, individual ecological receptors along a transect at 10m intervals are modelled. Ecological receptors are modelled up to a maximum distance of 200m regardless of whether the habitat extends beyond 200m. It is considered that the greatest impacts will have occurred in proximity to the road. LA 105 notes that only sites that are sensitive to nitrogen deposition need to be included in the assessment, it is not necessary to include sites for example that have been designated as a geological feature or water course. The ecological receptors along the 200m transect are modelled using the methodology for sensitive human receptors in Section 7.2.4.1.2.

Designated sites which are within 2km of the boundary of the Proposed Scheme are shown in Figure 12.3 in Volume 3 of this EIAR and are:

- North Dublin Bay Special Area of Conservation (SAC) (Site Code: 000206);
- South Dublin Bay and River Tolka Estuary Special Protection Area (SPA) (Site Code: 004024);
- Baldoyle Bay SAC (Site Code: 000199);
- Baldoyle Bay SPA (Site Code: 000199) and Royal Canal proposed National Heritage Area (pNHA) (Site Code: 002103); and
- North Dublin Bay pNHA (Site Code: 000206).

Consultation with the ecologist has been undertaken. Habitats of particular ecological importance at these sites are:

- Tidal Mudflats and Sandflats;
- Annual Vegetation of Drift Lines;
- Salicornia Mud;
- Atlantic Salt Meadows;
- Mediterranean Salt Meadows;
- Embryonic Shifting Dunes;
- Marram Dunes (White Dunes);
- Fixed Dunes (Grey Dunes); and
- Humid Dune Slacks.

Species of particular ecological importance include:

- Petalwort (*Petalophyllum ralfsii*);
- Light-bellied Brent Goose (*Branta bernicla hrota*);
- Shelduck (*Tadorna tadorna*);
- Ringed Plover (*Charadrius hiaticula*);
- Golden Plover (*Pluvialis apricaria*);
- Grey Plover (*Pluvialis squatarola*);
- Bar-tailed Godwit (*Limosa lapponica*); and
- Wetland and Waterbirds.

The Air Quality Regulations outline an annual critical level for NO_X for the protection of vegetation and natural ecosystems in general. The CAFE Directive defines ‘Critical Levels’ as:

> ‘*a level fixed on the basis of scientific knowledge, above which direct adverse effects may occur on some receptors, such as trees, other plants or natural ecosystems but not on humans*’.

The TII Ecological Guidelines reference the United Nations Economic Commission for Europe (UNECE) Critical Loads for Nitrogen where a *’Critical Load*‘ is defined by the UNECE as:

'*a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*' (UNECE 2003).

The guidance states that where the predicted environmental concentration (PEC) is less than 70% of the long-term critical level / load, the process contribution (PC) is likely to be insignificant.

The TII Ecological Guidelines outline a methodology to derive the road contribution to dry deposition and thereafter to compare with the published critical loads for the appropriate habitat.

The UNECE critical loads were subsequently updated in the 2010 Review and Revision of Empirical Critical Loads and Dose-Response Relationships (UNECE 2010). The pNHAs are not currently designated for the protection of a specific habitat type. In the absence of a specific designation, the most stringent published critical load in the 2010 Review and Revision of Empirical Critical Loads and Dose-Response Relationships for inland and surface water habitats (5kg(N)/ha/yr to 10kg(N)/ha/yr) (kilogrammes of nitrogen per hectare per year) has been used in the assessment.

In order to calculate the nitrogen deposition, the NO_2 / NO_X concentration determined through modelling including the background concentration must be converted firstly into a dry deposition flux using the equation below which is taken from UK Environment Agency publication 'AGTAG06 – Technical Guidance On Detailed Modelling Approach For An Appropriate Assessment For Emissions To Air' (EA 2014):

Dry deposition flux (µg m^{-2} s^{-1}) = ground-level concentration (µg/m^3) x deposition velocity (m/s)

Deposition velocities are provided in both the TII (TII 2011) and IAQM Guidance document (IAQM 2020) for NO_2 in grassland and forestry. Once the dry deposition flux (µg m^{-2} s^{-1}) is calculated it must then be converted to nitrogen equivalent acidification flux (k_{eq} ha^{-1} $year^{-1}$) for comparison with critical loads.

In order to convert the dry deposition flux from units of µg m^{-2} s^{-1} to units of kg ha^{-1} $year^{-1}$ the dry deposition flux is multiplied by the conversion factors. For NO_2 this factor is 96. In order to convert kg ha^{-1} $year^{-1}$ to k_{eq} ha^{-1} $year^{-1}$, where k_{eq} is a unit of equivalents (a measure of how acidifying the chemical species can be), the deposition flux in units of kg ha^{-1} $year^{-1}$ is multiplied by the conversion factor (taken from AQTAG06 (EA 2014)). The conversion factor for nitrogen is 0.071428. LA 105 Air Quality (UKHA 2019) states that if the change in N deposition is greater than 0.4kgN/ha/yr or 1% of the critical level / load consultation with the ecologist should occur.

7.2.4.4 Construction Phase Assessment

The greatest potential impact on air quality during the Construction Phase is from construction dust emissions, PM_{10} / $PM_{2.5}$ emissions and the potential for nuisance dust. Dust is characterised as encompassing PM with a particle size of between 1 micron and 75 microns (1µm to 75µm). Deposition of dust typically occurs in close proximity to the source and with IAQM Guidance (IAQM 2014) defining a maximum impact area of 350m from the dust generating activity. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

An appraisal has been carried out to assess the risk to sensitive receptors as a result of dust soiling, health impacts and ecology impacts due to the Construction Phase in accordance with the IAQM's Guidance on the Assessment of Dust from Demolition and Construction (IAQM 2014). This appraisal reviews the sensitivity of the site's location with respect to dust nuisance, human health and ecological impacts and then calculates a risk of impact using the magnitude of site activities.

Receptor sensitivity can be described as follows with respect to nuisance dust as per the IAQM guidance (IAQM 2014):

- High sensitivity receptor with respect to dust nuisance – surrounding land where:
  - Users can reasonably expect enjoyment of a high level of amenity;
  - The appearance, aesthetics or value of their property would be diminished by soiling;

  - The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land; or
  - Examples include dwellings, museums and other culturally important collections, medium and long-term car parks and car showrooms.
- Medium sensitivity receptor with respect to dust nuisance – surrounding land where:
  - Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home;
  - The appearance, aesthetics or value of their property could be diminished by soiling;
  - The people or property would not reasonably be expected to be present continuously or regularly for extended periods as part of the normal pattern of use of the land; or
  - Indicative examples include parks and places of work.
- Low sensitivity receptor with respect to dust nuisance – surrounding land where:
  - The enjoyment of amenity would not reasonably be expected;
  - Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling;
  - There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land; or
  - Indicative examples include playing fields, farmland (unless commercially sensitive horticultural), footpaths, short-term car parks and roads.

Receptor sensitivity can be described as follows with respect to human health as per the IAQM Guidance (IAQM 2014):

- High sensitivity receptor with respect to human health – surrounding land where:
  - Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24 hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day); or
  - Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.
- Medium sensitivity receptor with respect to human health – surrounding land where:
  - Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24 hour objectives, relevant location would be one where individuals may be exposed for eight hours or more in a day); or
  - Indicative examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.
- Low sensitivity receptor with respect to human health – surrounding land where:
  - Locations where human exposure is transient; or
  - Indicative examples include public footpaths, playing fields, parks and shopping streets.

Receptor sensitivity can be described as follows with respect to ecology as per the IAQM guidance (IAQM 2014):

- High sensitivity receptor with respect to ecology – surrounding land where:
  - Locations with an international or national designation and the designated features may be affected by dust soiling; or
  - Indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
- Medium sensitivity receptor with respect to ecology – surrounding land where:
  - Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or
  - Indicative example is a National Heritage Area (NHA) with dust sensitive features.

- Low sensitivity receptor with respect to ecology – surrounding land where:
  - Locations with a local designation where the features may be affected by dust deposition; or
  - Indicative example is a local Nature Reserve with dust sensitive features.

Prior to assessing the impact from dust emissions, the sensitivity of the area must be established. The sensitivity of the area is determined using the headings:

- Dust Soiling Effects on People and Property;
- Human Health Impacts; and
- Ecological Impacts.

The sensitivity of the area is considered as per the criteria outlined in the IAQM Guidance, and as reproduced in Table 7.11, Table 7.12 and Table 7.13.

In terms of the sensitivity of the area to dust soiling effects on people and property, the receptor sensitivity, number of receptors and their distance from the source are considered. Using these criteria, as outlined in Table 7.11, the sensitivity of the area to dust soiling can be established.

The IAQM Guidance (IAQM 2014) also outline the criteria for assessing the human health impact from PM_{10} emissions from construction activities based on the current annual mean PM_{10} concentration, receptor sensitivity and the number of receptors effected as per Table 7.12.

An assessment of the Proposed Scheme was completed with respect to the sensitivity criteria in Table 7.11 and Table 7.12. Where the number of receptors was not clear i.e. for an apartment building, conservative sensitivities were assumed. In addition, when calculating the sensitivity with respect to human health, the background concentrations of particulates was reviewed. The background air quality in the region of the Proposed Scheme is discussed in Section 7.3.2.

Table 7.11: Sensitivity of the Area to Dust Soiling Effects on People and Property (IAQM 2014)

Receptor Sensitivity	Number of Receptors	Distance from Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10 to 100	High	Medium	Low	Low
	1 to 10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 7.12: Sensitivity of the Area to Human Health Impacts (IAQM 2014)

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors	Distance from Source (m)				
			<20	<50	<100	<200	<350
High	> 32µg/m³	>100	High	High	High	Medium	Low
		10 to 100	High	High	Medium	Low	Low
		1 to 10	High	Medium	Low	Low	Low
	28µg/m³ - 32µg/m³	>100	High	High	Medium	Low	Low
		10 to 100	High	Medium	Low	Low	Low
		1 to 10	High	Medium	Low	Low	Low
	24µg/m³ - 28µg/m³	>100	High	Medium	Low	Low	Low
		10 to 100	High	Medium	Low	Low	Low

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors	Distance from Source (m)				
			<20	<50	<100	<200	<350
		1 to 10	Medium	Low	Low	Low	Low
	< 24µg/m³	>100	Medium	Low	Low	Low	Low
		10 to 100	Low	Low	Low	Low	Low
		1 to 10	Low	Low	Low	Low	Low
Medium	> 32µg/m³	>10	High	Medium	Low	Low	Low
		1 to 10	Medium	Low	Low	Low	Low
	28µg/m³ - 32µg/m³	>10	Medium	Low	Low	Low	Low
		1 to 10	Low	Low	Low	Low	Low
	24µg/m³ - 28µg/m³	>10	Low	Low	Low	Low	Low
		1 to 10	Low	Low	Low	Low	Low
	< 24µg/m³	>10	Low	Low	Low	Low	Low
		1 to 10	Low	Low	Low	Low	Low
Low	-	1+	Low	Low	Low	Low	Low

Dust deposition impacts on ecology can occur due to chemical or physical effects. This includes reduction in photosynthesis due to smothering from dust on the plants and chemical changes such as acidity to soils. Often impacts will be reversible once the works are completed, and dust deposition ceases. Designated sites within 50m of the boundary of the site or within 50m of the Proposed Scheme used by construction vehicles on public highways up to a distance of 500m from a construction site entrance can be affected according to the IAQM Guidance. The sensitivity of the area to ecological impacts are considered using the sensitivity criteria outlined in Table 7.13. There are no sensitive ecological receptors within 50m of the Proposed Scheme.

Table 7.13: Sensitivity of the Area to Ecological Impacts (IAQM 2014)

Receptor Sensitivity	Distance from Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

In order to determine the level of dust mitigation required during the Construction Phase, the potential dust emission magnitude for each dust generating activity needs to be taken into account, along with the already established sensitivity of the area. These major dust generating activities are divided into four types (where relevant) to reflect their different potential impacts as outlined below:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

Trackout is defined by the IAQM as the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

7.3 Baseline Environment

The following sections describe the baseline conditions in the vicinity of the Proposed Scheme based on a review of published data and on-site monitoring.

7.3.1 Meteorological Conditions

A key factor in assessing temporal and spatial variations in air quality is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels) (WHO 2006). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds, when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ to PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

Casement Aerodrome meteorological station, which is located approximately 15km south-west of the Proposed Scheme at the closest point, collects meteorological data in the correct format for the purposes of this assessment and has a data collection of greater than 90%. Long-term hourly observations at Casement Aerodrome meteorological station provide an indication of the prevailing wind conditions for the region (see Diagram 7.2). Results indicate that the prevailing wind direction is from south to westerly in direction over the period 2015 to 2019.

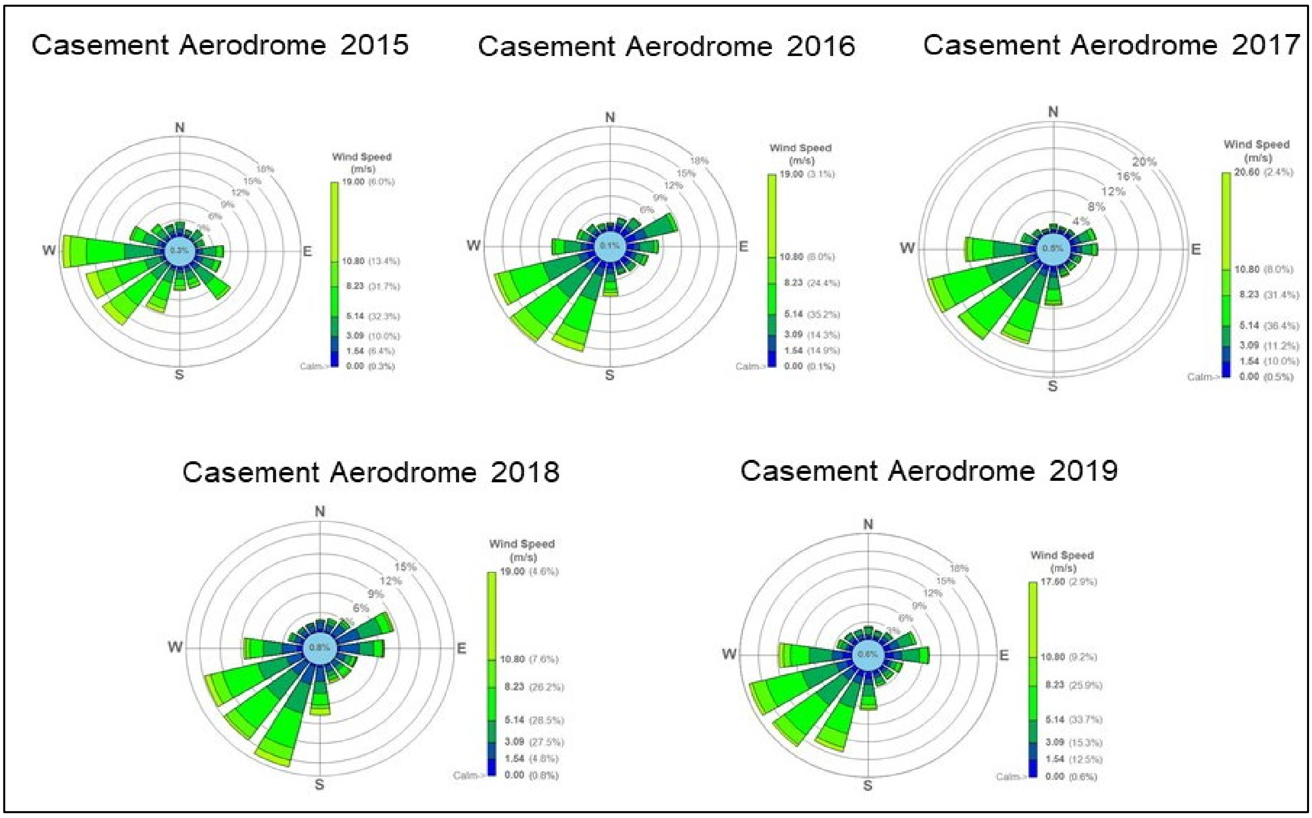

Diagram 7.2: Casement Aerodrome Meteorological Station Windrose 2015 to 2019 (Met Éireann 2020)

7.3.2 Baseline Ambient Air Quality

Background air quality is the air quality at a specific location when the local emissions of air quality have been subtracted from the measured air quality. Thus, a ‘background’ air concentration is usually representative of a wider area (such as an urban area or suburban area). Baseline air quality is the current air quality at a specific location including all local and non-local sources.

A desk study of the EPA air quality monitoring programs has been undertaken. The most recent annual report on air quality at the time of writing, Air Quality in Ireland 2019 (EPA 2020b), details the range and scope of monitoring undertaken throughout Ireland. In addition, scheme specific baseline air quality monitoring has been conducted. The data collected has been included to provide site specific baseline concentrations of NO_2 in areas which have the potential to be impacted by the Proposed Scheme.

7.3.2.1 EPA Data

As part of the implementation of S.I. No. 180/2011 - Air Quality Standards Regulations 2011, four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA 2020a). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. In terms of air monitoring zoning, the area of the Proposed Schemes is located within Zone A, as shown in Figure 7.2 in Volume 3 of this EIAR (EPA 2020a).

With regard to NO_2, continuous monitoring data from the EPA Zone A stations was reviewed. The stations representative of the Proposed Scheme are Ballyfermot, Swords, Rathmines and Dún Laoghaire. Sufficient data is available for the station in Ballyfermot, Swords, Rathmines and Dún Laoghaire to review long-term trends over a five year period (2015 to 2019), as outlined in Table 7.14. Long-term annual average levels at the four suburban background sites range from 13μg/m^3 to 22μg/m^3 over the period 2015 to 2019 compared to the annual limit value of 40μg/m^3, with an average concentration of 19μg/m^3 over this period. Average concentrations in 2019 were 18μg/m^3 across the representative stations.

The ambient NO_2 monitoring results for Ballyfermot, Dún Laoghaire, Swords and Rathmines over the period 2015 to 2019 based on a three-year rolling average, are shown in Diagram 7.3. The data and trend line indicate that levels are reasonably constant at each location over the five-year period.

Table 7.14: Trends In Suburban and Urban NO_2 Concentration (µg/m³) In Dublin 2015 to 2019

Station	Station Classification Council Directive 96/62/EC*	Averaging Period	Year					Limit Value
			2015	2016	2017	2018	2019	
Rathmines	Urban Background	Annual Mean NO_2 (µg/m³)	18	20	17	20	22	40
		99.8th%ile 1-hr NO_2 (µg/m³)	105	88	86	87	102	200
Ballyfermot	Suburban Background	Annual Mean NO_2 (µg/m³)	16	17	17	17	20	40
		99.8th%ile 1-hr NO_2 (µg/m³)	127	90	112	101	101	200
Dún Laoghaire	Suburban Background	Annual Mean NO_2 (µg/m³)	16	19	17	19	15	40
		99.8th%ile 1-hr NO_2 (µg/m³)	91	105	101	91	91	200
Swords	Suburban Background	Annual Mean NO_2 (µg/m³)	13	16	14	16	15	40
		99.8th%ile 1-hr NO_2 (µg/m³)	93	96	79	85	80	200

* Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management

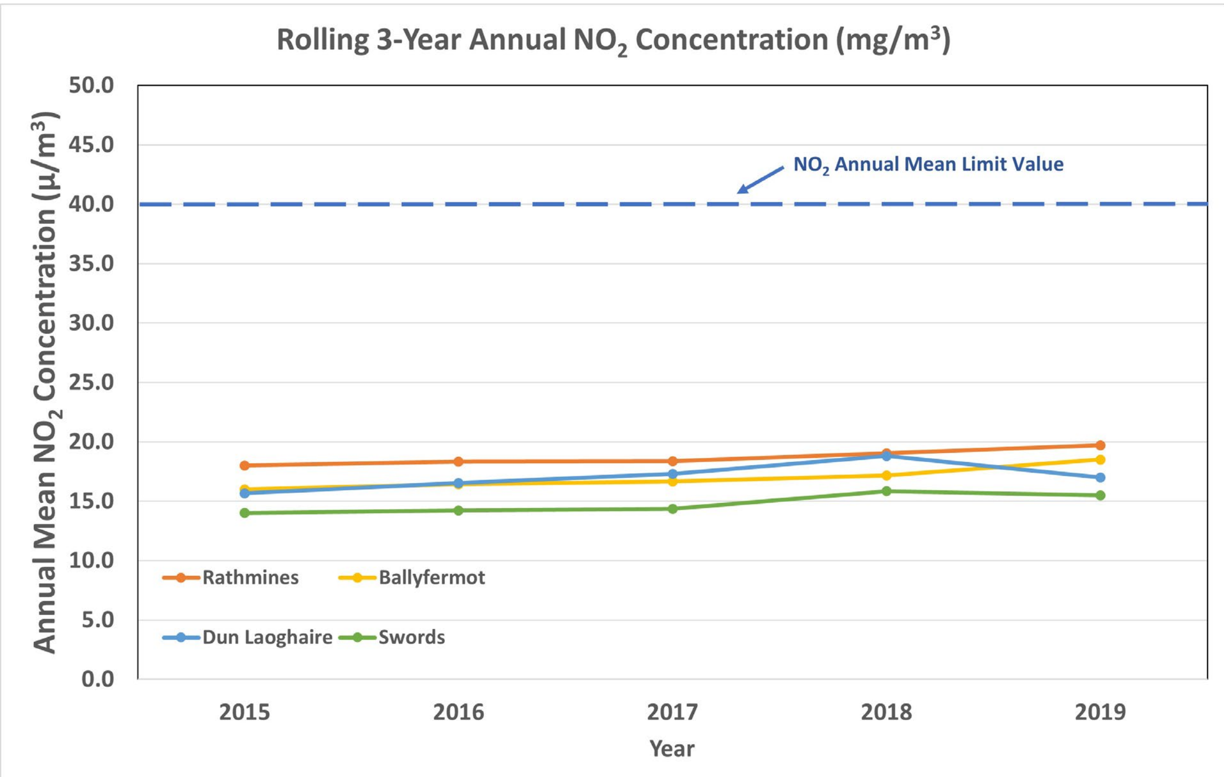

Diagram 7.3: Rolling Three-Year Annual NO_2 Concentration (µg/m³)

In addition to the continuous monitoring stations, the EPA has gathered NO_2 data using the passive diffusion tube methodology in proximity to the Proposed Scheme (EPA 2020c). The diffusion tube sampling was carried out in conjunction with Dublin City Council. Monitoring is for single year periods, therefore long-term averages are not available at diffusion tube locations. Further details on the diffusion tube methodology is discussed in Section 7.3.2.2 as part of the site-specific monitoring study. No exceedance of the annual mean NO_2 concentration in 2019 was recorded at the one EPA monitoring location within the study area.

Table 7.15 EPA NO_2 Diffusion Tube Monitoring Data

Monitoring Site	Monitoring Year	Annual Mean NO_2 Concentration (µg/m^3)
Coolock, Newtown	2019	20.9

With regard to PM_{10}, continuous monitoring data from the EPA Zone A stations was reviewed. The stations representative of the Proposed Scheme are Ballyfermot, Dún Laoghaire, Phoenix Park, Rathmines and Tallaght. Sufficient data is available to review long-term trends over a five year period (2015 to 2019), as outlined in Table 7.16. Long-term annual average levels range from 9µg/m^3 to 16µg/m^3 over the period 2015 to 2019 compared to the annual limit value of 40µg/m^3, with an average concentration of 13µg/m^3 over this period. Levels ranged between 11µg/m^3 - 15µg/m^3 in 2019, with a maximum of nine exceedances (at Rathmines) of the 24-hour limit value of 50µg/m^3 (35 exceedances are permitted per year). Average concentrations in 2019 were 13µg/m^3 across the representative stations.

Continuous $PM_{2.5}$ monitoring carried out at the Zone A locations of Ballyfermot, Phoenix Park, Finglas, Rathmines, St Anne's Park and Marino showed levels ranging between 8µg/m^3 to 10µg/m^3 in 2019. The Marino monitoring station is located towards the southern end of the Proposed Scheme. The annual average concentration measured in Marino was 9µg/m^3 in 2019, with the average concentrations of 6µg/m^3 to 9µg/m^3 over the period 2015 to 2019 compared to the annual limit value of 25µg/m^3. Marino monitors both PM_{10} and $PM_{2.5}$ allowing a ratio of PM_{10} to $PM_{2.5}$ to be calculated. The average $PM_{2.5}/PM_{10}$ ratio in Marino was 0.64 in 2019.

Table 7.16 Trends in Suburban and Urban PM_{10} Concentration (µg/m^3) In Dublin 2015 to 2019

Station	Station Classification Council Directive 96/62/EC*	Averaging Period	Year					Limit Value
			2015	2016	2017	2018	2019	
Ballyfermot	Suburban Background	Annual Mean PM_{10} (µg/m^3)	12	11	12	16	14	40
		90th%ile 24-hr PM_{10} (µg/m^3)	22	21	21	24	26	50
Dún Laoghaire	Suburban Background	Annual Mean PM_{10} (µg/m^3)	13	13	12	13	12	40
		90th%ile 24-hr PM_{10} (µg/m^3)	22	22	21	21	21	50
Tallaght	Suburban Background	Annual Mean PM_{10} (µg/m^3)	14	14	12	15	12	14
		90th%ile 24-hr PM_{10} (µg/m^3)	26	28	22	24	22	26
Phoenix Park	Urban Background	Annual Mean PM_{10} (µg/m^3)	12	11	9	11	11	40
		90th%ile 24-hr PM_{10} (µg/m^3)	20	20	16	18	18	50
Rathmines	Urban Background	Annual Mean PM_{10} (µg/m^3)	15	15	13	15	15	40
		90th%ile 24-hr PM_{10} (µg/m^3)	28	28	24	25	24	50

7.3.2.2 Site-Specific Monitoring Data

Monitoring of NO_2 in proximity to the Proposed Scheme, and roads that have the potential to be impacted by it, was carried out using passive diffusion tubes. The baseline monitoring study was carried out close to the alignment of the Proposed Scheme, with monitoring focusing on areas of greatest potential impact. The results of the monitoring survey allow for an indicative comparison with the annual limit value for NO_2. Diffusion tubes are a useful tool for assessing the spatial variation of NO_2 as they do not require an electrical connection and allow for multiple locations to be monitored at the same time. The results also provide information on the influence of road sources relative to the prevailing background level of these pollutants in the area. The spatial variation in

NO_2 levels away from air emission sources is particularly important, as a complex relationship exists between NO, NO_2 and O_3 leading to a non-linear variation of NO_2 concentrations with distance from these sources.

A baseline NO_2 monitoring survey was undertaken as part of the air quality assessment for the BusConnects Dublin - Core Bus Corridors Infrastructure Works (hereafter referred to as the Proposed Works). Monitoring at 112 locations was completed for a seven month data collection period (with six diffusion tube change overs between 15 November 2019 to 8 June 2020). However, due to COVID-19 impacts on the baseline traffic environment, the final two data sets (16 March 2020 to 8 June 2020) are considered non 'typical' baseline data and therefore are not included in the baseline data set.

Under TII Air Quality Guidelines (TII 2011) a minimum of one month baseline monitoring is required, ideally extending to at least three months. The TII Air Quality Guidelines specifically state that:

> *'Monitoring should ideally be carried out for a period of six months, including both summer and winter periods. However, for practical reasons, the monitoring period may be shorter, but, wherever possible, should extend for at least 3 months and should not be less than 1 month'.*

In general, four months of typical (i.e. prior to COVID-19 conditions) baseline data was collected which achieves the minimum monitoring period recommended in the TII Air Quality Guidelines.

Studies in the UK have shown that diffusion tube monitoring results generally have a positive or negative bias when compared to continuous analysers. This bias is laboratory specific and is dependent on the specific analysis procedures at each laboratory. A diffusion tube bias of 0.77 was obtained for the SOCOTEC laboratory (which analysed the diffusion tubes) from the UK DEFRA website (DEFRA 2018). In addition, three diffusion tubes were co-located with the continuous EPA NO_2 monitors at a number of locations across the Proposed Works in order to develop a local bias adjustment factor specific to the Proposed Works in order to develop a local bias adjustment factor specific to the Proposed Scheme. A bias adjustment factor was calculated for the St. John's Road (near Heuston Station) monitor of 0.76. A bias adjustment factor of 0.77 was selected for the diffusion tube monitoring results as this value was the more conservative of the laboratory derived and site-specific biases.

In addition to the bias adjustment, an annualisation factor is required as the monitoring period did not extend to a full year. The annualisation factor was prepared as per LAQM (TG16) (DEFRA, 2018). The annualisation factor is necessary as NO_2 concentrations vary across the year and this should be accounted for within the baseline monitoring. The factor was calculated using 2019 monitoring data from Ballyfermot, Winetavern, Davitt Road and St. Johns Road using Box 7.10 of LAQM (TG16). This factor was calculated to be 0.986 for the period of the diffusion tube monitoring.

The ten monitored locations in the vicinity of the Proposed Scheme are listed in Table 7.17 and shown in Figure 7.1 in Volume 3 of this EIAR. Table 7.18 and Diagram 7.4 outline the results of the baseline NO_2 diffusion tube monitoring over the period 15 November 2019 to 16 March 2020.

The highest four month average concentration was recorded at a roadside location in proximity to St. Joseph's CBS Secondary School (tube no. 1.10) in Fairview. This is located near where the Proposed Scheme will tie into the proposed Clontarf to City Centre Cycle Scheme (which is currently being proposed by DCC). Concentrations at this location averaged 38.2μg/m^3 or 95% of the annual mean limit value with the bias adjustment and annualization factor applied. The second highest concentration monitored was also monitored to the south of the Proposed Scheme at the roadside tube no.1.8. Concentrations at tube no.1.8 location averaged 37.1μg/m^3 or 93% of the annual mean limit value. All other monitoring locations, with the exception of the monitoring location near Artane Cottages, were below 70% of the annual mean limit value.

The lowest concentration was recorded in Belmayne (Tube no.1.1) (21.4μg/m^3). This location is a residential road roughly 570m from the Proposed Scheme.

Based on guidance from DEFRA, it can be considered that exceedances of the NO_2 one-hour limit value objective may occur at roadside sites if the annual mean is above 60μg/m^3 (DEFRA 2018). None of the ten sites monitored are considered likely to exceed the NO_2 one-hour limit value objective.

Table 7.17: Air Quality Monitoring Locations

Tube No.	Reference	Site	East (ITM)	North (ITM)
1.1	CBC0001DT001	44 / 46 Main Street, Clongriffin	722626	740782
1.2	CBC0001DT002	School Belmayne	721821	741294
1.3	CBC0001DT003	12 Slademore Court	720608	740051
1.4	CBC0001DT004	Lane next to Bunny Hops Creche and Montessori	719572	738634
1.5	CBC0001DT005	34 St. David's Wood	718938	738035
1.6	CBC0001DT006	Artane Cottages	719158	738233
1.7	CBC0001DT007	Colocation With Marino EPA Monitoring Station	717971	736819
1.8	CBC0001DT008	35 Carleton Road, Northsides, Dublin	717821	736582
1.9	CBC0001DT009	Malahide Road, Crescent Place Junction	717880	736544
1.10	CBC0001DT010	St. Joseph's CBS Secondary School	717529	736289

Table 7.18: Air Quality Monitoring Results

Tube No.	Site	15 Nov – 15 Dec 2019 ($\mu g/m^3$)	15 Dec 2019 – 15 Jan 2020 ($\mu g/m^3$)	15 Jan – 17 Feb 2020 ($\mu g/m^3$)	15 Feb – 16 Mar 2020 ($\mu g/m^3$)	Average	Locally Bias adjusted and annualised NO_2 Concentration ($\mu g/m^{-3}$) Note 1, Note 2
1.1	44 / 46 Main Street, Clongriffin	Lost	Lost	34.2	26.3	30.3	23.0
1.2	School Belmayne	35.5	28.3	30.3	18.9	28.3	21.4
1.3	12 Slademore Court	37.3	33.2	30.2	25.0	31.4	23.8
1.4	Lane next to Bunny Hops Creche and Montessori	37.3	33.3	29.9	26.3	31.7	24.1
1.5	34 St. David's Wood	36.5	34.8	32.1	21.6	31.3	23.7
1.6	Artane Cottages	53.3	50.1	39.8	22.4	41.4	31.4
1.7	Colocation With Marino EPA Monitoring Station	35.0	31.9	27.4	21.5	29.0	22.0
1.8	35 Carleton Road, Northsides, Dublin	40.8	39.1	36.1	27.6	35.9	27.2
1.9	Malahide Road, Crescent Place Junction	57.2	48.3	51.6	38.2	48.8	**37.1**
1.10	St. Joseph's CBS Secondary School	58.2	52.5	49.9	40.6	50.3	**38.2**
Average		43.5	39.1	36.2	26.8	35.8	27.2
Max		58.2	52.5	51.6	40.6	50.3	38.2
Min		35.0	28.3	27.4	18.9	28.3	21.4

Note 1: Bias adjustment factor: 0.77, Annualisation factor: 0.986

Note 2: Locally bias adjusted concentrations in bold exceed the 90% threshold value for screening modelling

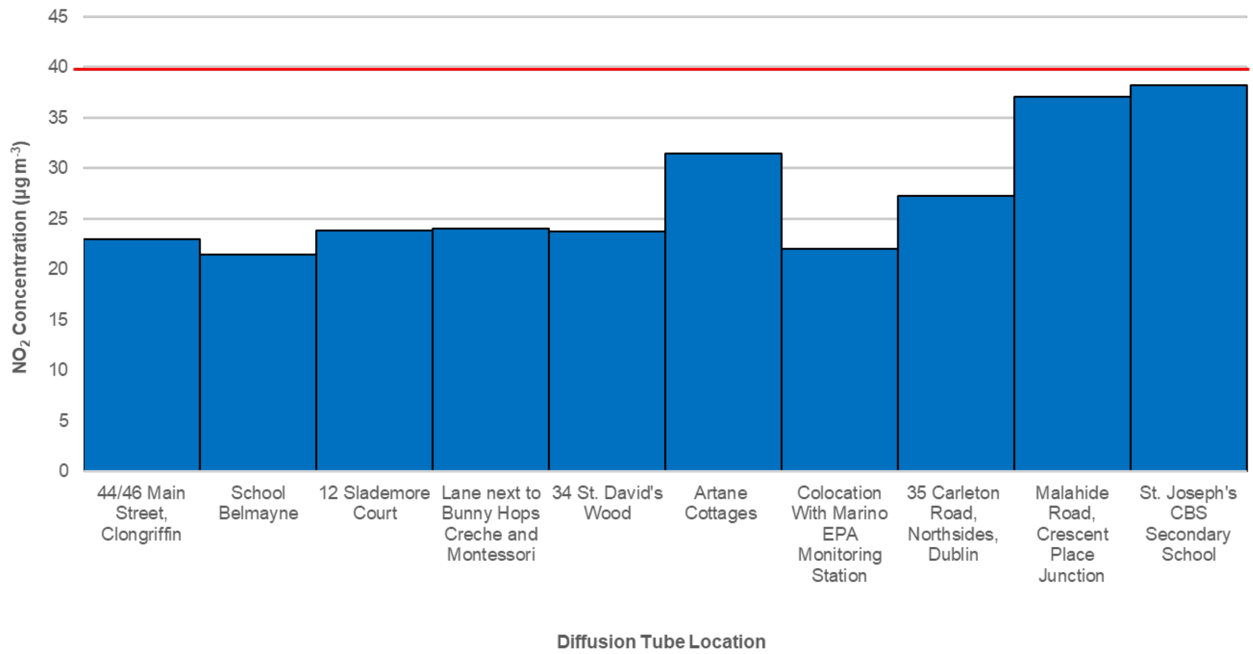

Diagram 7.4: Locally Bias Adjusted and Annualised NO_2 Concentration (µg/m^3)

* Annual mean limit value denoted by red line.

7.3.3 Existing Modelled Baseline Scenario

In the Existing Baseline Scenario, the current air quality environment experienced within the study area has been modelled. The Existing Baseline modelling scenario has been modelled using AMDS-Roads for the representative baseline year of 2019, to establish baseline concentrations at receptors within the Proposed Scheme study area. Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and the number of exceedances of the 24-hour PM_{10} limit value objective, at selected most impacted existing air quality sensitive receptors in the 2019 Existing Baseline scenario are listed in Table 7.19. Locations of these receptors are shown in Figures 7.3 to 7.8 in Volume 3 of this EIAR. Statistics for the full list of modelled receptors can be found in Table 1.1 (Appendix A7.1 – Detailed Modelling Results in Volume 4 of this EIAR).

Table 7.19: Existing Baseline Scenario Pollutant Statistics At Most Impacted Receptor Locations

Existing Baseline (2019)					
Receptor	**Receptor Location (ITM)**	**Annual Mean Conc. (µg/m^3)**			**No of PM_{10} days > 50µg/m^3**
		NO_2	PM_{10}	$PM_{2.5}$	
AQ65	718666,737772	24.9	14.7	10.5	<1
AQ67	719000,738050	25.4	14.9	10.6	<1
AQ68	719072,738123	25.4	14.8	10.5	<1
AQ200	718393,737436	26.3	14.9	10.6	<1
AQ202	718406,737455	25.7	15.0	10.6	<1
AQ256	719935,739246	22.6	14.5	10.3	<1
AQ295	721027,740785	24.6	14.7	10.5	<1
AQ296	721027,740785	32.5	15.8	11.2	1
AQ341	717730,736367	38.4	16.5	11.6	1
Air Quality Limit Value Objective		**40**	**40**	**25**	**35**

In the 2019 Existing Baseline scenario, annual mean concentrations of NO_2 are below the relevant national air quality limit value objective at all modelled receptors. Annual mean NO_2 concentrations did not exceed 60µg/m^3, indicating that exceedances of the NO_2 1-hour mean are unlikely to occur. Annual mean PM_{10} concentrations are below the relevant national air quality limit value objective in 2019 for all modelled receptors. At all receptors, modelling of the maximum 24-hour PM_{10} concentration indicated that there is likely to be no more than one exceedance of the 50µg/m^3 ambient limit value compared to the threshold which allows 35 daily exceedances in any one calendar year. Annual mean $PM_{2.5}$ concentrations are also below the relevant national air quality limit value objective for all modelled receptors.

7.4 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 7.5). Predicted 'residual' impacts taking into account any proposed mitigation is presented in Section 7.6.

7.4.1 Characteristics of the Proposed Scheme

In the context of the Proposed Scheme, the potential air quality impact on the surrounding environment must be considered for two distinct stages:

- Construction Phase; and
- Operational Phase.

7.4.2 Construction Phase

During the Construction Phase of the Proposed Scheme, works will involve predominately utility diversions, road widening works, road excavation works (where required), road and junction reconfiguration and resurfacing works, public realm improvements including landscaping, and construction traffic access routes including movement of machinery and materials within and to and from the Construction Compound along the Proposed Scheme.

Other works specific to the Proposed Scheme will include:

- Preparatory and site clearance works including ground investigations;
- The setting up of one Construction Compound; and
- A range of pavement works including construction of general traffic carriageways, bus lanes, on-road cycle tracks, off-road cycle tracks, off-line bus stops, bus terminals, traffic islands, off-line parking and loading bays.

Potential air quality impacts associated with the Proposed Scheme will be associated with the Construction Phase and the long term Operational Phase. During the Construction Phase, site clearance and preparation, landscaping, road and junction construction works all have the potential to generate dust and gaseous air emissions on site.

Chapter 5 (Construction) provides a full description of the proposed construction phasing and works for the Proposed Scheme.

For the purposes of the EIAR, two individual construction Sections are set out. Sections may be completed simultaneously and combined in certain areas. Table 5.1 in Chapter 5 (Construction) includes a summary of each Section with the estimated time for the completion of works in these areas.

It is envisaged that construction may be completed in the following Sections:

- **Section 1:** Mayne River Avenue to Gracefield Road – Malahide Road;
  - **Section 1a:** Mayne River Avenue Junction;
  - **Section 1b:** Clarehall Avenue / Malahide Road Junction;
  - **Section 1c:** Clarehall Avenue to Blunden Drive / Priorswood Road;

- **Section 1d:** Blunden Drive / Priorswood Road / Malahide Road Junction;
- **Section 1e:** Blunden Drive / Priorswood Road to Santry River;
- **Section 1f:** Santry River to Ardlea Road / Gracefield Road;
- **Section 1g:** Ardlea Road / Gracefield Road / Malahide Road Junction;

- **Section 2:** Gracefield Road to Marino Mart / Fairview – Malahide Road;
  - **Section 2a:** Ardlea Road / Gracefield Road to Killester Avenue;
  - **Section 2b:** Killester Avenue to Collins Avenue;
  - **Section 2c:** Collins Avenue Junction;
  - **Section 2d:** Collins Avenue to Clancarthy Road;
  - **Section 2e:** Clancarthy Road to Marino Avenue; and
  - **Section 2f:** Marino Avenue to Marino Mart / Fairview – Malahide Road.

Road works by their nature are transient in nature as the works progress along the length of the route of the Proposed Scheme. This includes excavation and fill works and road completion works.

The potential air quality impacts associated with this phase are set out within Sections 7.4.2.1 and 7.4.2.2.

7.4.2.1 Construction Dust Assessment

In order to determine the level of dust mitigation required during the proposed works, the potential dust emission magnitude for each dust generating activity needs to be taken into account, in conjunction with the sensitivity of the area, as outlined above (Section 7.2.4.4).

The Institute of Air Quality Management (IAQM) has issued guidelines (IAQM 2014) which also outline the assessment criteria for assessing the impact of dust emissions from construction activities based on both receptor sensitivity and the number of receptors affected. In terms of receptor sensitivity, the study area is characterised as having high, medium and low sensitivity receptors within 350m of the construction activities associated with the Proposed Scheme.

Table 7.11 identifies how the sensitivity of an area may be determined for dust soiling taking into account the number of receptors, the receptor sensitivity and distance from the source. The area in proximity to the proposed development would be an area of high sensitivity with greater than 100 receptors within 20m of the construction activities.

In addition, the IAQM guidelines outline the assessment criteria for assessing the impact of PM_{10} emissions from construction activities based on current annual mean PM_{10} concentration, receptor sensitivity and the number of receptors affected. The current PM_{10} concentration in Zone A locations as reported in Section 7.3.2.1 is approximately 15μg/m^3. Based on the criteria outlined in Table 7.12 the risk to human health from PM_{10} emissions at the nearest residential receptor (high sensitivity, distance less than 20m and with receptor numbers between >100) is considered medium under this guidance.

Table 7.13 identifies how the sensitivity of an area may be determined for ecological impacts taking into account the distance from the source to the ecological receptor and the sensitivity of the ecological receptor. The Royal Canal pNHA is an ecological receptor of medium sensitivity in proximity to the Proposed Scheme with a particularly important plant species, where its dust sensitivity is uncertain or unknown within 20m of the construction activities.

The major dust generating activities are divided into four types within the IAQM guidance (IAQM 2014) to reflect their different potential impacts. These are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

7.4.2.1.1 Demolition

There are no significant demolition activities associated with the proposed development. Therefore, there is no significant demolition impact predicted as a result of the works.

7.4.2.1.2 Earthworks

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling activities. Activities such as preparatory works, levelling and landscaping works are also considered under this category. The dust emission magnitude from earthworks can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- **Large:** Total site area > 10,000m^2, potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8m in height, total material moved >100,000 tonnes;
- **Medium:** Total site area 2,500m^2 to 10,000m^2, moderately dusty soil type (e.g. silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 to 8m in height, total material moved 20,000 to 100,000 tonnes; and
- **Small:** Total site area < 2,500m^2, soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4m in height, total material moved < 20,000 tonnes, earthworks during wetter months.

The dust emission magnitude for the proposed earthwork activities required for the Proposed Scheme is conservatively considered as large. The proposed construction compound plus the Proposed Scheme construction site areas will have a total site area of greater than 10,000m^2 and there may be more than 10 heavy earth moving vehicles within the construction compound in use at any one time during peak construction activities.

The sensitivity of the area is combined with the dust emission magnitude for each dust generating activity to define the risk of dust impacts in the absence of mitigation. The sensitivity of the area would be described as high for dust soiling and medium for human health impacts. As outlined in Table 7.20, this results in an overall medium risk of temporary dust soiling impacts and an overall low risk of temporary human health impacts as a result of the proposed earthworks activities. In relation to ecological impact, as the receptor is of medium sensitivity, the risk associated with the proposed earthwork activities is described as low.

Overall, in order to ensure that no dust nuisance occurs during the proposed earthworks activities, a range of dust mitigation measures associated with a low risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will not have a significant impact at nearby receptors.

Table 7.20: Risk of Dust Impacts - Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

7.4.2.1.3 Construction

Dust emission magnitude from construction can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- **Large:** Total building volume > 100,000m^3, on-site concrete batching, sandblasting;
- **Medium:** Total building volume 25,000m^3 to 100,000m^3, potentially dusty construction material (e.g. concrete), on-site concrete batching; and
- **Small:** Total building volume < 25,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

The dust emission magnitude for the proposed construction activities can be classified as small. There are no buildings being constructed as part of the works. The key construction activities after earthworks are installation of the paving materials.

The sensitivity of the area is combined with the dust emission magnitude for each dust generating activity to define the risk of dust impacts in the absence of mitigation. As outlined in Table 7.21, this results in an overall low risk of temporary dust soiling impacts and an overall low risk of temporary human health impacts as a result of the proposed construction activities. In relation to ecological impact, as the receptor is of medium sensitivity, the risk associated with the proposed construction activities is described as low.

Overall, in order to ensure that no dust nuisance occurs during the construction activities, a range of dust mitigation measures associated with a low risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will not have a significant impact at nearby receptors.

Table 7.21: Risk of Dust Impacts - Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

7.4.2.1.4 Trackout

Factors which determine the dust emission magnitude are vehicle size, vehicle speed, number of vehicles, road surface material and duration of movement. Dust emission magnitude from trackout can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- **Large:** > 50 HDV (> 3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100m;
- **Medium:** 10 - 50 HDV (> 3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 to 100m; and
- **Small:** < 10 HDV (> 3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length < 50m.

The dust emission magnitude for the proposed trackout can be classified as medium with between approximately 10 and 45 HDV outward movements in any one day during peak construction activity and with surface material with a low potential for dust release.

The sensitivity of the area is combined with the dust emission magnitude for each dust generating activity to define the risk of dust impacts in the absence of mitigation. As outlined in Table 7.22, this results in an overall medium risk of temporary dust soiling impacts and an overall medium risk of temporary human health impacts as a result of the proposed trackout activities. In relation to ecological impact, as the receptor is of medium sensitivity, the risk associated with the proposed trackout is described as low.

Overall, in order to ensure that no dust nuisance occurs during the trackout activities, a range of dust mitigation measures associated with a medium risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will not have a significant impact at nearby receptors.

Table 7.22: Risk of Dust Impacts - Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

7.4.2.1.5 Summary of Potential Dust Impacts

The risk of dust impacts as a result of the Proposed Scheme are summarised in Table 7.23 for each activity. The magnitude of risk determined is used to prescribe the level of site specific mitigation required for each activity in order to prevent significant impacts occurring.

In accordance with the EPA Guidelines (EPA 2017) the impacts associated with the Construction Phase dust emissions pre-mitigation are overall negative, not significant and short-term.

Table 7.23: Summary of Dust Impact Risk Used to Define Site-Specific Mitigation

Potential Impact	Dust Emission Magnitude			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	-	High Risk	Low Risk	Medium Risk
Human Health	-	Medium Risk	Low Risk	Medium Risk
Ecological	-	Low Risk	Low Risk	Low Risk

7.4.2.2 Construction Traffic Assessment

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

A detailed analysis of construction traffic volumes has been conducted to determine the expected HDV movements required to transport the materials extracted and delivered to site. A total of 12 public roads has been identified as required construction access routes where construction traffic will be permitted to travel along. Whilst the overall construction period is forecast as 24 months, construction traffic movements are assumed to occur over a 12-month period along construction access roads accessing specific work zones as a worst-case. For national and regional roads serving multiple work zones, a construction period of 18 months has been assumed.

Traffic volumes for the base scenario are based on the 2024 Do Minimum flows projected along the local road network. These are AADT flows with percentage HDV flows. An additional 340 HDV vehicles per day associated with construction traffic along each road including construction deliveries and earthworks material haulage are added to the base traffic volumes. The estimated construction traffic volumes are based on the peak construction period volumes and are therefore a worst-case assumption. In reality the Proposed Scheme will be constructed in phases with lower volumes and the corridor of the Proposed Scheme will be used for a large bulk of construction delivery vehicles along its route.

In order to determine the potential air quality impacts associated with additional construction traffic on the identified construction access routes, a comparison between ambient air concentrations for the 2024 Do Minimum scenario and the 2024 Do Something (construction) scenario was carried out.

7.4.2.2.1 ‘Do Minimum’ Scenario

The Do Minimum (DM) is a defined scenario within the traffic modelling analysis in Chapter 6 (Traffic & Transport) and is based on the likely conditions of the road network with all major committed transportation schemes in place that will impact on the use of public transport and private car, not including construction traffic associated with the Proposed Scheme. The output of this analysis and its impact on air quality has been modelled using AMDS-

Roads for the construction year of 2024. Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and the number of exceedances of the 24-hour PM_{10} limit value objective, at selected most impacted existing air quality sensitive receptors in the 2024 DM scenario are listed in Table 7.24. Locations of these receptors are shown in Figures 7.6 to 7.9 in Volume 3 of this EIAR. Statistics for the full list of modelled receptors can be found in Table 2.1 (Appendix A7.1 in Volume 4 of this EIAR). 'Most impacted' refers to those receptors with non-negligible impacts due to the Construction Phase of the Scheme.

Table 7.24: Predicted 2024 Do Minimum Construction Pollutant Statistics At Most Impacted Receptor Locations

DM (2024)					
Receptor	**Receptor Location (ITM)**	**Annual Mean Conc. (µg/m³)**			**No of PM_{10} days > 50µg/m³**
		NO_2	PM_{10}	$PM_{2.5}$	
AQ65	718666,737772	34.4	16.0	11.2	1
AQ67	719000,738050	34.3	15.9	11.2	1
AQ68	719072,738123	35.7	16.2	11.4	1
AQ200	718393,737436	31.0	15.6	11.0	1
AQ202	718406,737455	30.7	15.5	11.0	1
AQ256	719935,739246	30.0	15.5	10.9	<1
AQ295	721027,740785	32.1	16.0	11.2	1
Air Quality Limit Value Objective		**40**	**40**	**25**	**35**

In the 2024 DM scenario annual mean concentrations of NO_2 are below the relevant national air quality limit value objective for all modelled receptors. Annual mean NO_2 concentrations did not exceed 60µg/m³, indicating that exceedances of the NO_2 1-hour mean are unlikely to occur. Annual mean PM_{10} concentrations are below the relevant national air quality limit value objective for all modelled receptors. At all receptors, modelling of the maximum 24-hour PM_{10} concentration indicated that there is likely to be no more than one exceedance of the 50µg/m³ ambient limit value compared to the threshold which allows 35 daily exceedances in any one calendar year. Annual mean $PM_{2.5}$ concentrations are also below the relevant national air quality limit value objective for all modelled receptors.

7.4.2.2.2 'Do Something' Scenario

The Do Something (DS) is a defined scenario within the traffic modelling analysis in Chapter 6 (Traffic & Transport) and is based on the likely conditions of the road network with all major committed transportation schemes in place that will impact on the use of public transport and private car, including the construction traffic associated with the Proposed Scheme. The output of this analysis and its impact on air quality has been modelled using AMDS-Roads for the construction year of 2024 in line with the methodology set out in Section 7.2.4.1. Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and the number of exceedances of the 24-hour PM_{10} limit value objective, at selected most impacted existing air quality sensitive receptors in the 2024 DS scenario are listed in Table 7.26. Locations of these receptors are shown in Volume 3 of this EIAR. Statistics for the full list of modelled receptors can be found in Table 2.2 (Appendix A7.1 in Volume 4 of this EIAR). 'Most impacted' refers to those receptors with non-negligible impacts due to the Construction Phase of the Scheme.

Table 7.25: Predicted 2024 Do Something Construction Scenario Pollutant Statistics At Most Impacted Receptor Locations

DS (2024)					
Receptor	**Receptor Location (ITM)**	**Annual Mean Conc. (µg/m³)**			**No of PM_{10} days > 50µg/m³**
		NO_2	PM_{10}	$PM_{2.5}$	
AQ65	718666,737772	32.2	15.6	11.0	1
AQ67	719000,738050	32.0	15.6	11.0	1
AQ68	719072,738123	33.2	15.8	11.1	1
AQ200	718393,737436	28.5	15.2	10.8	<1

DS (2024)					
Receptor	Receptor Location (ITM)	Annual Mean Conc. ($\mu g/m^3$)			No of PM_{10} days > $50\mu g/m^3$
		NO_2	PM_{10}	$PM_{2.5}$	
AQ202	718406,737455	28.3	15.2	10.8	<1
AQ256	719935,739246	26.8	15.0	10.6	<1
AQ295	721027,740785	30.0	15.6	11.0	1
Air Quality Limit Value Objective		**40**	**40**	**25**	**35**

In the 2024 DS scenario annual mean concentrations of NO_2 are below the relevant national air quality limit value objective for all modelled receptors. This is no change from the DM scenario. Annual mean NO_2 concentrations did not exceed $60\mu g/m^3$, indicating that exceedances of the NO_2 1-hour mean are unlikely to occur. Annual mean PM_{10} concentrations are below the relevant national air quality limit value objective for all modelled receptors. At all receptors, modelling of the maximum 24-hour PM_{10} concentration indicated that there is likely to be no more than one exceedance of the $50\mu g/m^3$ ambient limit value compared to the threshold which allows 35 daily exceedances in any one calendar year. Annual mean $PM_{2.5}$ concentrations are also below the relevant national air quality limit value objective for all modelled receptors.

7.4.2.2.3 Comparison of Do Something with Do Minimum

Table 7.26 provides the predicted change in and impact on pollutant concentrations, between the DM and DS in 2024. Statistics for the full list of modelled receptors can be found in Table 2.3 (Appendix A7.1 in Volume 4 of this EIAR). 'Most impacted' refers to those receptors with non-negligible impacts due to the Construction Phase of the Scheme.

Table 7.26: Predicted Changes in Construction DM and DS and Impact Significance Criteria At Most Impacted Receptor Locations

Receptor	Receptor Location (ITM)	Change in Annual Mean Conc. ($\mu g/m^3$)			Change in No of PM_{10} days > $50\mu g/m^3$	Impact on Annual Mean Conc.		
		NO_2	PM_{10}	$PM_{2.5}$		NO_2	PM_{10}	$PM_{2.5}$
AQ65	721010,729699	-2.1	-0.4	-0.2	<1	Slight Beneficial	Negligible	Negligible
AQ67	721010,729701	-2.3	-0.3	-0.2	<1	Slight Beneficial	Negligible	Negligible
AQ68	721010,729702	-2.5	-0.4	-0.2	<1	Slight Beneficial	Negligible	Negligible
AQ200	721010,729834	-2.5	-0.3	-0.2	<1	Slight Beneficial	Negligible	Negligible
AQ202	721010,729836	-2.5	-0.3	-0.2	<1	Slight Beneficial	Negligible	Negligible
AQ256	721010,729890	-3.2	-0.4	-0.3	<1	Slight Beneficial	Negligible	Negligible
AQ295	721010,729929	-2.1	-0.3	-0.2	<1	Slight Beneficial	Negligible	Negligible

The significance of the changes in the concentration of each of the ambient receptors has been determined in the context of the TII significance criteria (TII 2011). As shown in Table 7.26 and Figure 7.6 in Volume 3 of this EIAR, the majority of modelled receptors are estimated to experience a negligible impact due to the Proposed Scheme in terms of the annual mean NO_2 concentration. A slightly beneficial impact is estimated at seven receptors. All beneficial impacts are modelled along the Proposed Scheme due to the diversion of traffic off these routes. As shown in Table 7.26 and Figure 7.7 in Volume 3 of this EIAR, the Proposed Scheme is overall neutral in terms of annual mean PM_{10} concentrations, with all receptors experiencing a negligible impact. As shown in Table 7.26 and Figure 7.8 in Volume 3 of this EIAR, the Proposed Scheme is overall neutral in terms of the annual mean $PM_{2.5}$ concentration with all receptors experiencing a negligible impact.

In accordance with the EPA Guidelines (EPA 2017) the impacts associated with the Construction Phase traffic emissions are overall neutral and short-term.

7.4.2.2.4 Ecological Assessment

No key ecological receptors were identified within 200 m of a construction access route or road that meets the DMRB criteria for detailed assessment, as described in Section 7.2.4.1. Therefore there are no impacts to report.

7.4.2.3 Regional Air Quality Assessment

The potential changes in regional air emissions due to the Construction Phase traffic impacts of the Proposed Scheme have been assessed using the NTA Environmental Appraisal Tool, which is based on ENEVAL. ENEVAL measures the regional emissions associated with road transport based on the various road links and their corresponding emissions.

Pollutant emissions (in tonnes) produced in both the DM and DS scenarios during the construction year 2024 of the Construction Phase are shown in Table 7.27. The Proposed Scheme will result in increases in emissions of all pollutants modelled. The majority of these emission increases result from redistribution of vehicles onto other longer diversion routes, while the construction of the scheme takes place. To produce these emissions estimates, the traffic model and therefore the ENEVAL tool have applied the peak construction day in 2024 across the whole year. Emissions are therefore worst-case and likely to be lower in reality.

Table 7.27: Construction Phase Regional Pollutant Emissions (tonnes) – Construction Year 2024

	Vehicle Class	NO_X (tonnes)	NO_2 (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	HC (tonnes)	CO (tonnes)	Benzene (tonnes)	Butadiene (tonnes)
DM	Car	204	61	2.3	2.2	11	207	2.9	0.2
DS		206	62	2.4	2.2	12	211	2.9	0.2
Change		2	0.6	0.02	0.02	0.1	4	0.06	0.001
% Change		1.0%	1.0%	1.0%	1.0%	1.2%	1.7%	2.0%	0.5%
DM	Goods	154	42	1.2	1.1	5	29	0.5	0.06
DS		156	43	1.2	1.2	5	29	0.6	0.06
Change		2.3	0.5	0.01	0.01	0.05	0.5	0.01	0.0003
% Change		1.5%	1.3%	1.1%	1.1%	0.9%	1.6%	1.5%	0.6%
DM	Bus	7	0.7	0.1	0.1	0.3	1.3	0	0.01
DS		7	0.7	0.1	0.1	0.3	1.4	0	0.01
Change		0.6	0.06	0.006	0.006	0.02	0.1	0	0.0003
% Change		9%	9%	5%	5%	6%	8%	0%	4%
DM	**Total**	**364**	**104**	**4**	**3**	**17**	**238**	**3.4**	**0.2**
DS		**369**	**105**	**4**	**4**	**17**	**242**	**3.5**	**0.2**
Change		**5**	**1**	**0.04**	**0.04**	**0.2**	**4**	**0.07**	**0.001**
% Change		**1.4%**	**1.2%**	**1.2%**	**1.2%**	**1.2%**	**1.8%**	**1.9%**	**0.6%**

In accordance with the EPA Guidelines (EPA 2017) and considering that the change in concentrations is within the traffic model and ENEVAL tool margin of variability, the regional impacts associated with the Construction Phase traffic emissions pre-mitigation are considered overall neutral and short-term.

7.4.3 Operational Phase

7.4.3.1 'Do Minimum' Scenario

The Do Minimum (DM) is a defined scenario within the traffic modelling exercise in Chapter 6 (Traffic & Transport) and is based on the likely conditions of the road network with all major committed transportation schemes in place that will impact on the use of public transport and private car, not including the Proposed Scheme. The output of this analysis and its impact on air quality has been modelled using ADMS-Roads for the opening year of 2028.

Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and the number of exceedances of the 24-hour PM_{10} objective, at selected most impacted existing air quality sensitive receptors in the 2028 DM scenario are listed in Table 7.28. Locations of these receptors are shown in Figures 7.3 to 7.5 in Volume 3 of this EIAR. Statistics for the full list of modelled receptors can be found in Table 3.1 (Appendix A7.1 in Volume 4 of this EIAR). 'Most impacted' refers to those receptors with non-negligible impacts due to the Operational Phase of the Scheme.

Table 7.28: Predicted 2028 Do Minimum Scenario Pollutant Statistics At Most Impacted Receptor Locations

DM (2028)					
Receptor	Receptor Location (ITM)	Annual Mean Conc. (µg/m³)			No of PM_{10} days > 50µg/m³
		NO_2	PM_{10}	$PM_{2.5}$	
AQ296	721027,740785	33.4	16.0	11.2	1
AQ341	717730,736367	36.6	16.4	11.5	1
Air Quality Limit Value Objective		**40**	**40**	**25**	**35**

In the 2028 DM scenario annual mean concentrations of NO_2 are below the relevant national air quality limit value objective for all modelled receptors. Concentrations at all modelled receptors can be found in Table 3.1 (Appendix A7.1 in Volume 4 of this EIAR). Some of these receptors have been excluded from this section as these locations experience a negligible impact due to the Scheme and are therefore not considered a most impacted receptor. Annual mean NO_2 concentrations did not exceed 60µg/m³, indicating that exceedances of the NO_2 1-hour mean are unlikely to occur. Annual mean PM_{10} concentrations are below the relevant national air quality limit value objectives for all modelled receptors. At all receptors, modelling of the maximum 24-hour PM_{10} concentration indicated that there is likely to be no more than one exceedance of the 50µg/m³ ambient limit value compared to the threshold which allows 35 daily exceedances in any one calendar year. Annual mean $PM_{2.5}$ concentrations are also below the relevant national air quality limit value limit value objectives for all modelled receptors. Reported concentrations are lower in 2028 due to the assumed modest improvements in vehicle emissions rates between now and then.

7.4.3.2 'Do Something' Scenario

The Do Something (DS) is a defined scenario within the traffic modelling exercise in Chapter 6 (Traffic & Transport) and is based on the likely conditions of the road network with all major committed transportation schemes in place that will impact on the use of public transport and private car, including the Proposed Scheme. The output of this analysis and its impact on air quality has been modelled using AMDS-Roads for the opening year of 2028 in line with the methodology set out in Section 7.2.4.1. Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and the number of exceedances of the 24-hour PM_{10} objective, at selected most impacted existing air quality sensitive receptors both along the Proposed Scheme and on routes affected by traffic diversions in the 2028 DS scenario are listed in Table 7.29. Locations of these receptors are shown in Volume 3 of this EIAR. Statistics for the full list of modelled receptors can be found in Table 3.2 (Appendix A7.1 in Volume 4 of this EIAR). 'Most impacted' refers to those receptors with non-negligible impacts due to the Operational Phase of the Scheme.

Table 7.29: Predicted 2028 Do Something Scenario Pollutant Statistics At Most Impacted Receptor Locations

DS (2028)					
Receptor	Receptor Location (ITM)	Annual Mean Conc. (µg/m³)			No of PM_{10} days > 50µg/m³
		NO_2	PM_{10}	$PM_{2.5}$	
AQ296	721027,740785	31.2	15.6	10.9	1
AQ341	717730,736367	37.2	16.4	11.4	1
Air Quality Limit Value Objective		**40**	**40**	**25**	**35**

In the 2028 DS scenario annual mean concentrations of NO_2 are below the relevant national air quality limit value objective at all modelled receptors, which is no change from the DM scenario. Concentrations at all modelled receptors can be found in Table 3.2 (Appendix A7.1 in Volume 4 of this EIAR). Some of these receptors have been excluded from this section as these locations experience a negligible impact due to the Scheme and are therefore not considered a most impacted receptor. Annual mean NO_2 concentrations did not exceed 60µg/m^3, indicating that exceedances of the NO_2 1-hour mean are unlikely to occur. Annual mean PM_{10} concentrations are below the relevant national air quality limit value objective for all modelled receptors. At all receptors, modelling of the maximum 24-hour PM_{10} concentration indicated that there is likely to be no more than one exceedance of the 50µg/m^3 ambient limit value compared to the threshold which allows 35 daily exceedances in any one calendar year. Annual mean $PM_{2.5}$ concentrations are also below the relevant national air quality limit value objective for all modelled receptors.

7.4.3.3 Comparison of Do Something with Do Minimum

Table 7.30 provides the predicted change in and impact on pollutant concentrations, between the DM and DS in 2028. Statistics for the full list of modelled receptors can be found in Table 3.3 (Appendix A7.1 in Volume 4 of this EIAR). 'Most impacted' refers to those receptors with non-negligible impacts due to the Operational Phase of the Scheme.

Table 7.30: Predicted Changes in Operational DM and DS and Impact Significance Criteria At Most Impacted Receptor Locations

Receptor	Receptor Location (ITM)	Change in Annual Mean Conc. (µg/m^3)			Change in No of PM_{10} days > 50µg/m^3	Impact on Annual Mean Conc.		
		NO_2	PM_{10}	$PM_{2.5}$		NO_2	PM_{10}	$PM_{2.5}$
AQ296	721010,729930	-2.2	-0.4	-0.2	-2.2	Slight Beneficial	Negligible	Negligible
AQ341	721010,729975	0.6	<0.1	<0.1	0.6	Slight Adverse	Negligible	Negligible

The significance of the changes in the concentration of each of the ambient receptors has been determined in the context of the TII significance criteria (TII 2011). As shown in Table 7.30 and Figure 7.3 in Volume 3 of this EIAR, the majority of modelled receptors are estimated to experience a negligible impact due to the Proposed Scheme in terms of the annual mean NO_2 concentration. A slightly beneficial impact is estimated at one receptor along the Proposed Scheme on the R107 Malahide Road and a slight adverse impact is expected at one receptor on the R105 Marino Mart, due to the diversion of traffic off the Proposed Scheme routes. As shown Table 7.30 and Figure 7.4 in Volume 3 of this EIAR, the Proposed Scheme will be overall neutral in terms of annual mean PM_{10} concentrations, with all receptors experiencing a negligible impact. As shown in Table 7.30 and Figure 7.5 in Volume 3 of this EIAR, the Proposed Scheme will be overall neutral in terms of the annual mean $PM_{2.5}$ concentration with all receptors experiencing a negligible impact.

In accordance with the EPA Guidelines (EPA 2017) the impacts associated with the Operational Phase traffic emissions pre-mitigation are overall neutral and long-term.

The predictions reported are based on conservative assumptions regarding background pollutant concentrations and the improvement in vehicle emission rates. 2019 background pollutant concentrations have been used to represent 2028 and are likely be lower by the opening year than in 2019. Older fleet projections were used in the absence of a fleet that incorporates the effects of 2021 Climate Action Plan measures – a larger proportion of electric vehicles is planned by the opening year than has been modelled. In reality, total concentrations (and magnitude of change) are likely to be lower than those reported here.

7.4.3.4 Ecological Assessment

An assessment of the impact of the Proposed Scheme has been undertaken using the approach outlined in the IAQM guidance document A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites (Version 1.1) (IAQM 2020). The guidance states that where the PEC is less than 70% of the long-term critical level / load, the PC is likely to be insignificant. Where the process contribution is greater than 1% of the critical level / load it is recommended that the project ecologist should be consulted.

The impact of the Proposed Scheme on the nearby ecologically sensitive areas within 200m of roads impacted by the Proposed Scheme, as defined in Section 7.2.4.1, is outlined in Table 7.31. The annual mean NO_X

concentration has been compared to the critical level of 30µg/m³ at each of the designated habitat sites. All sites exceed the critical level for NO_X in both the DM and the DS scenarios.

Nitrogen deposition levels have been compared to the lower and higher critical loads for the designated habitat sites in Table 7.32. All sites are below the lower critical load for the designated habitat site in both the DM and the DS scenarios.

In accordance with the EPA Guidelines (EPA 2017) the ecological impacts associated with the Operational Phase traffic emissions are overall negative, slight and long-term.

Table 7.31: Significance of Impacts at Key Ecological Receptors (NO_X Annual Mean Concentration In 2028)

Annual Mean NO_X In 2028 At Closest Point Within Ecological Site To Road							
Receptor	Receptor Location (ITM)	Do Minimum (µg/m³)	Distance from road beyond which concentration is below critical level (30µg/m³) (m)	Do Something (µg/m³)	Distance from road beyond which concentration is below critical level (30µg/m³) (m)	Impact (DS – DM) (µg/m³)	Change as a percentage of critical level (30µg/m³) (%)
Royal Canal pNHA (Newcomen Bridge, western side)	716870, 735475	77.9	140m	77.1	140m	-0.7	-2%
Royal Canal pNHA (Newcomen Bridge, eastern side)	716874, 735462	77.0	130m	76.3	130m	-0.7	-2%
North Dublin Bay pNHA (Clontarf Road)	718639, 736161	56.3	150m	57.5	160m	1.2	4%
South Dublin Bay and River Tolka Estuary SPA (Clontarf Road)	718639, 736161	56.3	150m	57.5	160m	1.2	4%

Table 7.32: Significance of Impacts at Key Ecological Receptors (N Deposition In 2028)

Annual Mean N Deposition In 2028 At Closest Point Within Ecological Site To Road									
Receptor	Receptor Location (ITM)	Lower critical load for most sensitive feature (kgN/ha/yr)	Do Minimum (kgN/ha/yr)	Distance from road beyond which deposition is below critical load (m)	Do Something (kgN/ha/yr)	Distance from road beyond which deposition is below critical load (m)	Change relative to lower critical load (%)	Distance from road beyond which the change is <1% (m)	Change in deposition kgN/ha/yr
Royal Canal pNHA (Newcomen Bridge, western side)	716870, 735475	5	4.39	0m	4.36	0m	-0.6%	0m	-0.03
Royal Canal pNHA (Newcomen Bridge, eastern side)	716874, 735462	5	4.36	0m	4.32	0m	-0.6%	0m	-0.03
North Dublin Bay pNHA (Clontarf Road)	718639, 736161	5	3.40	0m	3.46	0m	1.2%	10m	0.06
South Dublin Bay and River Tolka Estuary SPA (Clontarf Road)	718639, 736161	5	3.40	0m	3.46	0m	1.2%	10m	0.06

7.4.3.5 Regional Air Quality Assessment

The potential changes in regional air emissions due to the Operational Phase traffic impacts of the Proposed Scheme have been assessed using the NTA Environmental Appraisal Tool, which is based on ENEVAL. ENEVAL measures the regional emissions associated with road transport based on the various road links and their corresponding emissions.

Pollutant emissions (in tonnes) produced in both the DM and DS scenarios during the opening year of the Operational Phase are shown in Table 7.33. The Proposed Scheme will be overall beneficial, with reductions in emissions of all pollutants modelled. The majority of these reductions result from a predicted modal shift, with decreased car usage (Section 6.4.5.2.2, Chapter 6 (Traffic & Transport) and a cleaner and more efficiently routed bus fleet. The NTA has committed to replacing its diesel-powered vehicles with plug-in hybrid and fuel cell electric buses by 2028 and zero emission vehicles by 2043, so the reductions in emissions due to the Proposed Scheme are due to more efficiently operated routes, meeting the Scheme Objectives.

Table 7.33. Operational Phase Regional Pollutant Emissions (tonnes) – Opening Year 2028

	Vehicle Class	NO_X (tonnes)	NO_2 (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	HC (tonnes)	CO (tonnes)	Benzene (tonnes)	Butadiene (tonnes)
DM	Car	1317	382	9.17	8.71	79.35	1698	0.86	1.16
DS		1315	381	9.15	8.69	79.17	1697	0.86	1.15
Change		-2.7	-0.8	-0.02	-0.02	-0.2	-1.6	-0.002	-0.002
% Change		-0.21%	-0.21%	-0.22%	-0.22%	-0.22%	-0.10%	-0.19%	-0.21%
DM	Goods	1673	472	3.77	3.58	46.42	247	0.44	0.54
DS		1674	473	3.77	3.59	46.42	247	0.44	0.54
Change		1.1	0.2	0.001	0.001	0.002	0.2	0.001	0.0003
% Change		0.07%	0.05%	0.04%	0.04%	0.00%	0.10%	0.21%	0.05%

	Vehicle Class	NO_X (tonnes)	NO_2 (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	HC (tonnes)	CO (tonnes)	Benzene (tonnes)	Butadiene (tonnes)
DM	Urban Bus	17	1.67	0.17	0.16	0.73	5.44	0	0.00627
DS		17	1.67	0.17	0.16	0.73	5.43	0	0.00626
Change		-0.003	-0.0003	-0.0004	-0.0004	-0.002	-0.01	0	-0.00002
% Change		-0.02%	-0.02%	-0.25%	-0.25%	-0.26%	-0.24%	0%	-0.24%
DM	**Total**	**3007**	**856**	**13.11**	**12.45**	**126**	**1951**	**1.31**	**1.71**
DS		**3006**	**856**	**13.09**	**12.44**	**126**	**1949**	**1.31**	**1.70**
Change		**-1.6**	**-0.6**	**-0.02**	**-0.02**	**-0.2**	**-1.4**	**-0.001**	**-0.002**
% Change		**-0.05%**	**-0.07%**	**-0.15%**	**-0.15%**	**-0.14%**	**-0.07%**	**-0.05%**	**-0.13%**

Pollutant emissions (in tonnes) produced in both the DM and DS scenarios during the opening year of the Operational Phase are shown in Table 7.34. The Proposed Scheme will be overall beneficial, with reductions in emissions of all pollutants modelled except NO_x, where an increase in emissions from light and heavy goods vehicles offsets the reductions achieved by more electric cars in the fleet. This also reflects the technical challenges in converting particularly the heavy goods fleet to electric vehicles, which would reduce NO_X and NO_2 emissions.

Table 7.34. Operational Phase regional pollutant emissions (tonnes) – Design Year 2043

	Vehicle Class	NO_X (tonnes)	NO_2 (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	HC (tonnes)	CO (tonnes)	Benzene (tonnes)	Butadiene (tonnes)
DM	Car	508	147	4.27	4.06	37.28	654	0.35	0.56
DS		507	146	4.26	4.05	37.21	653	0.35	0.56
Change		-0.8	-0.2	-0.01	-0.01	-0.07	-0.5	-0.0005	-0.001
% Change		-0.16%	-0.16%	-0.19%	-0.19%	-0.19%	-0.08%	-0.14%	-0.15%
DM	Goods	1080	284	3.28	3.12	33.56	189	0.27	0.38
DS		1081	284	3.28	3.12	33.57	189	0.27	0.38
Change		0.9	0.2	0.001	0.001	0.009	0.1	0.0003	0.0004
% Change		0.08%	0.07%	0.03%	0.03%	0.03%	0.05%	0.10%	0.11%
DM	Urban Bus	16	1.58	0.16	0.15	0.72	5.48	0	0.00611
DS		16	1.58	0.16	0.15	0.72	5.47	0	0.00610
Change		-0.01	-0.001	-0.0004	-0.0004	-0.002	-0.01	0	-0.00001
% Change		-0.07%	-0.07%	-0.25%	-0.25%	-0.27%	-0.23%	0%	-0.21%
DM	**Total**	**1604**	**432**	**7.71**	**7.32**	**72**	**848**	**0.63**	**0.95**
DS		**1604**	**432**	**7.70**	**7.32**	**72**	**848**	**0.63**	**0.95**
Change		**0.03**	**-0.04**	**-0.01**	**-0.01**	**-0.06**	**-0.41**	**-0.0002**	**-0.0004**
% Change		**0.002%**	**-0.01%**	**-0.10%**	**-0.10%**	**-0.09%**	**-0.05%**	**-0.03%**	**-0.04%**

In accordance with the EPA Guidelines (EPA 2017) and considering that the change in emissions is within the traffic model and ENEVAL tool margin of uncertainty, the regional impacts associated with the Operational Phase traffic emissions pre-mitigation are considered overall neutral and long-term.

7.5 Mitigation and Monitoring Measures

In order to sufficiently ameliorate the likely air quality impact, a schedule of mitigation measures has been formulated for the Construction Phase of the Proposed Scheme.

7.5.1 Construction Phase

7.5.1.1 Construction Dust

In order to minimise dust nuisance impacts, a series of mitigation measures that are applicable to the Construction Phase of the Proposed Scheme will be implemented by the appointed contractor. In summary, the mitigation measures will include:

- Public roads affected by the Proposed Scheme works will be regularly inspected for soiling associated with the construction activities and cleaned as necessary;
- Material handling systems and stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays (or similar dust suppression methods) will be used as required if particularly dusty activities associated with the construction contract are necessary during dry or windy periods;
- During movement of dust generating materials both on and off-site, trucks will be covered with tarpaulin, and before entrance onto public roads, trucks will be checked to ensure the tarpaulins are properly in place; and
- The appointed contractor will provide a site hoarding of 2.4m height along noise sensitive boundaries, at a minimum, at the Construction Compound, which will assist in minimising the potential for dust impacts off-site.

The appointed Contractor will keep the effectiveness of the mitigation measures under review and revise them as necessary. In the event of dust nuisance occurring outside the works boundary associated with the Proposed Scheme, movements of materials likely to raise dust will be curtailed and satisfactory procedures implemented to rectify the problem.

7.5.1.2 Construction Traffic

Construction vehicles, generators etc., may give rise to some NO_2 and PM_{10} / $PM_{2.5}$ emissions. Table 7.35 summarises the Construction Phase impacts prior and post mitigation. In terms of construction traffic impacts, the scheme will have a generally neutral impact on air quality, with some slight and moderate beneficial impacts. Due to worst-case scenario modelling where in reality the works will be short-term and temporary in nature, the impact on air quality will not be significant. Therefore, no specific construction phase mitigation or monitoring measures are required.

Table 7.35:Summary of Predicted Construction Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Potential Impact (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
Construction dust	Negative, Not significant, Short-term	Negative, Imperceptible, Short-term
Road traffic impacts on local human receptors	Neutral, Short-term	Neutral, Short-term
Regional air quality	Neutral, Short-term	Neutral, Short-term

7.5.2 Operational Phase

Table 7.36 summarises the Operational Phase impacts prior and post mitigation. As all ambient air pollutants will remain in compliance with the ambient air quality standards and the scheme will have a generally neutral impact on air quality, no specific operation phase mitigation or monitoring measures are required.

Table 7.36:Summary of Predicted Operational Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Potential Impact (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
Road traffic impacts on local human receptors	Neutral, Long-term	Neutral, Long-term
Road traffic impacts on local ecological receptors	Positive, Slight, Long-term	Positive, Slight, Long-term
Regional air quality	Neutral, Long-term	Neutral, Long-term

7.6 Residual Impacts

7.6.1 Construction Phase

When the dust minimisation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors. Thus, there will be no residual Construction Phase dust impacts.

The air dispersion modelling assessment of Construction Phase traffic emissions has found that the Proposed Scheme will be neutral overall in the study area. In 2024 all receptors will have ambient air quality in compliance with the ambient air quality standards for the DS (and DM) scenario. There are no substantial or moderate adverse effects expected as a result of the Construction Phase of the Proposed Scheme.

Therefore, overall it is considered that the residual effects as a result of the Proposed Scheme’s construction are neutral and short-term. No significant residual impacts have been identified during the Construction Phase of the Proposed Scheme, whilst meeting the scheme objectives set out in Chapter 1 (Introduction).

7.6.2 Operational Phase

The air dispersion modelling assessment has found that the Proposed Scheme will be neutral overall in the study area. In 2028 and 2043 all receptors will have ambient air quality in compliance with the ambient air quality standards for the Do Something (and Do Minimum) scenario. There are no substantial or moderate adverse effects expected as a result of the Operational Phase of the Proposed Scheme.

Therefore, overall it is considered that the residual effects as a result of the Proposed Scheme’s operation are neutral and long-term. No significant residual impacts have been identified during the Operational Phase of the Proposed Scheme, whilst meeting the scheme objectives set out in Chapter 1 (Introduction).

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