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 BusConnects Galway: Cross-City Link (University Road to Dublin Road) (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 the key access routes through the city of Galway, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the scheme. The objectives of the Proposed Scheme are described in Chapter 1 (Introduction). The Proposed Scheme which is described Chapter 4 (Proposed Scheme Description) has been designed to meet these objectives.

The design of the Proposed Scheme has evolved through the application of a comprehensive design iteration process 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 programme 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 General

Air quality assessments are concerned with the presence of airborne pollutants in the atmosphere. The likely significant effects of the proposed development on air quality have been assessed by considering the background concentration levels of pollutants in the atmosphere and the potential for construction, operational and decommissioning (where relevant) effects associated with the proposed development.

This assessment has been undertaken with regard to the National Roads Authority (NRA (now Transport Infrastructure Ireland (TII)) (2011)) Guidelines for the Treatment of Air Quality during the Planning and Construction of National Roads Schemes (hereafter referred to as “TII Guidelines”) and Institute of Air Quality Management (IAQM) (2014) Guidance on the assessment of dust from demolition and construction (hereafter referred to as “IAQM Guidance”). These guidelines provide a methodology for the assessment, management and mitigation of air quality which can be adapted accordingly depending on the nature of the works.

The potential impacts to air quality relate to alterations to traffic patterns, with a 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.

7.2.2 Study Area

7.2.2.1 Extent of Study Area

The Proposed Scheme is located across Galway City centre, representing a west-east public transport corridor commencing at the junction of University Road/Newcastle Road, routing over Salmon Weir Bridge and onto St. Francis Street/Eglinton Street, continuing through Eyre Square and onto Forster Street and College Road, ultimately connecting with the existing outbound bus lane on the R338 Dublin Road to the east of the junction at Moneenageisha. Refer to Diagram 1.1 (Chapter 1- Introduction) of this EIAR for the extents of the proposed development.

The works will be at specific locations along the existing road network from University Road, west of the River Corrib to the R338 Dublin Road, adjacent to Lough Atalia, east of the city centre. The works will also extend to the Dyke Road/Headford Road junction.

The existing land use in Galway City is typical of an urban setting with a continuous range and mixture of facilities alongside residential and commercial uses. The existing land use across the proposed road development will stay largely the same with works designed to improve the existing road infrastructure to facilitate pedestrians, cyclists and buses moving across the city centre. Existing land use changes include where land used for traffic will be re-established as areas of public space including east of Galway Cathedral, Waterside adjacent to the Salmon Weir Bridge, Woodquay and at Forster Street/Bóthar Uí hEithir.

It is proposed to demolish two private residential properties, one on St. Brendan's Avenue and one on Headford Road to facilitate road widening and make junction improvements. In addition, road widening on College Road between Lough Atalia Road/College Road junction to the Moneenageisha junction, will result in boundary removal of a number of private properties to facilitate these proposed works and the partial acquisition of the existing petrol station on College Road.

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 IAQM Guidance with the key impacted study areas focused up to a maximum of 100m depending on the types of air emission sources and the local area under consideration.

7.2.2.2 Sensitive Receptors

The TII Guidelines defines sensitive receptor locations as *"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."*

For the purposes of this assessment the focus is on air quality sensitive receptors which bound the Proposed Scheme and those along diverted traffic routes within the study area.

There is a range of air quality sensitive receptors within the study area mainly comprising residential dwellings, commercial developments, schools, leisure, and community facilities, as follows:

- There are schools and colleges located across the study area including Saint Patricks Primary School, Saint Nicholas Parochial School, Yeat's College, Our Lady's College Galway, Scoil Croi Iosa, Mercy Primary School and National University of Ireland Galway.
- There are religious premises and places of worship located throughout the study area including Galway Cathedral, Poor Clares Convent, St Francis the Abbey, United Methodist Presbyterian Church, St Patrick's Church, Saint Nicholas Collegiate Church and Saint Joseph's Church.
- There are several recreational and amenity facilities within the study area including Millennium Children's Park, Town Hall Theatre, Eyre Square, Connaught Rugby Pitches, Galway Greyhound Track and Lough Atalia Park.
- The University Hospital Galway (UHG) is located on the western side of the study area. The community facilities within the study area consist of Galway Court House, Bus Éireann bus depot and Irish Rail stations (Galway Ceannt train station), Galway Coach Station (Fairgreen Road), Galway General Post Office, County Hall and City Hall.
- The commercial developments are primarily located within the city-centre at Eyre Square, Corbett Court Shopping Centre and Corrib Shopping Centre.
- The majority of residential developments are located on the eastern boundary of the study area with clusters of housing estates and ribbon developments. In addition, there are a number of housing estates located along the western boundary of the study area.

The TII Guidelines consider ecologically designated sites (Irish and European designations) as highly sensitive air quality receptors. The closest designated sites to the Proposed Scheme include the following:

- Galway Bay Complex SAC and pNHA (Site Code 000268) and Lough Corrib SAC (000297) are located on the south-western boundary of the study area.
- Inner Galway Bay SPA (Site Code 004031) located approximately 0.01km south of the study area.
- Lough Corrib SPA (Site Code 004042) located approximately 2.8km from the study area.
- Moycullen Bogs NHA (Site Code: 002364) located 2.3km north-east of the study area.
- Cregganna Marsh SPA (Site Code 004142) located approximately 7.12km from the study area.
- Lough Fingall Complex SAC (Site Code 000606) located approximately 13.2km from the study area.
- Ross Lake and Woods SAC (Site Code 001312) located approximately 13.2km from the study area.

- East Burren Complex SAC (Site Code 001926) located approximately 13.6km from the study area.
- Connemara Bog Complex SAC (Site Code 002034) located approximately 12.1km from the study area.

The ecological sensitivities associated with these areas are assessed in Chapter 12 (Biodiversity).

7.2.3 Relevant Guidelines, Policy and Legislation

Guidelines, policy and legislation specifically relevant to the air quality assessment are outlined this section.

7.2.3.1 Overview

The following Environmental Protection Agency (EPA) guideline was considered and consulted in the preparation of this assessment:

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

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 7.2.3.2.

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:

- IAQM Guidance (IAQM 2014, 2020);
- The TII 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 Guidance) (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).
- World Health Organization (WHO) Global Air Quality Guidelines (2021)

7.2.3.2 Ambient Air Quality Standards / Limit Values

The Air Quality Regulations came into force and transposed EU Directive 2008/50/EC on ambient air quality and cleaner air for Europe into Irish law. The purpose of the Air Quality Regulations is to:

- Establish limit values and alert thresholds for concentrations of certain pollutants;
- Provide for the assessment of certain pollutants using methods and criteria common to other European Member States;
- Ensure that adequate information on certain pollutant concentrations is obtained and made publicly available; and
- Provide for the maintenance and improvement of ambient air quality where necessary.

The limit values established under the Air Quality Regulations relevant to this assessment (pollutants of concern) are included in Table 7.1.

Table 7.1: Limit Values in the Air Quality Regulations

Pollutant	Limit value for the protection of:	Averaging period	Limit value ($\mu g/m^3$)	Basis of application of limit value
NO_2 (Nitrogen Dioxide)	Human Health	1-hour	200	≤ 18 exceedances p.a. (99.79%ile)
		Calendar year	40	Annual mean
NO_x (Oxides of Nitrogen)	Vegetation	Calendar year	30	Annual mean
PM_{10} (Particulate Matter)	Human Health	24-hours	50	≤ 35 exceedances p.a. (90%ile)
		Calendar year	40	Annual mean
$PM_{2.5}$	Human Health	Calendar year	25	Annual mean

Pollutant	Limit value for the protection of:	Averaging period	Limit value ($\mu g/m^3$)	Basis of application of limit value
(Particulate Matter)				
Carbon Monoxide	Human Health	8 hours	10,000	Maximum daily 8 hour mean
Benzene	Human Health	Calendar year	5	Annual mean

The WHO Global Air Quality Guidelines (WHO 2021) values relating to NO_2, PM_{10} and $PM_{2.5}$ are shown in Table 7.2. The WHO Global Air Quality Guidelines values are more stringent than the European Union (EU) statutory limit values.

Table 7.2: Global Air Quality Guidelines (WHO 2021)

Pollutant	Limit Type	Value
NO_2	24-hour limit for protection of human health	25$\mu g/m^3$
	Annual limit for protection of human health	10$\mu g/m^3$
PM (as PM_{10})	24-hour limit for protection of human health	45$\mu g/m^3$
	Annual limit for protection of human health	15$\mu g/m^3$
PM (as $PM_{2.5}$)	24-hour limit for protection of human health	15$\mu g/m^3$
	Annual limit for protection of human health	5$\mu g/m^3$

The WHO Guidelines were updated in 2021 to reflect the current increasing understanding and evidence that shows how air pollution affects many aspects of human health, even at low levels - as such, the WHO Guidelines are considerably lower than the EU statutory limit values. However, as the EU statutory limit values have not been updated since the release of the new WHO guidelines, 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. Therefore, the assessment considers compliance with the EU statutory limits only.

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines, at European or national level, regarding the maximum dust deposition levels, that may be generated during construction activities.

However, Verein Deutscher Ingenieure (VDI) German Technical Instructions on Air Quality Control - TA-Luft standard for dust deposition (VDI 2002) (non-hazardous dust) provides a guideline for the rate of dust deposition of 350 mg/m^2/day averaged over one year.

The EPA concurs that this guideline may be applied, although the EPA typically applies the guideline limit as a 30-day average. This guidance value can be implemented with regard to dust impacts from the construction of the Proposed Scheme.

7.2.3.3 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. The 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 National Emission Ceiling Directive) until 2020 and established 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 7.3. 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 7.3.

Table 7.3: 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%

7.2.3.4 Institute of Air Quality Management Guidance

The IAQM Guidance on the assessment of Dust from Demolition and Construction, 2014 gives guidance to air quality consultants and environmental health officers on how to assess air quality impacts from construction activities. The IAQM Guidance provides a method for classifying the significance of effect from construction activities based on the ‘dust magnitude’ (high, medium or low) and proximity of the site to the closest receptors. The guidance recommends that once the significance of effect from construction is identified, the appropriate mitigation measures are implemented. The guidance notes that once the appropriate mitigation measures are applied, in most cases the resulting dust impacts can be reduced to negligible levels.

7.2.4 Data Collection and Collation

The baseline data for this assessment has been collected through carrying out a desk study, availing of the most up-to-date available data including national ambient air quality monitoring data, at the time of writing, in addition to site-specific baseline ambient monitoring surveys.

7.2.4.1 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. The most recent annual report, Air Quality in Ireland 2020 (EPA 2021), details the range and scope of monitoring undertaken throughout Ireland. The baseline air quality data collected through the desk study is detailed in Section 7.3.

7.2.4.2 Site Specific Baseline Surveys

A site-specific baseline monitoring study was undertaken at monthly intervals from September 2021 to December 2021 as part of the air quality assessment for NO_2 using diffusion tube monitoring at 15 locations as detailed in Section 7.3 and as shown in Figure 7.1 of 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 the sampling, the tubes were analysed using ultraviolet (UV) spectrophotometry, at an accredited laboratory in Switzerland.

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. Details of the baseline data collected is discussed in Section 7.3.

7.2.5 Appraisal Method for the Assessment of Impacts

This section sets out the air quality assessment has been undertaken and highlights where input from other environmental disciplines has been included within the assessment.

7.2.5.1 Overview

The air quality assessment has been carried out in accordance with the Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2022). The EPA significance of impacts matrix has been used to determine the significance of impact (Table 7.4).

Table 7.4: EPA Significance Matrix

Significance		**Sensitivity**				
		Very Low	**Low**	**Medium**	**High**	**Very High**
Magnitude	**Very Low**	Imperceptible	Not significant	Slight	Slight	Slight
	Low	Not significant	Slight	Moderate	Moderate	Moderate
	Medium	Slight	Moderate	Moderate	Significant	Significant
	High	Slight	Moderate	Significant	Very significant	Profound
	Very High	Slight	Moderate	Significant	Profound	Profound

The methodology for this assessment topic is informed by existing best practice and experience on other infrastructure projects. The assessment methodologies have been applied to assess both the potential impacts during the construction phase and the potential impacts during the operational phase of the Proposed Scheme, unless otherwise stated.

7.2.5.2 Traffic Screening Criteria

The TII Guidelines state that increases in Annual Average Daily Traffic (AADT) flows of less than 5% and 10% during the operational and construction phases respectively are unlikely to result in significant air quality effects. Likely significant effects on air quality are therefore assessed when the AADT flows are projected to increase above these thresholds due to the construction and/or operation of the proposed development.

LA 105 Air Quality Guidance states that the following scoping criteria shall be used to determine whether the air quality impacts 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 if a modelling assessment is required for the operational phase. Based on the redistribution of traffic in the operational phase there are multiple road links resulting in an AADT increase above 1,000 or more. As such, it has been determined that a modelling assessment is required for the operational phase. Sensitive receptors within 200m of impacted road links were included within the modelling assessment as detailed in Section 7.2.2.2.

The LA 105 Air Quality Guidance 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. The NO_2 concentrations (Section 7.3) were found to be generally below 36µg/m^3 along the Proposed Scheme, however, given the number of sensitive receptors in close proximity to the road combined with the redistribution of traffic volumes, the scheme has been determined as medium sensitivity.

LA 105 Air Quality Guidance states that modelling should be conducted for NO_2 for the base, opening and design years for both the Do Minimum (without the Proposed Scheme) and Do Something (with Proposed Scheme) scenarios. The potential concentrations due to the operation of the Proposed Scheme are then compared to the relevant limit values described in Table 7.1 to determine likely significant effects.

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. The concentrations of PM_{10} are included in Section 7.3. LA 105 Air Quality guidance states that modelling of $PM_{2.5}$ is not required. The guidance suggests that modelling of PM_{10} can be used to show that the project does not impact on the $PM_{2.5}$ limit value on the basis that assuming compliance with the PM_{10} limit is achieved then compliance with the $PM_{2.5}$ limit will also be achieved.

Historically modelling of CO, lead and benzene was required by TII Guidance, however, guidance has now been updated by the LA 105 Air Quality Guidance as concentrations of these pollutants have been monitored to be significantly below their air quality limit values in recent years, even in urban centres[1] CO, lead and benzene have been scoped out of detailed assessment.

7.2.5.3 Construction 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 dust impacts. As outlined in Section

[1] EPA (2020) Urban Environmental Indicators: Nitrogen dioxide levels in Dublin

7.2.5.2, the construction phase traffic has been scoped out of further assessment based on the screening criteria outlined in TII Guidelines and LA 105 Air Quality Guidance. As such, 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.

The construction effects have been assessed using the qualitative approach described in the latest IAQM Guidance, as detailed in Section 7.2.3.4. The guidance applies to the assessment of dust from construction and demolition activities.

An ‘impact’ is described as a change in pollutants concentrations or dust deposition, while an ‘effect’ is described as the consequence of an impact. The main impacts that may arise during construction of the proposed development are:

- Dust deposition, resulting in the soiling of surfaces;
- Visible dust plumes;
- Elevated PM_{10} concentrations as a result of dust generating activities on site; and
- Increase in NO_2 and PM_{10} concentrations due to exhaust emissions from non-road mobile machinery (NRMM) and vehicles accessing the site.

The IAQM Guidance considers the potential for dust emissions from dust-generating activities including:

- Demolition of existing structures;
- Earthworks;
- Construction of new structures; and
- Track-out.

Earthworks refer to the processes of soil stripping, ground levelling, excavation and land capping, while track-out is the transport of dust and dirt from the site onto the public road network where it may be deposited and then re-suspended by vehicles using the network.

This arises when vehicles leave the site with dusty materials, which may then spill onto the road, or when they travel over muddy ground on site and then transfer dust and dirt onto the road network.

For each of these dust-generating activities, the guidance considers three separate effects:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to a significant increase in PM_{10} exposure.

The receptors can be human or ecological and are chosen based on their sensitivity to dust soiling and PM_{10} exposure. The sensitive receptors are listed in Section 7.2.2.2.

The methodology takes into account the scale to which the above effects are likely to be generated (classed as small, medium or large), along with the levels of background PM_{10} concentrations and the distance to the closest receptor, in order to determine the sensitivity of the area. This is then taken into consideration when deriving the overall risk for the site. Suitable mitigation measures are also proposed to reduce the risk of the site. The steps to undertaking the dust assessment as per the IAQM Guidance are outlined below.

Step 1: Screen the need for detailed assessment

The first step is the initial screening to determine whether a detailed assessment is required. According to the IAQM Guidance, an assessment is required where there are sensitive receptors within 350m of the site boundary, for ecological receptors within 50m of the site boundary and/or within 50m of the route(s) used by the construction vehicles on the public highway and up to 500m from the site entrance(s).

There are sensitive receptors within 350m of the site boundary so therefore an assessment of the air quality effects is required.

The following ecological sensitive areas, as noted in Section 7.2.2.2, are in close proximity to the proposed development (as per above thresholds, within 50m), therefore, the potential air quality effects on such receptors are screened in for further assessment:

- Galway Bay Complex SAC and pNHA (Site Code 000268) located on the south-western boundary of the study area.
- Lough Corrib SAC (000297) are located on the south-western boundary of the study area.
- Inner Galway Bay SPA (Site Code 004031) located approximately 10m south of the study area.

Refer to Table 7.5 for the sensitivity of ecological impacts.

Table 7.5: Sensitivity of the Area to Ecological Impacts

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

Step 2: Assess the Risk of Dust Impacts Arising

This step is split into three sections as follows:

- Define the potential dust emission magnitude;
- Define the sensitivity of the area; and
- Define the risk of impacts.

Each of the dust-generating activities is given a dust emission magnitude depending on the scale and nature of the works (Step 2A) based on the criteria shown in Table 7.6**.**

Table 7.6: Categorisation of Dust Emission Magnitude

Dust Emission Magnitude		
Small	**Medium**	**Large**
Demolition		
• total building volume <20,000m^3 • construction material with low potential for dust release (e.g. metal cladding or timber) • demolition activities <10m above ground • demolition during wetter months	• total building volume 20,000 - 50,000m^3 • potentially dusty construction material • demolition activities 10 - 20m above ground level	• total building volume >50,000m^3 • potentially dusty construction material (e.g. concrete) • on-site crushing and screening • demolition activities >20m above ground level
Earthworks		
• 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 <10,000 tonnes • earthworks during wetter months	• total site area 2,500m^2 - 10,000m^2 • moderately dusty soil type (e.g. silt) • 5 – 10 heavy earth moving vehicles active at any one time • formation of bunds 4 - 8m in height • total material moved 20,000 - 100,000 tonnes	• 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
Construction		
• total building volume <25,000m^3 • construction material with low potential for dust release (e.g. metal cladding or timber)	• total building volume 25,000 - 100,000m^3 • potentially dusty construction material (e.g. concrete) • on-site concrete batching	• total building volume >100,000m^3 • on-site concrete batching • sandblasting
Trackout		
• <10 HDV (>3.5t) outward movements in any one day • surface material with low potential for dust release • unpaved road length <50m	• 10 – 50 HDV (>3.5t) outward movements in any one day • moderately dusty surface material (e.g. high clay content) • unpaved road length 50 – 100m;	• >50 HDV (>3.5t) outward movements in any one day • potentially dusty surface material (e.g. high clay content) • unpaved road length >100m

The sensitivity of the surrounding area is then determined (Step 2B) for each dust effect from the above dust-generating activities, based on the proximity and number of receptors, their sensitivity to dust, the local PM_{10} background concentrations and any other site-specific factors. Table 7.7 and Table 7.8 show the criteria for defining the sensitivity of the area to different dust effects.

The health effects of PM_{10} on *high sensitivity receptors* includes residential areas, residential properties, schools and residential care homes in close proximity to the proposed development.

Table 7.7: Sensitivity of the Area to Human Health Impacts

<table>
<tr><th rowspan="2">Background PM_{10} concentrations (annual mean)</th><th rowspan="2">Number of receptors</th><th colspan="5">Distance from the source (m)</th></tr>
<tr><th>< 20</th><th>< 50</th><th>< 100</th><th>< 200</th><th>< 350</th></tr>
<tr><td colspan="7">High receptor sensitivity</td></tr>
<tr><td rowspan="3">> 32$\mu g/m^3$</td><td>> 100</td><td rowspan="3">High</td><td rowspan="2">High</td><td>High</td><td>Medium</td><td rowspan="3">Low</td></tr>
<tr><td>10 – 100</td><td>Medium</td><td rowspan="2">Low</td></tr>
<tr><td>< 10</td><td>Medium</td><td>Low</td></tr>
<tr><td rowspan="3">28 – 32$\mu g/m^3$</td><td>> 100</td><td rowspan="3">High</td><td>High</td><td>Medium</td><td rowspan="3">Low</td><td rowspan="3">Low</td></tr>
<tr><td>10 – 100</td><td rowspan="2">Medium</td><td rowspan="2">Low</td></tr>
<tr><td>< 10</td></tr>
<tr><td rowspan="3">24 – 28$\mu g/m^3$</td><td>> 100</td><td rowspan="2">High</td><td rowspan="2">Medium</td><td rowspan="3">Low</td><td rowspan="3">Low</td><td rowspan="3">Low</td></tr>
<tr><td>10 – 100</td></tr>
<tr><td>< 10</td><td>Medium</td><td>Low</td></tr>
<tr><td rowspan="3">< 24$\mu g/m^3$</td><td>> 100</td><td>Medium</td><td rowspan="3">Low</td><td rowspan="3">Low</td><td rowspan="3">Low</td><td rowspan="3">Low</td></tr>
<tr><td>10 – 100</td><td rowspan="2">Low</td></tr>
<tr><td>< 10</td></tr>
<tr><td colspan="7">Medium receptor sensitivity</td></tr>
<tr><td rowspan="2">–</td><td>> 10</td><td>High</td><td>Medium</td><td rowspan="2">Low</td><td rowspan="2">Low</td><td rowspan="2">Low</td></tr>
<tr><td>< 10</td><td>Medium</td><td>Low</td></tr>
<tr><td colspan="7">Low receptor sensitivity</td></tr>
<tr><td>–</td><td>> 1</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
</table>

Table 7.8: Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		< 20	< 50	< 100	< 350
High	> 100	High	High	Medium	Low
	10 – 100	High	Medium	Low	Low
	< 10	Medium	Low	Low	Low
Medium	> 1	Medium	Low	Low	Low
Low	> 1	Low	Low	Low	Low

The overall risk of the impacts for each activity is then determined (Step 2C) prior to the application of any mitigation measures (defined in Table 7.9) and an overall risk for the site is derived.

Table 7.9: Risk of Dust Impacts

Sensitivity of area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
Demolition			
High	High risk site	Medium risk site	Medium risk site
Medium	High risk site	Medium risk site	Low risk site
Low	Medium risk site	Low risk site	Negligible
Earthworks			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Construction			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Trackout			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Low risk site	Negligible
Low	Low risk site	Low risk site	Negligible

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.

The TII Air Quality Guidelines (TII 2011) also outlines an approach to assessing the impact of dust emissions from construction activities with standard mitigation in place, as shown in Table 7.10. The TII guidance does acknowledge however that '*it is very difficult to accurately quantify dust emissions arising from construction activities.*

It is thus not possible to easily predict changes to dust soiling rates or PM_{10} concentrations. A semi-quantitative approach is recommended to determine the likelihood of a significant impact, which should be combined with an assessment of the proposed mitigation measures'.

Table 7.10: Assessment Criteria for the Impact of Dust Emissions from Construction Activities with Standard Mitigation in Place

Source		Potential Distance for Significant Effects (Distance from Source)		
Scale	**Description**	**Soiling**	**PM_{10}***	**Vegetation Effects**
Major	Large construction sites with high use of construction access routes	100m	25m	25m
Moderate	Moderate sized construction sites with moderate use of construction access routes	50m	15m	15m
Minor	Minor construction sites with limited use of construction access routes	25m	10m	10m

*Significance based on the PM_{10} Stage 1 limit to be complied with by 2005, which allows 35 daily exceedances / year. This standard is set out in S.I. No. 271/2002 - Air Quality Standards Regulations 2002

7.2.5.4 Operational Phase

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. As outlined in Section 7.2.5.2, the operational phase traffic has been screened in for detailed assessment as per the screening criteria outlined in TII Guidelines and LA 105 Air Quality Guidance.

The potential changes in regional air emissions due to the operational phase traffic impacts of the Proposed Scheme have been assessed using the National Transport Authority (NTA) Environmental Appraisal Module, which is based on the ENEVAL software. Use of the ENEVAL tool allows for a robust large-scale assessment of the impact of regional air impacts due to the Proposed Scheme.

The tool allows for a better representation of potential traffic impacts at a regional level which would be otherwise left unaccounted for. This data also takes into account the modal shift from private car to bus (walk or cycle). ENEVAL was developed by Systra Ltd in 2015 on behalf of the National Transport Authority (NTA). Emissions from the zonal level ENEVAL tool can provide information on the air emissions for the different traffic scenarios on a regional basis.

Vehicle-derived air emissions were modelled using the ADMS-Roads dispersion model (Version 5.0.0.1) which has been developed by Cambridge Environmental Research Consultants (CERC). The model is a steady-state Gaussian plume model used to assess ambient pollutant concentrations associated with road sources.

The ADMS-Roads dispersion model 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 opening year (2023).

The modelling incorporated the following features:

- Hourly-sequenced meteorological information for Knock Airport in 2019 has been used in the model. The selection of the appropriate meteorological data has followed the guidance issued by the LAQM (TG16) (DEFRA 2021 A primary requirement is that the data used should have a data capture of greater than 90% for all parameters;
- The street canyon effect was taken into account in the ADMS-Roads dispersion model. Street canyons were found in the city centre locations due to narrow streets causing a small separation between facades either side of the street. The street canyon effect can impact dispersion, such as increasing concentrations on the leeside of the road. The ADMS-Roads street canyon option was selected to model this dispersion impact at receptors within the city centre and central area; and
- Specific air sensitive receptors (ASRs) were also mapped into the model. Receptor heights were input at 1.5m to represent breathing height. For elevated receptors, it has been assumed that each floor is 3m and therefore first floor receptors are at 4.5m. Concentrations were reported for each ASR modelled for all modelling scenarios.

The opening year for the Proposed Scheme is 2023 and the design year is 2038. Road traffic emission rates are derived using traffic data for the opening year of 2023 and design year of 2038 provided by the traffic consultant and using emission factors from the COPERT 5.3 database (European Environment Agency (EEA) 2019) which has been incorporated into the UK DEFRA Emission Factor Toolkit (EFT) Version 11.0 (DEFRA 2021). Furthermore, the addition of electric vehicles to the fleet will assist in significantly reducing emissions between 2023 and 2038, as outlined in Table 7.11 below, even in circumstances where the number of vehicles using a road link increases. Emissions per road link using the EFT Version 11.0 were calculated for the 2023 Do Something scenario and compared to the 2038 Do Something scenario. Conservative assumptions were made for future fleet and uptake of electric vehicles. As the fleet is expected to improve in future years, the 2023 modelled impacts can be considered worst-case. As a result, detailed modelling of the design year 2038 was scoped out for all pollutants on the basis that emissions will be lower compared to 2023 emissions.

The EFT Version 11.0 has been incorporated into the ADMS-Roads model. The toolkit provides emission rates from 2018 to 2030 and traffic emissions for the Proposed Scheme were based on the following assumptions as specified by the user guide[2]:

- EFT Version 11.0 is based on eight vehicle categories including petrol cars, diesel cars, diesel Light Goods Vehicles (LGV), rigid Heavy Goods Vehicles (HGVs) and buses;
- Northern Ireland has been selected to calculate the vehicle emissions in the DEFRA EFT, as it is considered to be most representative for the impacted areas;

[2] https://laqm.defra.gov.uk/wp-content/uploads/2021/11/EFTv11.0-user-guide-v1.0.pdf

- The 2019 projections were used for detailed modelling of the 2019 base year and 2023 projections for the opening year. The default basic fleet proportions built in the DEFRA EFT has been used for the baseline year of 2019. The transport consultant provided the fleet composition data (Table 7.11) for the opening year (2023) and they were used for car and LGV. Default fleet proportions for buses and HGV in 2023 have been used.

Table 7.11: Summary of Fleet Proportions

Vehicle Type		Opening Year 2023	Design Year 2038
Car	Petrol Car	38%	25%
	Diesel Car	55%	14%
	Electric Car	7%	61%
LGV	LGV	80%	34%
	Electric LGV	20%	66%
Bus	Electric LGV	-	100%
	Diesel Bus	100%	-

7.2.5.5 Ecology (Deposition)

The impacts of dust to ecological receptors during the construction phase is determined using the methodology outlined in Section 7.2.5.3 using the IAQM Guidance methodology. There is potential for impacts from pollutant deposition at ecologically sensitive sites due to the operation of the Proposed Scheme.

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 occur (CERC 2020). 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 NO_X emissions as the most likely source of significant impacts from road traffic. Pollutants such as CO_2, CO, SO_2, ammonia and volatile organic compounds are not considered in this guidance and 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.

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. The LA 105 Air Quality Guidance 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 7.2.5.4.

The designated sites in proximity to the Proposed Scheme are listed in Section 7.2.2.2. The designated sites which are within 2km of the boundary of the Proposed Scheme are:

- Galway Bay Complex SAC and pNHA (Site Code 000268) located on the south-western boundary of the study area.
- Lough Corrib SAC (000297) located on the south-western boundary of the study area.
- Inner Galway Bay SPA (Site Code 004031) located approximately 10m south of the study area.

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

- Mudflats and sandflats;
- Coastal lagoons;
- Reefs;
- Semi-natural dry grasslands and scrublands;
- Calcareous and alkaline fens;
- Salt meadows;
- Oligotrophic and standing waters;
- Active raised bogs and raised bogs still capable of regeneration;
- Limestone pavements;
- Oak woods and bog woodland;
- Wetlands.

Species of particular ecological importance include the following:

- Otter;
- Harbour seal;

- Freshwater Pearl Mussel;
- Crayfish, Lamprey, Salmon;
- Breeding and wintering birds.

Chapter 12 (Biodiversity) includes further details on the ecological sensitivities associated with these sites.

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 *'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 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 0.071.

7.3 Baseline Environment

7.3.1 Overview

Galway City falls within Zone C. A desk study of the EPA air quality monitoring programs has been undertaken. Concentrations of each pollutant recorded in Zone C are averaged to represent typical background levels.

The most recent annual report on air quality Air Quality in Ireland 2020 (EPA 2021) details the range and scope of monitoring undertaken throughout Ireland. The EPA air quality monitoring data was used for NO_2, PM_{10} and $PM_{2.5}$.

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 Site Specific Monitoring (NO_2)

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 statutory limit value for NO_2. The results also provide information on the influence of road sources relative to the prevailing background level of these pollutants in the area.

A baseline NO_2 monitoring survey was undertaken as part of the air quality assessment for the Proposed Scheme. There were 15 monitoring locations tested on a monthly basis over 3 months and in triplicate to ascertain general NO_2 concentrations around Galway City. Samples were tested using diffusion tubes (20% TEA / Water) and analysed by SP01 Photometer in an accredited laboratory. 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’.

The 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. The bias for the tubes was determined by assessment against a reference analyser calibrated with ISO 17025 gases. A bias adjustment factor was applied to the monitoring results to account for this bias. Refer to Appendix 7.1 (Volume 4 of this EIAR) for the full Air Quality Monitoring Report.

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. This factor was calculated using 2021 EPA published annual and period averages, from Zone C locations, with more than 90% data coverage. (Dundalk, Kilkenny, Limerick, Navan, Portlaoise, Waterford). It should be noted that while this data is ratified by the EPA, it is not yet ratified by the EU for use and therefore some caution is needed with the use of this factor until ratification is complete, though the factor itself is unlikely to change with no resultant variations in baseline levels.

The diffusion tubes were put in place from 19th September 2021 with samples taken monthly for October (17th), November (14th) and December (12th). The average across the three months were taken for each sample location, as included in Table 7.12.

Table 7.12: Monitoring Data from Sample Locations (adjusted for bias)

Monitor Sample		NO_2 Concentrations µg/m^3			Average Concentration (Period Mean) µg/m^3	NO_2 Annual Limit Calendar Year µg/m^3
No.	Location	Oct-21	Nov-21	Dec-21		
M1	Millenium Bridge	11.8	13.3	16.6	13.9	40
M2	Salmon Weir	8.3	9.2	11.5	9.7	40
M3	Dublin Road	8.0	9.5	13.0	10.2	40
M4	Tuam Road	14.4	15.5	15.7	15.2	40
M5	Newcastle Road Lower	21.6	15.4	15.2	17.4	40
M6	The Crescent	9.2	10.9	12.2	10.8	40
M7	Presentation Road	6.9	8.1	11.6	8.9	40
M8	University Road	15.1	15.3	15.8	15.4	40
M9	Francis Street	22.2	23.7	22.3	22.7	40
M10	Eglington Street	10.5	11.5	13.9	12.0	40
M11	Forester Street	15.9	18.0	20.4	18.1	40
M12	College Road	8.7	10.2	12.3	10.4	40
M13	Lough Atalia College Road	13.8	14.2	18.5	15.5	40
M14	Lough Atalia Fairgreen	9.7	12.0	13.9	11.9	40
M15	Fairgreen Road	13.2	13.6	16.8	14.5	40

Table 7.13: Calculation of the Annualization Factor Based on the EPA Data for the Annual and Period Means for Zone C Locations

Parameter	**Abbrev.**	**NO_2 Concentration (µg/m^3)**					
		Dundalk	Kilkenny	Limerick	Navan	Portlaoise	Waterford
Annual Mean (2021) for Zone C (Dundalk, Kilkenny, Limerick, Navan, Portlaoise and Waterford)	AM	14.2	5.11	13.3	38.1	11.1	8.0
Period mean for 19/09/21 to 12/12/21 (Dundalk, Kilkenny, Limerick, Navan, Portlaoise and Waterford)	PM	11.8	3.70	10.3	21.1	9.37	7.89
Ratio of AM/PM	R	1.19	1.38	1.29	1.81	1.18	1.02
Average of R (Annualised Factor)	RA	1.31					

Table 7.14 includes the results of adjusted annual mean for the monitoring locations with the annualization factor applied.

Table 7.14: Annualised Monitoring Data Relative to the AQS Limit

No.	Monitor Sample	Period Mean x Annualised Factor RA from Table 7.12 (µg/m^3)	AQS Annual Average Limit Value (µg/m^3)
M1	Millenium Bridge	18.2	40
M2	Salmon Weir	12.7	40
M3	Dublin Road	13.4	40
M4	Tuam Road	19.9	40
M5	Newcastle Road Lower	22.8	40
M6	The Crescent	10.8	40
M7	Presentation Road	14.1	40
M8	University Road	20.2	40
M9	Francis Street	29.7	40
M10	Eglington Street	15.7	40
M11	Forester Street	23.7	40
M12	College Road	13.6	40
M13	Lough Atalia College Road	20.3	40
M14	Lough Atalia Fairgreen	15.6	40
M15	Fairgreen Road	18.9	40

The annualised background concentrations are well within the air quality standards for NO_2 at all locations.

7.3.3 EPA Data

As outlined in Section 7.3.1, the Proposed Scheme is located within Zone C. The continuous monitoring data from EPA monitoring stations in Zone C was reviewed Table 7.15 presents a three-year average of background pollutant concentration values for NO_2, $PM_{2.5}$ and PM_{10}. The EPA monitoring reports state that the NOx annual mean limit value for the protection of vegetation only applies to Zone D. Background levels from 2018, 2019 and 2020 air quality monitoring of NO_2, $PM_{2.5}$ and PM_{10} in Zone C provided by the EPA are presented in Table 7.15.

Table 7.15: Annual Mean Background Pollutant Concentrations for Zone C

Year	Annual Average NO_2 (µg/m^3)	Annual Average PM_{10} (µg/m^3)	Annual Average $PM_{2.5}$ (µg/m^3)
Limit	**40 µg/m^3**	**40 µg/m^3**	**25 µg/m^3**
2018	10.3	14.00	8.25
2019	12.0	16.3	12.2

Year	Annual Average NO_2 (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)
Limit	**40 µg/m³**	**40 µg/m³**	**25 µg/m³**
2020	11.4	14.4	9.5
Average	11.2	14.9	10.0

The background concentrations are well within the air quality standards for all pollutants.

7.3.4 Model Verification

Model verification used the following diffusion tube monitoring sites:

- Millennium Bridge;
- Dublin Road;
- Tuam Road;
- Newcastle Road Lower;
- Presentation Road;
- University Road;
- Forester Street;
- College Road;
- Lough Atalia College Road;
- Lough Atalia Fairgreen; and
- Fairgreen Road

These are roadside sites on the modelled road network. Other monitoring sites were not included in the model verification as they were either too far from the proposed development site, not located on the modelled road network or the substantial over-prediction concentrations at some locations.

Monitoring results for the above-mentioned locations were obtained from a site specific monitoring surveys, outlined in Section 7.3.2. The annualised results have been assumed to be representative of the baseline and they were compared with modelled concentrations at the same locations. The model verification was undertaken following the methodology described in LAQM.TG16[3]. The model both over and under-predicted concentrations at the verification sites.

A comparison of monitored and modelled annual mean NO_2 concentrations for 2019 is shown in Table 7.16.

The percentage difference between the monitored and modelled results before adjustment is between -23.9% and 21.3%, which is with the recommended guideline stated in Defra's LAQM.TG16[3] of ±25%. As such, model results were not adjusted.

Table 7.16: Comparison of Modelled and Monitored Annual Mean NO_2 Concentrations

Site ID	Site type	Background NO_2 concentration (µg/m³)	Monitored NO_2 concentration (µg /m³)	Modelled NO_2 concentration (µg/m³)	% Difference (modelled - monitored)/ monitored
Millennium Bridge	Roadside	12	18.2	18.9	3.8
Dublin Road			13.4	16.2	21
Tuam Road			19.9	20.3	1.9
Newcastle Road Lower			22.8	18.8	-17.6
Presentation Road			14.1	14.0	-0.8
University Road			20.2	17.3	-14.2
Forester Street			23.7	18.0	-23.9
College Road			13.6	16.5	21.3
Lough Atalia College Road			20.3	17.5	-13.6
Lough Atalia Fairgreen			15.6	16.2	3.7
Fairgreen Road			18.9	15.2	-20

7.3.5 Baseline Modelling 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 ADMS-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 at selected most impacted existing air quality sensitive receptors in the 2019 Existing Baseline scenario are listed in

[3] Defra (2016) Local Air Quality Management Technical Guidance. TG(16)

Table 7.17. Locations of these receptors are shown in Figure 7.2, Volume 3 of this EIAR.

Table 7.17: Existing Baseline Scenario Pollutant Statistics at Most Impacted Receptor Locations

Existing Baseline (2019)					
Receptor	**Receptor Location (ITM) (m)**		**Annual Mean Concentration (µg/m³)**		
	X	**Y**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**
R113	530919.6	726063.2	18.7	17.2	12.7
R89	530168.9	725010	18.0	17.1	12.7
R111	530978.1	726091.6	19.4	17.4	12.8
R109	530414.5	725303.9	16.8	17.0	12.6
R84	529712.2	724979.5	34.5	19.1	13.9
R76	529978	725112.9	21.3	17.5	12.9
R108	530280.2	725396.7	14.3	16.6	12.4
R7	529038.5	726082.8	19.9	17.2	12.8
R80	529873.2	725072.2	22.1	17.1	13.0
R96	529812.9	725494.8	15.3	17.4	12.4
R6	529084.1	725989.5	17.3	17.0	12.6
R85	529779.5	724950.1	15.6	19.1	12.5
R43	529234.8	725301.9	13.6	17.5	12.3
R10	528936.1	726311	24.5	16.6	13.3
R38	529135.7	725305.3	17.1	17.3	12.6
R44	529347.1	725229.5	14.2	17.7	12.4
R79	529934.7	725142.9	18.3	16.7	12.7
R15	528727.4	725985.7	18.8	17.0	12.8
R37	529087.5	725421.3	16.9	16.7	12.6
R5	529062.6	725763.3	17.7	16.5	12.6
R18	528629.9	725964.5	17.1	18.1	12.6
R78	529940	725149.3	17.8	17.0	12.6
R8	529016.3	726146.6	18.2	16.6	12.7
R14	528690	726040.9	18.8	17.1	12.8
R36	529101.6	725445	16.6	17.2	12.6
R94	530121.9	725387.8	19.5	17.0	12.8
R13	529044.6	726135.7	18.2	17.0	12.7
R39	529123.8	725209.3	20.5	17.0	12.9
R9	528992.5	726186.3	16.8	17.0	12.6
R35	529059	725561.4	15.2	17.1	12.5
R30	528308.6	725326.1	16.7	17.3	12.7
R97	529872.3	725524.5	14.2	17.0	12.4
R110	530524.1	725486.4	14.7	17.3	12.5

Existing Baseline (2019)					
Receptor	Receptor Location (ITM) (m)		Annual Mean Concentration (µg/m^3)		
	X	Y	NO_2	PM_{10}	$PM_{2.5}$
R17	528637.5	726026.6	17.5	17.1	12.7
R75	530028.1	725173.7	16.3	17.5	12.5
R42	529215.1	725106.4	14.7	17.0	12.4
R41	529134	725172.2	15.8	16.8	12.5
R34	528080.1	725733	14.5	17.1	12.4
R146	531544.5	726021.2	16.5	16.6	12.6
R81	529773.2	724977.2	16.2	16.7	12.5
R31	528419.7	725280.4	16.0	17.1	12.6
R24	528196.3	726085	13.9	16.8	12.4
R138	532088.7	725860.3	15.6	16.6	12.5
R98	529994.8	725587.8	14.4	16.8	12.4
R145	531854.1	725888.1	15.1	16.6	12.5
R143	530882.8	726257.3	15.8	17.0	12.6
R144	530990.8	726278	17.6	16.8	12.7
R16	528536.2	726298	16.2	16.9	12.6
R87	529770.6	724951.7	16.0	16.6	12.5
R25	528076.9	725803.2	13.7	16.8	12.3
R63	529727.3	725377.6	14.6	16.6	12.4
R129	531205.2	726741.3	15.2	16.8	12.5
R141	531760.6	726687.1	14.8	16.7	12.4
R130	531471.8	726871.9	15.3	16.9	12.6
R62	529722.2	725397.8	18.3	17.1	12.7
R82	529619.9	724966.8	24.8	18.1	13.3
R77	530058.5	725266.2	15.3	16.7	12.5
R142	531815.6	726984.3	15.9	16.9	12.5
R65	529781.8	725462.3	16.5	16.8	12.5
R74	530077.3	725233.9	15.3	16.7	12.5
R71	530033.6	725303.9	15.2	16.7	12.4
R73	530064.4	725270.7	15.5	16.8	12.5
R112	531021.8	726174.4	19.2	17.5	12.9
R115	530518.8	725638.8	14.8	16.7	12.4
R66	529886.8	725376.8	15.9	16.7	12.5
R2	529372.3	725591.9	18.3	17.3	12.8
R3	529262.8	725625.7	17.3	17.2	12.7
R99	530076.2	725542.2	16.1	16.8	12.5
R64	529768.2	725329.6	17.0	16.9	12.6
R107	530233.4	725585.3	17.2	16.9	12.6

Existing Baseline (2019)					
Receptor	**Receptor Location (ITM) (m)**		**Annual Mean Concentration (µg/m³)**		
	X	**Y**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**
R67	529911.5	725415.9	16.2	16.8	12.5
R61	529659.2	725665.0	15.2	16.7	12.4
R105	529879.9	725756.3	18.2	17.1	12.7
R12	529491.5	725117.0	17.0	16.9	12.6
R11	529444.4	725294.3	15.5	16.7	12.5
R46	529476.3	725014.9	18.6	17.1	12.7
R59	529697.3	725575.1	23.6	17.4	12.9
R93	529767.4	725318.1	19.5	17.2	12.8
R72	530106.5	725371.1	17.0	16.9	12.6
R102	529760.1	725611.1	18.3	17.1	12.7
R45	529498.9	725074.3	19.5	17.2	12.8
R69	530036.8	725479.0	17.0	16.9	12.5
R68	530031.6	725488.2	17.1	16.9	12.6
R95	529779.3	725469.5	18.6	17.1	12.7
R106	529931.9	725810.8	20.1	17.4	12.8
R104	529883.1	725729.3	18.9	17.2	12.7
R1	529457.3	725584.9	18.0	17.2	12.7
R57	529610.2	725600.1	16.8	16.9	12.6
R100	530132.1	725629.1	21.6	17.5	12.9
R117	530258.9	725516.8	22.7	17.6	13.0
R116	530333.6	725505.9	19.5	17.3	12.8
Air Quality Limit Value Objective			**40**	**40**	**25**

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 20µg/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 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 exceedances of the 50mg/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. Therefore, as PM is in line with statutory limits it can be screened out of further assessment, in line with the LA 105 Air Quality guidance outlined in Section 7.2.5.2.

7.4 Potential Impacts

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

The Construction Phase of the Proposed Scheme 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, pavement works including bus lanes, cycle tracks, bus terminals, and movement of machinery and materials along the Proposed Scheme.

7.4.2.1 Construction Dust

Chapter 4 **(**Proposed Scheme Description) provides a description of the proposed development with Chapter 5 **(**Construction) providing details of the proposed construction strategy for the proposed development.

Dust emissions are likely to arise from the following activities:

- Site clearance;
- Utility diversions;
- Earthworks;
- Stockpiling of excavated materials;
- Use of the on-site crusher for processing materials for recycling/reuse;
- Handling of construction materials; and
- Construction traffic movements.

Where possible, excavated material will be reused and quantities of waste minimised, as outlined in Chapter 17 (Waste & Resources) of this EIAR.

Dust Emission Magnitude

Following the methodology outlined in Section 7.2.5.3 each dust generating activity has been assigned a dust emission magnitude as shown in Table 7.18, in accordance with Table 7.6. As outlined in Section 7.2.5.3 the IAQM guidance was used to assess the potential air quality impacts on sensitive receptors during the construction phase.

Table 7.18: Dust Emission Magnitude for Construction Activities

Activity	Dust emission magnitude	Reasoning
Demolition	Small	Demolition activities <10m above ground
Earthworks	Large	Total site area >10,000 m^2
Construction	Medium	Potentially dusty construction material
Trackout	Small	<10 HDV (>3.5t) outward movements in any one day

Sensitivity of the Area

The sensitivity of the area to dust soiling has been assigned as *high*, due to the number of sensitive receptors within proximity of dust generating activities.

The sensitivity of the area to human health has been assigned as *low* as the background PM_{10} concentration is less than the lower value of 24µg/m^3 outlined in Table 3 of the IAQM Guidance.

The overall sensitivity has been summarised as shown in Table 7.19.

Table 7.19: Sensitivity of the Area

Potential Impact	Sensitivity
Human Health	Low
Dust Soiling	High
Ecological	Medium

Risk of Impacts

Taking into consideration the dust emission magnitude and the sensitivity of the area, the risk of dust impacts is presented in Table 7.20.

Table 7.20: Risk of Dust Impacts

Potential Impact	Sensitivity of the surrounding area			
	Demolition	Earthworks	Construction	Trackout
Human Health	Negligible	Low	Low	Negligible
Dust Soiling	Medium	High	Medium	Low
Ecological	Low	Medium	Medium	Negligible

Overall, the site has been classified as *high risk* for earthworks, *medium risk* for demolition and construction, and *low risk* for trackout, without mitigation as summarised in Table 7.21.

Table 7.21: Result of Dust Assessment Prior to Mitigation

Activity	Dust risk prior to mitigation
Demolition	Medium
Earthworks	High

Activity	Dust risk prior to mitigation
Demolition	Medium
Construction	Medium
Track-out	Low

There are a number of sensitive receptors located close to the proposed works, as described in Section 7.2.2.2, therefore, there is potential for air quality effects arising from dust during construction activities. The impact risk is assigned a worst-case risk, as shown in Table 7.19, prior to the implementation of mitigation measures. In accordance with IAQM guidance, the significance of effects is determined after the application of mitigation measures. Specific mitigation is described in Section 7.5.

7.4.2.2 Construction Traffic

As outlined in Chapter 6 (Traffic and Transport) (Section 6.5.6.2), a maximum of 2-3 HGVs in the AM and PM hours are likely to be generated during the construction phase. In accordance with the methodology outlined in Section 7.2.5, as there is no projected increase in traffic volumes above 10% during the construction phase, no further assessment is required. Furthermore, there are no significant effects expected to regional emissions or from nitrogen deposition during the construction phase. Any potential significant impacts associated with the diversion of traffic is considered under the operational phase assessment.

7.4.3 Operational Phase

The redistribution of traffic during the operational phase of the proposed road development has the potential to generate air quality impacts at sensitive receptors[4] thus has been assessed with ADMS modelling as outlined Section 7.2.5. The effects of operational traffic to regional air quality and ecological receptors are also considered.

7.4.3.1 'Do-Minimum' Scenario

The Do Minimum (DM) is a defined scenario within the traffic modelling exercise in Chapter 6 (Traffic and Transport). The output of this analysis and its impact on air quality has been modelled using AMDS-Roads for the opening year of 2023. Predicted annual mean concentrations of NO_2, at selected most impacted existing air quality sensitive receptors in the 2023 DM scenario are listed in Table 7.22. Locations of these receptors are shown in Figure 7.2 in Volume 3 of this EIAR. The full list of modelled receptors can be found in Appendix 7.2 (Volume 4 of this EIAR).

[4] 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, Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes, 2011)

Table 7.22: Predicted 2023 Do Minimum Scenario Pollutant Statistics at Most Impacted Receptor Locations

DM (2023)			
Receptor	Receptor Location (ITM) (m)		Annual Mean Concentration (µg/m^3)
	x	y	NO_2
R113	530919.6	726063.2	19.4
R89	530168.9	725010.0	17.3
R111	530978.1	726091.6	19.4
R109	530414.5	725303.9	16.5
R84	529712.2	724979.5	30.5
R76	529978.0	725112.9	20.1
R108	530280.2	725396.7	14.4
R7	529038.5	726082.8	17.9
R80	529873.2	725072.2	20.2
R96	529812.9	725494.8	15.4
R6	529084.1	725989.5	16.1
R85	529779.5	724950.1	15.0
R43	529234.8	725301.9	13.6
R10	528936.1	726311.0	22.4
R38	529135.7	725305.3	17.1
R44	529347.1	725229.5	14.1
R79	529934.7	725142.9	17.2
R15	528727.4	725985.7	18.1
R37	529087.5	725421.3	16.7
R5	529062.6	725763.3	20.9
R18	528629.9	725964.5	16.8
R78	529940.0	725149.3	16.8
R8	529016.3	726146.6	16.9
R14	528690.0	726040.9	18.0
R36	529101.6	725445.0	16.3
R94	530121.9	725387.8	19.8
R13	529044.6	726135.7	16.9
R39	529123.8	725209.3	20.6
R9	528992.5	726186.3	15.8
R35	529059.0	725561.4	15.0
R30	528308.6	725326.1	15.9
R97	529872.3	725524.5	14.3
R110	530524.1	725486.4	14.5
R17	528637.5	726026.6	16.9
R75	530028.1	725173.7	15.7
R42	529215.1	725106.4	14.3

DM (2023)			
Receptor	Receptor Location (ITM) (m)		Annual Mean Concentration (µg/m³)
	x	y	NO_2
R41	529134.0	725172.2	15.7
R34	528080.1	725733.0	15.1
R146	531544.5	726021.2	16.0
R81	529773.2	724977.2	15.5
R31	528419.7	725280.4	15.2
R24	528196.3	726085.0	13.9
R138	532088.7	725860.3	15.3
R98	529994.8	725587.8	14.5
R145	531854.1	725888.1	14.7
R143	530882.8	726257.3	15.3
R144	530990.8	726278.0	17.1
R16	528536.2	726298.0	15.9
R87	529770.6	724951.7	15.3
R25	528076.9	725803.2	13.7
R63	529727.3	725377.6	14.3
R129	531205.2	726741.3	14.8
R141	531760.6	726687.1	14.7
R130	531471.8	726871.9	14.8
R62	529722.2	725397.8	17.5
R82	529619.9	724966.8	22.4
R77	530058.5	725266.2	15.0
R142	531815.6	726984.4	15.4
R65	529781.8	725462.3	16.8
R74	530077.3	725234.0	15.0
R71	530033.6	725303.9	14.9
R73	530064.4	725270.7	15.1
R112	531021.8	726174.4	19.1
R115	530518.8	725638.8	15.3
R66	529886.8	725376.8	16.3
R2	529372.3	725592.0	18.6
R3	529262.8	725625.7	17.6
R99	530076.2	725542.2	16.4
R64	529768.1	725329.6	16.2
R107	530233.4	725585.3	17.5
R67	529911.5	725415.9	16.8
R61	529659.2	725665.0	14.8
R105	529879.9	725756.3	17.7
R12	529491.5	725117.0	16.4

DM (2023)			
Receptor	**Receptor Location (ITM) (m)**		**Annual Mean Concentration (µg/m³)**
	x	**y**	**NO_2**
R11	529444.4	725294.3	15.1
R46	529476.3	725014.9	17.6
R59	529697.3	725575.1	25.5
R93	529767.4	725318.1	18.2
R72	530106.5	725371.1	17.1
R102	529760.1	725611.1	18.0
R45	529498.9	725074.3	18.4
R69	530036.8	725479.0	18.1
R68	530031.6	725488.2	18.2
R95	529779.3	725469.5	18.5
R106	529932.0	725810.8	19.5
R104	529883.1	725729.3	18.4
R1	529457.3	725584.9	18.5
R57	529610.2	725600.1	17.0
R100	530132.1	725629.1	21.3
R117	530259.0	725516.8	24.3
Air Quality Limit Value			**40.0**

In the 2023 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 Appendix 7.2 (Detailed Modelling Results) in Volume 4 of this EIAR. Annual mean NO_2 concentrations did not exceed 20µg/m3, indicating that exceedances of the NO_2 1-hour mean are unlikely to occur.

7.4.3.2 'Do Something' Scenario

The Do Something (DS) is a defined scenario within the traffic modelling exercise in Chapter 6 (Traffic and Transport). The output of this analysis and its impact on air quality has been modelled using AMDS-Roads for the opening year of 2023 in line with the methodology set out in Section 7.2.5. Predicted annual mean concentrations of NO_2 at selected most impacted existing air quality sensitive receptors in the 2023 DS scenario are listed in Table 7.23.

Locations of these receptors are shown in Figure 7.2 in Volume 3 of this EIAR. The full list of modelled receptors can be found in Appendix 7.2 (Volume 4 of this EIAR).

Table 7.23: Predicted 2023 Do Something Scenario Pollutant Statistics at Most Impacted Receptor Locations

DS (2023)			
Receptor	Receptor Location (ITM) (m)		Annual Mean Concentration (µg/m^3)
	x	y	NO_2
R113	530919.6	726063.2	23.8
R89	530168.9	725010	21.6
R111	530978.1	726091.6	23.5
R109	530414.5	725303.9	20.3
R84	529712.2	724979.5	33.9
R76	529978	725112.9	22.5
R108	530280.2	725396.7	16.7
R7	529038.5	726082.8	20.1
R80	529873.2	725072.2	22.3
R96	529812.9	725494.8	17.2
R6	529084.1	725989.5	17.6
R85	529779.5	724950.1	16.5
R43	529234.8	725301.9	15.0
R10	528936.1	726311	23.9
R38	529135.7	725305.3	18.4
R44	529347.1	725229.5	15.5
R79	529934.7	725142.9	18.6
R15	528727.4	725985.7	19.4
R37	529087.5	725421.3	18.0
R5	529062.6	725763.3	22.2
R18	528629.9	725964.5	18.0
R78	529940	725149.3	18.0
R8	529016.3	726146.6	18.1
R14	528690	726040.9	19.2
R36	529101.6	725445	17.5
R94	530121.9	725387.8	20.9
R13	529044.6	726135.7	18.0
R39	529123.8	725209.3	21.6
R9	528992.5	726186.3	16.7
R35	529059	725561.4	15.9
R30	528308.6	725326.1	16.6
R97	529872.3	725524.5	15.0
R110	530524.1	725486.4	15.2
R17	528637.5	726026.6	17.6
R75	530028.1	725173.7	16.4

DS (2023)			
Receptor	**Receptor Location (ITM) (m)**		**Annual Mean Concentration ($\mu g/m^3$)**
	x	**y**	**NO_2**
R42	529215.1	725106.4	14.8
R41	529134	725172.2	16.2
R34	528080.1	725733	15.6
R146	531544.5	726021.2	16.5
R81	529773.2	724977.2	16.0
R31	528419.7	725280.4	15.6
R24	528196.3	726085	14.3
R138	532088.7	725860.3	15.6
R98	529994.8	725587.8	14.9
R145	531854.1	725888.1	15.1
R143	530882.8	726257.3	15.7
R144	530990.8	726278	17.4
R16	528536.2	726298	16.2
R87	529770.6	724951.7	15.6
R25	528076.9	725803.2	14.0
R63	529727.3	725377.6	14.0
R129	531205.2	726741.3	14.4
R141	531760.6	726687.1	14.3
R130	531471.7	726871.9	14.4
R62	529722.2	725397.8	17.0
R82	529619.9	724966.8	21.9
R77	530058.5	725266.2	14.5
R142	531815.6	726984.3	14.9
R65	529781.8	725462.3	16.3
R74	530077.3	725234.0	14.5
R71	530033.6	725303.9	14.3
R73	530064.5	725270.7	14.6
R112	531021.7	726174.4	18.5
R115	530518.8	725638.8	14.6
R66	529886.8	725376.8	15.5
R2	529372.3	725591.9	17.8
R3	529262.8	725625.6	16.8
R99	530076.2	725542.2	15.6
R64	529768.1	725329.5	15.4
R107	530233.4	725585.3	16.5
R67	529911.5	725415.9	15.7
R61	529659.2	725665.0	13.7

DS (2023)			
Receptor	Receptor Location (ITM) (m)		Annual Mean Concentration (µg/m^3)
	x	y	NO_2
R105	529879.9	725756.3	16.4
R12	529491.4	725116.9	15.1
R11	529444.4	725294.3	13.7
R46	529476.3	725014.8	16.3
R59	529697.3	725575.1	24.1
R93	529767.4	725318.1	16.8
R72	530106.5	725371.1	15.7
R102	529760.1	725611.1	16.3
R45	529498.9	725074.	16.4
R69	530036.8	725479.0	16.0
R68	530031.6	725488.2	16.0
R95	529779.3	725469.5	16.2
R106	529931.9	725810.8	17.2
R104	529883.1	725729.3	15.9
R1	529457.3	725584.9	15.9
R57	529610.2	725600.1	14.4
R100	530132.1	725629.1	18.6
R117	530258.9	725516.7	20.3
Air Quality Limit Value			**40**

In the 2023 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 Appendix 7.2 (Detailed Modelling Results) in Volume 4 of this EIAR. Annual mean NO_2 concentrations did not exceed 25µg/m^3, indicating that exceedances of the NO_2 1-hour mean are unlikely to occur.

7.4.3.3 Comparison of ‘Do-Minimum’ and ‘Do Something’ Scenarios

Table 7.24 provides the predicted change in and impact on pollutant concentrations, between the DM and DS in 2023. Statistics for the full list of modelled receptors can be found in Appendix 7.2 (Detailed Modelling Results) in Volume 4 of this EIAR.

Table 7.24: Predicted Changes in Operational DM and DS and Impact Significance Criteria at Most Impacted Receptor Locations

Difference (2023)				
Receptor	Receptor Location (ITM) (m)		Difference in Annual Mean Conc. (µg/m^3)	Impact on Annual Mean Concentration
	x	y	NO_2	NO_2
R113	530919.6	726063.2	4.37	Slight Adverse
R89	530168.9	725010	4.3	Slight Adverse
R111	530978.1	726091.6	4.13	Slight Adverse
R109	530414.5	725303.9	3.74	Negligible
R84	529712.2	724979.5	3.35	Negligible
R76	529978	725112.9	2.43	Negligible
R108	530280.2	725396.7	2.3	Negligible
R7	529038.5	726082.8	2.18	Negligible
R80	529873.2	725072.2	2.1	Negligible
R96	529812.9	725494.8	1.81	Negligible
R6	529084.1	725989.5	1.55	Negligible
R85	529779.5	724950.1	1.5	Negligible
R43	529234.8	725301.9	1.47	Negligible
R10	528936.1	726311	1.42	Negligible
R38	529135.7	725305.3	1.34	Negligible
R44	529347.1	725229.5	1.34	Negligible
R79	529934.7	725142.9	1.32	Negligible
R15	528727.4	725985.7	1.27	Negligible
R37	529087.5	725421.3	1.27	Negligible
R5	529062.6	725763.3	1.26	Negligible
R18	528629.9	725964.5	1.21	Negligible
R78	529940	725149.3	1.19	Negligible
R8	529016.3	726146.6	1.17	Negligible
R14	528690	726040.9	1.17	Negligible
R36	529101.6	725445	1.16	Negligible
R94	530121.9	725387.8	1.11	Negligible
R13	529044.6	726135.7	1.1	Negligible
R39	529123.8	725209.3	1.06	Negligible
R9	528992.5	726186.3	0.9	Negligible
R35	529059	725561.4	0.87	Negligible
R30	528308.6	725326.1	0.74	Negligible
R97	529872.3	725524.5	0.67	Negligible
R110	530524.1	725486.4	0.67	Negligible
R17	528637.5	726026.6	0.66	Negligible
R75	530028.1	725173.7	0.63	Negligible

Difference (2023)				
Receptor	Receptor Location (ITM) (m)		Difference in Annual Mean Conc. (µg/m^3)	Impact on Annual Mean Concentration
	x	y	NO_2	NO_2
R42	529215.1	725106.4	0.55	Negligible
R41	529134	725172.2	0.52	Negligible
R34	528080.1	725733	0.52	Negligible
R146	531544.5	726021.2	0.52	Negligible
R81	529773.2	724977.2	0.49	Negligible
R31	528419.7	725280.4	0.45	Negligible
R24	528196.3	726085	0.4	Negligible
R138	532088.7	725860.3	0.39	Negligible
R98	529994.8	725587.8	0.36	Negligible
R145	531854.1	725888.1	0.36	Negligible
R143	530882.8	726257.3	0.34	Negligible
R144	530990.8	726278	0.32	Negligible
R16	528536.2	726298	0.31	Negligible
R87	529770.6	724951.7	0.31	Negligible
R25	528076.9	725803.2	0.3	Negligible
R63	529727.3	725377.6	-0.31	Negligible
R129	531205.2	726741.3	-0.35	Negligible
R141	531760.6	726687.1	-0.38	Negligible
R130	531471.8	726871.9	-0.39	Negligible
R62	529722.2	725397.8	-0.41	Negligible
R82	529619.9	724966.8	-0.45	Negligible
R77	530058.5	725266.2	-0.45	Negligible
R142	531815.6	726984.4	-0.48	Negligible
R65	529781.8	725462.3	-0.5	Negligible
R74	530077.3	725234	-0.5	Negligible
R71	530033.6	725303.9	-0.55	Negligible
R73	530064.4	725270.7	-0.59	Negligible
R112	531021.8	726174.4	-0.59	Negligible
R115	530518.8	725638.8	-0.72	Negligible
R66	529886.8	725376.8	-0.77	Negligible
R2	529372.3	725592	-0.78	Negligible
R3	529262.8	725625.7	-0.81	Negligible
R99	530076.2	725542.2	-0.84	Negligible
R64	529768.1	725329.6	-0.86	Negligible
R107	530233.4	725585.3	-1.02	Negligible
R67	529911.5	725415.9	-1.09	Negligible
R61	529659.2	725665	-1.12	Negligible

Difference (2023)				
Receptor	Receptor Location (ITM) (m)		Difference in Annual Mean Conc. (μg/m^3)	Impact on Annual Mean Concentration
	x	y	NO_2	NO_2
R105	529879.9	725756.3	-1.37	Negligible
R12	529491.5	725117	-1.37	Negligible
R11	529444.4	725294.3	-1.38	Negligible
R46	529476.3	725014.9	-1.38	Negligible
R59	529697.3	725575.1	-1.4	Negligible
R93	529767.4	725318.1	-1.41	Negligible
R72	530106.5	725371.1	-1.44	Negligible
R102	529760.1	725611.1	-1.66	Negligible
R45	529498.9	725074.3	-2	Negligible
R69	530036.8	725479	-2.15	Negligible
R68	530031.6	725488.2	-2.19	Negligible
R95	529779.3	725469.5	-2.26	Negligible
R106	529932	725810.8	-2.33	Negligible
R104	529883.1	725729.3	-2.53	Negligible
R1	529457.3	725584.9	-2.56	Negligible
R57	529610.2	725600.1	-2.62	Negligible
R100	530132.1	725629.1	-2.71	Negligible
R117	530259	725516.8	-3.95	Negligible
R116	530333.6	725505.9	-4.1	Slight Beneficial
Air Quality Standard			**40**	

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 7.24 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 and a slight adverse impact is expected at three receptors, refer to Table 7.24.

In accordance with the EPA Guidelines (EPA 2022) the impacts associated with the operational phase traffic emissions pre-mitigation are overall neutral and long-term.

7.4.3.4 Ecological

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). An assessment of the ecologically sensitive sites listed in Section 7.2.5.5 has been carried out.

As outlined in Section 7.2.5.5, there are three ecologically designated sites which are within 2km of the boundary of the Proposed Scheme, namely Galway Bay Complex SAC and pNHA (Site Code 000268), Lough Corrib SAC (Site Code 000297) and Inner Galway Bay SPA (Site Code 004031).

However, the predicted annual mean NO_2 concentrations at Galway Bay Complex SAC and Inner Galway Bay SPA are lower in the 2023 Do Something scenario in comparison to the 2023 Do Minimum for all locations modelled. This is due to a decrease in traffic along Grattan Road and the Seapoint Promenade when the Proposed Scheme is operational. As such, these designated sites are predicted to experience beneficial impacts due to the Proposed Scheme, therefore, further assessment at these sites will not be required. The model results of Galway Bay Complex SAC and Inner Galway Bay SPA are presented in Appendix 7.2 (Detailed Modelling Results) in Volume 4 of this EIAR).

Nitrogen deposition levels have been compared to the relevant critical loads for the Lough Corrib SAC (Site Code 00297) in Table 7.25, for the worst-case ecologically sensitive receptors. The ground level concentrations are assessed at the closest locations within the ecological site to the nearest road. The dry nitrogen deposition results are included for the highest maximum ground level concentration and the highest concentration contribution. The full modelling results of Lough Corrib SAC are presented in Appendix 7.2 (Detailed Modelling Results in Volume 4 of this EIAR).

Table 7.25: Predicted Dry Deposition Results at Closest Point within Ecological Sites to Road

Parameter (Annual Mean)	Predicted Ground Level Concentration (including background) µg/m3	Deposition velocity (m/s)	Dry deposition flux (µg m2/s)	Dry deposition flux conversion factors (kg N / ha / yr)	Result (kg N / ha / yr)	Limit-critical load (kg N/ha/yr)
Lough Corrib SAC						
Maximum predicted ground level concentration						
Do-Minimum NO_2	14.82	0.003	0.044	96	4.3	5-10
Do-Something NO_2	14.34	0.003	0.043	96	4.1	5-10
Difference between Do-Something and Do-Minimum					-0.5	
Change relative to lower critical load (%)					-10%	
Maximum predicted ground level concentration due to Proposed Scheme						
Do-Minimum NO_2	12.94	0.003	0.039	96	3.7	5-10
Do-Something NO_2	13.08	0.003	0.039	96	3.8	5-10
Difference between Do-Something and Do-Minimum					0.1	

Parameter (Annual Mean)	Predicted Ground Level Concentration (including background) µg/m3	Deposition velocity (m/s)	Dry deposition flux (µg m2/s)	Dry deposition flux conversion factors (kg N / ha / yr)	Result (kg N / ha / yr)	Limit-critical load (kg N/ha/yr)
Change relative to lower critical load (%)					2%	

The results are all lower than the Critical Loads for Nitrogen for oligotrophic waters of 5-10 KgN/ha/yr (Table A9.1: UNECE (2003) Critical Loads for Nitrogen, TII guidance).

Predicted maximum deposition of nitrogen (including background) is in compliance with the worst-case critical load at the worst-case receptor. The IAQM guidance states that where the PC is less than 70% of the long-term critical level / load, the PC is likely to be insignificant. There will therefore be no impact on ecologically sensitive sites. In accordance with the EPA Guidelines (EPA 2022) the ecological impacts associated with the operational phase traffic emissions are overall neutral and long-term.

7.4.3.5 Regional Air Quality Assessment

The potential changes in regional air emissions due to the traffic impacts of the Proposed Scheme during the operational phase has been assessed using the NTA Environmental Appraisal Tool, which is based on ENEVAL.

The latest version of the NTA Eastern Regional Model Transport model incorporates ENEVAL, as part of the Appraisal Tool, in a Geographical Information System environment. ENEVAL measures the air 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 7.26. The Proposed Scheme will result in minor increases in regional emission concentrations for all pollutants modelled for the opening year. However, given the low ambient air concentrations, these increases are expected to have a slight, negative, long-term impact to air quality. There is potential for the predicted emissions to be lower with potential for an increased modal shift, further decreasing car usage and thus the associated emissions.

Table 7.26: Operational Phase Regional Pollutant Emissions (Tonnes) – Opening Year 2023

	Vehicle Class	NO_X (tonnes)	NO_2 (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	HC (tonnes)	CO (tonnes)	Benzene (tonnes)
DM	Car	437.5	136.1	47.2	28.4	21.3	648.5	0.478
DS		438.3	136.3	47.3	28.5	21.3	649.7	0.479
Change		0.8	0.2	0.1	0.0	0.1	1.2	0.001

	Vehicle Class	NO_X (tonnes)	NO_2 (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	HC (tonnes)	CO (tonnes)	Benzene (tonnes)
% Change		0.18%	0.18%	0.12%	0.12%	0.26%	0.19%	0.26%
DM	Goods	189.7	54.2	14.9	9.1	6.1	30.3	0.039
DS		192.0	54.9	15.0	9.1	6.2	30.8	0.040
Change		2.3	0.6	0.1	0.1	0.1	0.5	0.001
% Change		1.22%	1.15%	0.66%	0.73%	1.10%	1.67%	2.95%
DM	Urban Bus	13.5	1.4	1.2	0.7	0.4	2.2	0
DS		13.8	1.4	1.2	0.7	0.4	2.2	0
Change		0.3	0.0	0.0	0.0	0.0	0.0	0
% Change		2.14%	2.14%	-0.14%	-0.11%	0.02%	0.87%	0.00%
DM	Total	640.7	191.7	63.3	38.2	27.8	680.9	0.517
DS		644.1	192.6	63.5	38.3	27.9	682.7	0.519
Change		3.4	0.9	0.2	0.1	0.1	1.8	0.002
% Change		0.53%	0.47%	0.24%	0.26%	0.44%	0.26%	0.47%

Pollutant emissions (in tonnes) produced in both the DM and DS scenarios during the design year of the operational phase are shown in Table 7.27. The Proposed Scheme will result in slight increases in regional emission concentrations for all pollutants modelled for the design year. This reflects the technical challenges in converting particularly the heavy goods fleet to electric vehicles, which would reduce emissions. However, given the low ambient air concentrations, these increases are expected to have a slight, negative, long-term impact to air quality. There is potential for the predicted emissions to be lower with potential for an increased modal shift, further decreasing car usage and thus the associated emissions.

Table 7.27: Operational Phase Regional Pollutant Emissions (Tonnes) – Design Year 2038

Scenario	Vehicle Class	NO_X (tonnes)	NO_2 (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	HC (tonnes)	CO (tonnes)	Benzene (tonnes)
DM	Car	70.5	17.7	51.2	28.4	10.4	474	0.16
DS		70.9	17.8	51.6	28.6	10.4	475	0.16
Change		0.4	0.1	0.4	0.2	0.05	1	0
% Change		0.6	0.5	0.6	0.6	0.5	0.2	0
DM	Goods	123.6	33.1	13.12	7.23	4.01	21.9	0.023
DS		124.1	33.2	13.16	7.25	4.03	22.1	0.023
Change		0.5	0.1	0.04	0.02	0.02	0.2	0
% Change		0.4	0.4	0.31	0.31	0.7	0.9	0
DM	Urban Bus	0	0	0.99	0.53	0	0	0
DS		0	0	0.99	0.53	0	0	0

Scenario	Vehicle Class	NO_X (tonnes)	NO_2 (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	HC (tonnes)	CO (tonnes)	Benzene (tonnes)
Change		0	0	0	0	0	0	0
% Change		0	0	0	0	0	0	0
DM	Total	194.2	50.8	65.4	36.2	14.36	496.3	0.18
DS		195.0	51.1	65.7	36.3	14.44	497.4	0.18
Change		0.8	0.3	0.3	0.1	0.08	1.1	0
% Change		0.45	0.45	0.5	0.5	0.56	0.21	0

In accordance with the EPA Guidelines (2022), 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

The appropriate mitigation and monitoring measures are proposed to minimise the effects of the Proposed Scheme, as detailed below.

7.5.1 Construction Phase

7.5.1.1 Construction Phase Mitigation Measures

The following mitigation measures will be implemented for the construction phase of the proposed development, in order to reduce the dust risk associated with the construction activities.

In order to ensure that no significant dust nuisance occurs, a series of mitigation measures that are applicable to the Construction Phase of the Proposed Scheme will be implemented. In summary, the mitigation measures will include:

- Fully enclose structures with screens during demolition to minimise dust dispersion;
- Public roads outside the Proposed Scheme will be regularly inspected for cleanliness and cleaned as necessary;
- Material handling systems and site 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 or potentially hazardous 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 boundaries where works are taking place adjacent ecological sensitive receptors (Lough Atalia and Lough Corrib) and at the Harbour Construction Compounds 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 Phase Monitoring Measures

The following monitoring measures, will be implemented for the construction phase of the proposed development:

- The contractor will undertake on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to Galway City Council on request. The frequency of the inspections will be increased during site activities with a high potential to produce dust are being carried out.
- Dust monitoring will be undertaken at the three nearest sensitive receptors (with agreement from the landowner) to the works during the construction phase. The TA Luft dust deposition limit values of 350 mg/m^2/day applied as a 30-day average.

The monitoring measures are included in the Construction Environmental Management Plan (CEMP) (Appendix 5.1 of Volume 4 of this EIAR).

7.5.1.3 Summary of Construction Effects

The construction works will be short-term and temporary in nature, the impact on air quality will not be significant. When the dust minimisation measures detailed in Section 7.5.1.1 are implemented, fugitive emissions of dust from the site will be slight, negative, short-term.

7.5.2 Operational Phase

7.5.2.1 Operational Phase Mitigation and Monitoring

There are no significant effects to air quality predicted during the operational phase 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, therefore, no specific operation phase mitigation or monitoring measures are required.

7.5.2.2 Summary of Operational Effects

Table 7.28 summarises the Operational Phase impacts prior and post mitigation.

Table 7.28: Summary of Potential 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)
Construction dust emissions	-	Slight, negative, short-term
Road traffic impacts on local human receptors	Neutral, Long-term	Neutral, Long-term
Road traffic impacts on local ecological receptors	Neutral, Long-term	Neutral, Long-term
Regional air quality	Slight, Negative, Long-term	Slight, Negative, Long-term

7.6 Residual Impacts

7.6.1 Construction Phase

With the implementation of the mitigation measures outlined in Section 7.5.1, no significant adverse residual effects on air quality are predicted during the construction phase of the Proposed Scheme. Overall, it is considered that the residual effects as a result of the Proposed Scheme's construction are slight, negative and short-term.

7.6.2 Operational Phase

The air dispersion modelling assessment has found that all receptors will be in compliance with ambient air quality standards for the Do Something (and Do Minimum) scenario. There are no substantial or moderate adverse effects predicted as a result of the operational phase of the Proposed Scheme.

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

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