Chapter 13

Air Quality and Climate

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13.1 Introduction

This chapter assesses the likely air quality and climate impacts, if any, associated with the proposed Foynes to Limerick Road (including Adare Bypass). A full description of the proposed road development is provided in Chapter 4: Description of the Proposed Road Development.

This Chapter interacts with the following Chapters:

- Chapter 6 Population and Human Health;
- Chapter 7 Biodiversity.

13.2 Background Information

13.2.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "*Air Quality Standards*" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table 13.1 and Appendix 13.1).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which give effect to EU Directive 2008/50/EC, which has set limit values for Nitrogen Dioxide (NO_2), Particulate Matter > 10 µg (PM_{10}), Particulate Matter > 2.5 µg ($PM_{2.5}$), benzene (C_6H_6), Lead (Pb), Sulphur Dioxide (SO_2) and Carbon Monoxide (CO). The pollutants of concern in relation to the proposed road development are NO_2, PM_{10}, $PM_{2.5}$, benzene and carbon monoxide (see Table 13.1). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by EU Directives are used which are triggers for particular actions (see Appendix 13.1).

13.2.2 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002 (UNFCCC, 1997; 1999). For the purposes of the EU burden sharing agreement under Article 4 of the Doha Amendment to the Kyoto Protocol, in December 2012, Ireland agreed to limit the net growth of the six Greenhouse Gases (GHGs) under the Kyoto Protocol to 20% below the 2005 level over the period 2013 to 2020 (UNFCCC, 2012). The GHGs of concern are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) with the addition of nitrogen trifluoride (NF_3). The UNFCCC is continuing detailed negotiations in relation to GHG reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP24) took place in Katowice, Poland from the 4th to the 14th December 2018 and focussed on advancing the implementation of the Paris Agreement. The Paris Agreement was agreed by over 200 nations and has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 Giga-tonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, on the 23/24th of October 2014, agreed the "2030 Climate and Energy Policy Framework" (EU 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in GHG emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030.

13.2.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$.

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005 (DEHLG, 2004; 2007). Data available from the EPA in 2019 indicated that Ireland complied with the emissions ceilings for SO_2 and NH_3 but failed to comply with the ceiling for NO_X and non-methane volatile organic compounds (NMVOCs) (EPA, 2019a). Directive (EU) 2016/2284 "*On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC*" was published in December 2016. The Directive will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4 (Methane). In relation to Ireland, 2020 emission targets are 25.5 kt for SO_2 (65% on 2005 levels), 66.9 kt for NO_X (49% reduction on 2005 levels), 56.9 kt for NMVOCs (25% reduction on 2005 levels), 112 kt for NH_3 (1% reduction on 2005 levels) and 15.6 kt for $PM_{2.5}$ (18% reduction on 2005 levels). In relation to 2030, Ireland's emission targets are 10.9 kt (85% below 2005 levels) for SO_2, 40.7 kt (69% reduction) for NO_x, 51.6 kt (32% reduction) for NMVOCs, 107.5 kt (5% reduction) for NH_3 and 11.2 kt (41% reduction) for $PM_{2.5}$.

Table 13.1 Air Quality Standards Regulations

Pollutant	Regulation Note 1	Limit Type	Value
Nitrogen Dioxide (NO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3
		Annual limit for protection of human health	40 µg/m^3
		Critical level for protection of ecosystems	30 µg/m^3 NO + NO_2
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3
		Annual limit for protection of human health	40 µg/m^3
Particulate Matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 µg/m^3 (1 Jan 2015) 20 µg/m^3 (1 Jan 2020)
Benzene (C_6H_6)	2008/50/EC	Annual limit for protection of human health	5 µg/m^3
Carbon Monoxide (CO)	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	10 mg/m^3 (8.6 ppm)

Note 1 EU 2008/50/EC – Clean Air for Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

13.3 Assessment Methodology

13.3.1 Construction Stage

13.3.1.1 Air Quality

The current assessment focuses on identifying the existing baseline levels of PM_{10} and $PM_{2.5}$ in the region of the proposed road development by an assessment of EPA monitoring data. Thereafter, the impact of the construction phase of the development on air quality was determined by a qualitative assessment of the nature and scale of dust generating construction activities associated with the proposed road development in line with Appendix 8 of the TII document *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (TII, 2011).

Construction phase traffic also has the potential to impact air quality and climate. The UK DMRB guidance (UK Highways Agency, 2007), on which the TII guidance (2011) was based, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 AADT or more;
- HGV flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km/h or more; or

- Peak hour speed changes by 20 km/h or more.

The construction stage traffic does not meet the above criteria and, therefore, has been scoped out from any further assessment.

13.3.1.2 Climate

The impact of the construction phase of the proposed road development on climate has been estimated using the TII Carbon Assessment Tool which is designed specifically to account for the climatic impact from road projects in Ireland. The carbon calculator measures the greenhouse gas impacts of construction activities (in terms of CO_2eq) by calculating the embodied CO_2eq of material plus the CO_2eq associated with their transportation. The model can also consider personnel travel, site energy use and waste management. The majority of emission factors are similar to those used in the UK Environment Agency's carbon calculator tool (Version 3.6, 2014).

Information on the material quantities, waste product and construction traffic was obtained for this assessment (as detailed in Chapter 4). This information was input into the Carbon Calculator to determine an estimate of the GHG emissions associated with the development.

13.3.2 Operational Stage

13.3.2.1 Local Air Quality Assessment

The air quality assessment has been carried out following procedures described in the publications by the Environmental Protection Agency (EPA) (2002, 2003, 2015, 2017) and using the methodology outlined in the guidance documents published by the UK Department for Environment, Food and Rural Affairs (DEFRA) (2016; 2018). Transport Infrastructure Ireland (TII) reference the use of the UK DEFRA guidance and methodology in their document *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011). This approach is considered best practice in the absence of Irish guidance. The assessment of air quality was carried out using a phased approach as recommended by the UK DEFRA (2016). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards.

In the assessment for the proposed road development, an initial scoping of possible key pollutants was carried out and the likely location of air pollution "*hot-spots*" identified. An examination of recent EPA and Local Authority data in Ireland (EPA, 2019) has indicated that SO_2 and smoke are unlikely to be exceeded at locations such as the current one and thus these pollutants do not require detailed monitoring or assessment to be carried out.

However, the analysis did indicate potential issues in regard to nitrogen dioxide (NO_2), PM_{10} and $PM_{2.5}$ at busy junctions in urban centres (EPA, 2019b). Benzene, although previously reported at quite high levels in urban centres, has recently been measured at several city centre locations to be well below the EU limit value (EPA, 2019b). Historically, carbon monoxide (CO) levels in urban areas were a cause for concern. However, CO concentrations have decreased significantly over the past number of years and are now measured to be well below the limits, even in urban centres (EPA 2018; 2019b). Due to the rural nature of the proposed road development, background concentrations of pollutants are likely to be low. On the basis of the initial scoping the key pollutants reviewed in the following assessments for the proposed road are NO_2, PM_{10}, $PM_{2.5}$, benzene and CO, with particular focus on NO_2 and PM_{10}.

Key pollutant concentrations were predicted for nearby sensitive receptors for the following scenarios:

- The Baseline scenario (2017), for model verification;
- Opening Year Do-Minimum scenario (DM), which assumes the retention of present site usage with no proposed road development in place (2024);
- Opening Year Do-Something scenario (DS), which assumes the proposed road development is in place (2024);
- Design Year Do-Minimum scenario (DM), which assumes the retention of present site usage with no proposed road development in place (2039); and
- Design Year of the Do-Something scenario (DS), which assumes the proposed road development is in place (2039).

In terms of receptor sensitivity, for the purposes of this assessment, high sensitivity receptors are regarded as residential properties where people are likely to spend the majority of their time, schools and hospitals. Commercial properties and places of work are regarded as medium sensitivity while low sensitivity receptors are places where people are present for short periods or do not expect a high level of amenity. High sensitivity receptors have been included in this assessment.

The air quality assessment methodology involved air dispersion modelling using the UK Design Manual for Roads and Bridges (DMRB) Screening Model (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet (Version 7.1, 2019), and following the TII *Guidelines for Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011), and guidance issued by the UK Highways Agency (2007), UK DEFRA (2016; 2018), UK DETR (1998) and the EPA (2002; 2003; 2015; 2017).

The TII guidance (2011) states that the assessment must progress to detailed modelling if:

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

The UK DMRB guidance (UK Highways Agency, 2007), on which the TII guidance was based, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 AADT or more;
- HGV flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km/h or more; or
- Peak hour speed changes by 20 km/h or more.

Concentrations of key pollutants are calculated at sensitive receptors that have the potential to be affected by the proposed road development. For road links which are deemed to be affected by the proposed road development as per the above criteria and within 200m of the chosen sensitive receptors, inputs to the air dispersion model consist of:

- road layouts;

- receptor locations;
- annual average daily traffic movements (AADT);
- percentage heavy goods vehicles;
- annual average traffic speeds; and
- background concentrations.

The UK DMRB guidance states that road links at a distance of greater than 200m from a sensitive receptor will not influence pollutant concentrations at the receptor. Using this input data, the model predicts the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case road contributions are then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the proposed road development with these ambient air quality standards.

The TII *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2011)* detail a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the proposed development. The TII significance criteria have been adopted for the proposed road development and are detailed below in Table 13.2 to Table 13.4. The significance criteria are based on PM_{10} and NO_2 as these pollutants are the ones most likely to exceed the annual mean limit values (40 µg/m^3). However, the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

Table 13.2 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

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

Table 13.3 Air Quality Impact Significance Criteria for Annual Mean Nitrogen Dioxide and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration Note 1		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value with Scheme (≥40 $\mu g/m^3$ of NO_2 or PM_{10}) (≥25 $\mu g/m^3$ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with Scheme (36 - <40 $\mu g/m^3$ of NO_2 or PM_{10}) (22.5 - <25 $\mu g/m^3$ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with Scheme (30 - <36 $\mu g/m^3$ of NO_2 or PM_{10}) (18.75 - <22.5 $\mu g/m^3$ of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with Scheme (<30 $\mu g/m^3$ of NO_2 or PM_{10}) (<18.75 $\mu g/m^3$ of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value with Scheme (≥40 $\mu g/m^3$ of NO_2 or PM_{10}) (≥25 $\mu g/m^3$ of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value with Scheme (36 - <40 $\mu g/m^3$ of NO_2 or PM_{10}) (22.5 - <25 $\mu g/m^3$ of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with Scheme (30 - <36 $\mu g/m^3$ of NO_2 or PM_{10}) (18.75 - <22.5 $\mu g/m^3$ of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value with Scheme (<30 $\mu g/m^3$ of NO_2 or PM_{10}) (<18.75 $\mu g/m^3$ of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

Note 1 Well Below Standard = <75% of limit value.

Table 13.4 Air Quality Impact Significance Criteria for Changes to Number of Days with PM_{10} Concentration Greater than 50 $\mu g/m^3$ at a Receptor

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

13.3.2.2 Regional Air Quality and Climate Impact Assessment

The impact of the proposed road development at a national / international level has been determined using the procedures given by Transport Infrastructure Ireland in the document *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011) and the methodology provided in Annex 2 in the UK Design Manual for Roads and Bridges (2018). The assessment focused on determining the resulting change in emissions of volatile organic compounds (VOCs), nitrogen oxides (NO_x) and carbon dioxide (CO_2). The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes. The inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds.

As part of the proposed road development a number of trees are to be planted for screening and mitigation purposes. Trees are a natural carbon sink and absorb CO_2 from the atmosphere helping in the reduction of climate change; increased planting of trees on suitable lands will, over time, help to increase the carbon sink potential of the land and benefit climate. The advice in the "Best Practice Guidelines for the Irish Wind Energy Industry" (Fehily Timoney & Company 2012) was used for calculating the GHG sinks due to the planting of trees along the length of the proposed road development.

Trees have the ability to sequester carbon with the peak CO_2 uptake rate for tree stands of the order of 5 – 20 tonnes of CO_2/ha/year with CO_2 uptake rates declining before stand maturity. Additionally, after afforestation on mineral soils, there will be an increase of soil carbon soon after planting of the order of 0.2 – 1.7 tonnes of CO_2/ha/year (IPCC, 2006). Therefore, there is the potential uptake of up to 21.7 tonnes of CO_2/ha/year. As a worst-case conservative approach, this factor has been halved and a factor of 10.85 tonnes of CO_2/ha/year has been used in the current assessment to determine the potential minimum CO_2 uptake rate as a result of additional tree planting as not all tree types have the same CO_2 uptake rate.

13.3.2.3 Conversion of NO_x to NO_2

NO_x (NO + NO_2) is emitted by vehicles exhausts. The majority of emissions are in the form of NO, however, with greater numbers of diesel vehicles and some regenerative particle traps on HGVs the proportion of NOx emitted as NO_2, rather than NO is increasing. With the correct conditions (presence of sunlight and O_3 (Ozone)), emissions in the form of NO have the potential to be converted to NO_2.

TII outlines the recommended method for the conversion of NO_x to NO_2 in "*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*" (2011). The TII guidelines recommend the use of DEFRA's NO_x to NO_2 calculator (2019) which was originally published in 2009 and is currently on version 7.1. This calculator (which can be downloaded in the form of an excel spreadsheet) accounts for the predicted availability of O_3 and proportion of NO_x emitted as NO for each local authority across the UK. O_3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO_2 or PM_{10}.

The calculator includes Local Authorities in Northern Ireland and the TII guidance recommends the use of 'Armagh, Banbridge and Craigavon' as the choice for local authority when using the calculator. The choice of Craigavon provides the most suitable relationship between NO_2 and NO_x for Ireland. The "*All Other Non-Urban UK Traffic"* traffic mix option was used.

13.3.2.4 Ecological Sites

For routes that pass within 2km of a designated area of conservation (either Irish or European designation) the TII Guidelines require consultation with an ecologist (2011). However, in practice, the potential for impact to an ecological site is highest within 200m of a proposed development and when significant changes in AADT (>5%) occur.

Transport Infrastructure Ireland's *Guidelines for Assessment of Ecological Impacts of National Road Scheme*s (2009) and *Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities* (DEHLG, 2010) provide details regarding the legal protection of designated conservation areas.

If both of the following assessment criteria are met, an assessment of the potential for impact due to nitrogen deposition should be conducted:

- A designated area of conservation is located within 200 m of the proposed development; and
- A significant change in AADT flows (>5%) will occur.

One of the bridges for the proposed road development will cross the River Maigue which is a part of the Lower River Shannon SAC at Islandea/Ardshanbally (approximate Ch. 61+000). In addition, the proposed route east of Foynes near Robertstown (approximate Ch. 2+000) passes within 200m of the River Shannon & River Fergus Estuaries SPA (site code 004077). Dispersion modelling and prediction was carried out at typical traffic speeds at these locations and ambient NO_x concentrations predicted for the opening and design years along a transect of up to 200m within the Lower River Shannon SAC and River Shannon & River Fergus Estuaries SPA were modelled. The road contribution to dry deposition along the transect was also calculated using the methodology outlined in Appendix 9 of the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (TII, 2011).

13.3.2.5 Update to NO2 Projections using DMRB

In 2011 the UK DEFRA published research on the long term trends in NO_2 and NO_x for roadside monitoring sites in the UK. This study found a marked decrease in NO_2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this study is that there now exists a gap between projected NO_2 concentrations which UK DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the DMRB screening model can under-predict NO_2 concentrations predicted for future years. Subsequently, the UK Highways Agency (HA) published an Interim advice note (IAN 170/12) in order to correct the DMRB results for future years.

13.4 Description of Receiving Environment

13.4.1 Air Quality

The predominant source of air pollutants in the region of the proposed road development is from the existing road network, primarily the N69, N21 and N20/M20. A review of EPA Licenced Integrated Pollution Prevention and Control (IPPC) and Industrial Emissions Directive (IED) sites with emissions to atmosphere in the area showed that there are three licenced sites within the study area: Aughinish Alumina Ltd. (Licence no. P0035-06), Wyeth Nutritionals (Licence no. P0395-03) and ABP Rathkeale (Licence no. 0191-02). These sites have various emission points which will emit pollutants to atmosphere, however, each site must comply with the emission limits stipulated within their licence and, as such, should not be impacting significantly on the air quality in the area. Background concentrations for the study area incorporate emissions from these existing sources.

Sensitive receptors in the region of the proposed road development consist primarily of once off residential housing along the majority of the route. There are a number of towns and villages also in the area, such as Foynes, Askeaton, Rathkeale, Croagh and Adare.

13.4.1.1 Meteorological Data

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

The nearest representative weather station collating detailed weather records is Shannon Airport, which is located approximately 19km north of the proposed road at its furthest point. Shannon Airport meteorological data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Plate 13.1). For data collated during five representative years (2014 - 2018) (Met Éireann, 2019), the predominant wind direction is westerly to southerly, with generally moderate wind speeds averaging 4.7 m/s in 2018.

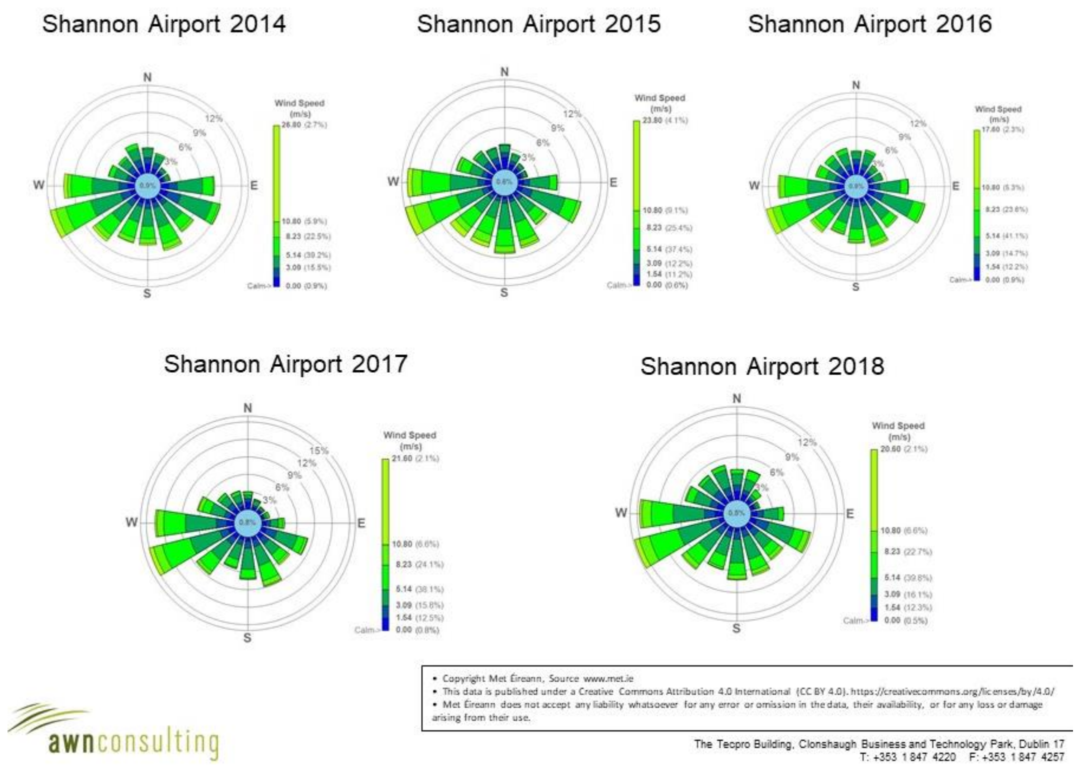

Plate 13.1 Shannon Airport Windrose 2014 – 2018

13.4.1.2 Trends in Air Quality

Air quality is variable and subject to both significant spatial and temporal variation. In relation to spatial variations in air quality, concentrations generally fall significantly with distance from major road sources (WHO, 2006). Thus, residential exposure is determined by the location of sensitive receptors relative to major road sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction.

13.4.1.3 Baseline Air Quality – Review of Available Background Data

A baseline monitoring study was carried out within the vicinity of the proposed road development. The results of the survey allow an indicative comparison with the annual limit values for NO_2 and PM_{10}, and the 24-hour limit value for PM_{10}. The results also provide information on the influence of road sources relative to the prevailing background level of these pollutants in the area. The monitoring methodology and results are described below.

Air quality monitoring programmes have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is "*Air Quality In Ireland 2017 – Indicators of Air Quality*" (EPA, 2018). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2019b).

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2019b). Dublin is defined as Zone A and Cork as Zone B. Zone C comprises 23 towns, all with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In terms of air monitoring and assessment, the proposed road development is within Zone D (EPA, 2019b). The long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed road development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

NO_2

<u>*EPA Background Data*</u>

NO_2 monitoring was carried out between 2012 – 2017 at two rural Zone D locations, Emo (Co. Laois) and Kilkitt (Co. Monaghan) and in two urban areas, Enniscorthy (Co. Wexford) and Castlebar (Co. Mayo) (EPA, 2018). The NO_2 annual average in 2017 for both rural sites, Emo and Killkitt was 3 $\mu g/m^3$ and 2 $\mu g/m^3$ respectively; with the results for Castlebar averaging 7 $\mu g/m^3$. Hence long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 $\mu g/m^3$. The average results over the last five years at a range of rural Zone D locations suggests an upper average annual mean NO_2 concentration of no more than 11 $\mu g/m^3$ as a background concentration as shown in Table 13.5.

Table 13.5 Trends In Zone D Air Quality - Nitrogen Dioxide (NO_2)

Station	Averaging Period Notes 1,2	Year					
		2012	2013	2014	2015	2016	2017
Castlebar	Annual Mean NO_2 (µg/m^3)	8	11	8	8	9	7
	Max 1-hr NO_2 (µg/m^3)	74	100	106	96	91	112
Killkitt	Annual Mean NO_2 (µg/m^3)	4	4	3	2	3	2
	Max 1-hr NO_2 (µg/m^3)	42	72	38	97	80	25
Emo	Annual Mean NO_2 (µg/m^3)	-	4	3	3	4	3
	Max 1-hr NO_2 (µg/m^3)	-	38	30	34	194	33
Enniscorthy	Annual Mean NO_2 (µg/m^3)	-	-	13	9	10	-
	Max 1-hr NO_2 (µg/m^3)	-	-	122	87	136	-

Note 1 Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).
Note 2 1-hour limit value - 200 µg/m^3 as a 99.8th%ile, i.e. not to be exceeded >18 times per year (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Monitoring Data

NO_2 was monitored, using nitrogen dioxide passive diffusion tubes, over a two-month period (05/12/17 – 05/02/18) at 9 locations close to the route of the proposed road development (see Plate 13.2, Locations L1 – L9). The locations were chosen in order to assess roadside and background levels of NO_2. Monitoring with passive diffusion tubes 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 sampling, the tubes were analysed using UV spectrophotometry, by SOCOTEC, Oxfordshire (a UKAS accredited laboratory). Results are in the form of an average concentration for the 4 week period.

The results allow an indicative comparison with the annual average limit value and an assessment of the spatial variation of NO_2 away from existing road sources. The spatial variation is particularly important for NO_2, as a complex relationship exists between NO, NO_2 and O_3 leading to a non-linear variation of NO_2 concentrations with distance.

Studies in the UK have shown that diffusion tube monitoring results generally have a positive or negative bias when compared to continuous analysers. This bias is laboratory specific and is dependent on the specific analysis procedures at each laboratory. A diffusion tube bias of 0.77 was obtained for the SOCOTEC laboratory from the UK Department for Environment Food and Rural Affairs Local Air Quality Management website (UK DEFRA, 2018). This bias was applied to the diffusion tube monitoring results.

Table 13.6 shows the results of the baseline NO_2 diffusion tube monitoring at 9 locations, as shown in Plate 13.2. The bias adjusted average monitoring results for the two month period indicate that concentrations ranged from 1.9 – 12.8 µg/m^3 over the two monitoring periods. The highest concentrations were recorded at L1 along the existing N69. Baseline concentrations on the proposed road development are less than 32% of the annual mean limit for NO_2 of 40 µg/m^3 at all locations. Due to low annual mean concentrations, it is not predicted that the maximum 1-hour limit value will be exceeded at any of the monitoring locations.

Based on the above information and the EPA monitoring data, an estimate of the current background NO_2 concentration, for the region of the proposed road development in 2018 is 12 µg/m^3.

Table 13.6 NO_2 Monitoring Results

Location	Site Type	NO_2 Concentration (µg/m^3)		Bias Adjusted Average (µg/m^3)	Average as % of Limit
		Period 1 (05/12/17 - 05/01/18)	Period 2 (05/01/18 - 05/02/18)		
L1	Roadside	13.1	12.6	12.8	32%
L2	Roadside	5.6	5.8	5.7	14%
L3	Background	3.4	2.9	3.2	8%
L4	Background	3.0	3.0	3.0	8%
L5	Background	4.2	3.9	4.1	10%
L6	Background	7.4	6.1	6.7	17%
L7	Background	4.5	4.4	4.5	11%
L8	Background	6.0	7.5	6.7	17%
L9	Background	1.6	2.2	1.9	5%
Limit Value				*40 µg/m^3 Note 1*	

Note 1 Limit Value from EU Council Directive 2008/50/EC

NO_X

Long term NO_X monitoring has been carried out at two rural Zone D locations, Emo and Kilkitt and two urban stations, Castlebar and Enniscorthy. Annual mean concentrations of NO_X at the urban monitoring sites over the period 2012 – 2017 ranged from 11 - 25 µg/m^3, with concentrations for the rural monitoring sites ranging from 2 – 6 µg/m^3 for the same period. An estimate for the current background NO_X concentration in the region of the proposed road development is 10 µg/m^3.

PM_{10}

EPA Background Data

Long-term PM_{10} monitoring was carried out at the urban Zone D locations of Castlebar, Enniscorthy and Claremorris. In 2017, the average annual mean concentration measured at the two urban sites was 11 µg/m^3 (see Table 13.7). Long-term PM_{10} measurements carried out at the rural Zone D location in Kilkitt gave an average level of 9 µg/m^3 (EPA, 2018). The average results over the last five years at a range of Zone D locations suggests an upper average of no more than 19 µg/m^3 as a background concentration. In addition, there were at most 9 exceedances (in Enniscorthy) of the daily limit value of 50 µg/m^3 in 2015 (35 exceedances are allowed per year).

Table 13.7 Trends In Zone D Air Quality - PM_{10}

Station	Averaging Period Notes 1,2	Year					
		2012	2013	2014	2015	2016	2017
Castlebar	Annual Mean PM_{10} (µg/m^3)	12	15	12	13	12	11
	24-hr Mean > 50 µg/m^3 (days)	1	7	2	2	1	1
Killkitt	Annual Mean PM_{10} (µg/m^3)	9	11	9	9	8	8
	24-hr Mean > 50 µg/m^3 (days)	1	3	2	1	0	0
Claremorris	Annual Mean PM_{10} (µg/m^3)	10	13	10	10	10	11
	24-hr Mean > 50 µg/m^3 (days)	0	3	0	0	0	1
Enniscorthy	Annual Mean PM_{10} (µg/m^3)	-	-	22	18	17	-
	24-hr Mean > 50 µg/m^3 (days)	-	-	6	9	7	-

Note1 Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).
Note 2 24-hour limit value - 50 µg/m^3 as a 90.4th%ile, i.e. not to be exceeded >35 times per year (EU Council Directive 1999/30/EC & S.I. No. 180 of 2011).

Monitoring Data

The PM_{10} & $PM_{2.5}$ monitoring program was carried out by means of a Turnkey Instruments® Osiris Environmental Dust Monitor at one location (see Location L9 in Plate 13.2). The location was positioned to allow an assessment of background levels in the vicinity of the proposed road development. The Osiris instrument is a light scattering device capable of continuous measurement of PM_{10}, and $PM_{2.5}$. The air sample was continuously drawn into the instrument by a pump through a heated inlet at a flow rate of 600 ml/min. The incoming air passed through a laser beam in a photometer. The light scattered by the individual particles of dust was measured by the photometer and this information used to measure the size and concentration of the dust particles.

Monitoring of PM_{10} and $PM_{2.5}$ concentrations was carried out at a rural location along the proposed Foynes to Limerick Road, roughly 3km south of Askeaton. Data for PM_{10} concentration measured over a 63 day period (05/12/17 – 05/02/18) found that average daily PM_{10} concentrations are 27% of the daily limit value and 34% of the annual mean limit value and average $PM_{2.5}$ concentrations are 39% of the annual limit value (Table 13.8). The average background value for PM_{10} at the rural location was 13.7 µg/m^3, this is well below the ambient air quality standard and in line with representative EPA data for rural Zone D locations.

Based on the above information and the EPA background data, an estimate of the current background PM_{10} concentration for the region of the proposed road development in 2018 is 15 µg/m^3.

Table 13.8 Summary results for PM_{10} and $PM_{2.5}$ over the monitoring period (05/12/17 – 05/02/18)

	PM_{10}	**$PM_{2.5}$**
Total No. of Days Sampling	63	63
No. Days >50 µg/m^3	1	n/a
90.4th percentile of 24-hour averages (µg/m^3)	22.8	n/a
Average Daily	13.7	9.7
Maximum Daily	51.0	36.2
Limit *value (µg/m^3)*	*50*	*25*

$PM_{2.5}$

The baseline monitoring programme showed an average $PM_{2.5}$ result of 9.7 µg/m^3 (Table 13.8) with a $PM_{2.5}/PM_{10}$ ratio of 0.7. Monitoring of $PM_{2.5}$ was undertaken at the EPA Zone D monitoring station at Claremorris from 2012 - 2017. The results of this EPA monitoring indicated a $PM_{2.5}/PM_{10}$ ratio ranging from 0.50 - 0.62. Based on this information, a conservative ratio of 0.7 was used to generate a current background $PM_{2.5}$ concentration of 10.5 µg/m^3.

Benzene

In terms of benzene, monitoring data for the Zone D location of Shannon Town is available for the period 2011 – 2012 with an average concentration of 0.4 µg/m^3. More recent data for Zone D locations is not available. Monitoring in the Zone C location of Kilkenny for the period 2014 – 2017 showed an upper average concentration of no more than 0.2 µg/m^3, which is significantly below the 5 µg/m^3 limit value. Based on this monitoring data an estimate of the current background concentration in the region of the proposed road development is 0.2 µg/m^3.

Carbon Monoxide

With regard to CO, annual averages at the Zone D, location of Enniscorthy for the 2014 – 2016 period are low, peaking at 6% of the limit value of 10 mg/m^3 (EPA, 2018). Based on this EPA data, an estimate of the current background CO concentration in the region of the proposed road development is 0.6 mg/m^3.

Background concentrations for Opening Year 2024 and Design Year 2039 have been calculated. These have used current estimated background concentrations and the year on year reduction factors provided by Transport Infrastructure Ireland in the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011) and the UK Department for Environment, Food and Rural Affairs LAQM.TG (16) (UK DEFRA, 2018).

Plate 13.2 Location of Baseline Monitoring Stations

13.4.2 Climate

Anthropogenic emissions of greenhouse gases in Ireland included in the EU 2020 strategy are outlined in the most recent review by the EPA which details emissions up to 2017 (EPA, 2019c). Agriculture was the largest contributor in 2017 at 33.3% of the total, with the transport sector accounting for 19.8% of emissions of CO_2 (EPA, 2019c).

GHG emissions from the transport sector decreased for the first time in four years by 2.4% in 2017. The use of biofuels in transport increased by 35.9% in 2017 with petrol use decreasing by 9.8% and diesel use increasing by 0.4% (EPA, 2019c).

2017 is the fifth year where compliance with the European Union's Effort Sharing Decision "EU 2020 Strategy" (Decision 406/2009/EC) was assessed. Ireland had total GHG emissions of 60.74 Mt CO_2eq in 2017. This is 2.94 Mt CO_2eq higher than Ireland's annual target for emissions in 2017 (EPA, 2019c). Emissions are predicted to continue to exceed the targets in future years, therefore, reduction measures are required in all sectors.

The EPA 2019 GHG Emissions Projections Report for 2018 – 2040 (EPA 2019d) notes that there is a long-term projected decrease in GHG emissions as a result of inclusion of new climate mitigation policies and measures that formed part of the National Development Plan (NDP) which was published in 2018. Implementation of these are classed as a "*With Additional Measures scenario*" for future scenarios. A change from generating electricity using coal and peat to wind power and from diesel and petrol vehicle engines to electric vehicle engines are envisaged under this scenario. While emissions are projected to decrease in these areas, emissions from agriculture are projected to grow steadily due to an increase in animal numbers. Moreover, over the period 2013 - 2020 Ireland is projected to cumulatively exceed its compliance obligations with the EU's Effort Sharing Decision (Decision No 406/2009/EC) 2020 targets by approximately 10 Mt CO_2eq under the *With Existing Measures scenario* and 9 Mt CO_2eq under the *With Additional Measures scenario* (EPA, 2019d).

The Climate Action and Low Carbon Development Act 2015 (Government of Ireland, 2015) was developed to provide for the approval of plans by the government in relation to climate change and to enable achievement of the national transition objective of achieving decarbonisation by 2050. Under this Act the National Mitigation Plan (DCCAE, 2017) and the National Adaptation Framework (DCCAE, 2018) were established. The National Mitigation Plan sets out objectives for achieving a reduction in GHG emissions and transitioning the four key sectors (power generation, built environment, transport and agriculture) to decarbonisation, while the National Adaptation Framework aims to reduce the vulnerability of the country to the negative effects of climate change and to avail of positive impacts. With the implementation of the Climate Action and Low Carbon Development Act 2015 Ireland has implemented a number of strategies to reduce GHG emissions in future years, with a number of other strategies currently being proposed. As a result of this, moving forward, GHG emissions should be lowered in future years, reducing impacts on climate.

13.5 Predicted Impacts for Air Quality and Climate

The proposed road development has an expected opening year of 2024. When considering a development of this nature, the potential air quality and climate impact on the surroundings must be considered for each of two distinct stages:

(a) construction phase, and;

(b) operational phase.

The primary sources of air and climatic emissions in the operational context are deemed long term and will involve the change in traffic flows or congestion in the local areas which are associated with the proposed road development.

During the operational phase of the proposed road development there will be different sources of potential air quality impacts. The following describes the primary sources of potential air quality impacts which have been assessed as part of this EIAR.

13.5.1 Do-Minimum Scenario

The Do-Minimum scenario includes retention of the current sites without the proposed road development. In this scenario, ambient air quality in the area will remain as per the baseline and will change in accordance with trends within the wider area (including influences from potential new developments in the surrounding area, changes in road traffic, etc).

The Do-Minimum scenario for the operational phase of the proposed road development is assessed in Section 13.5.3.1.

13.5.2 Construction Phase

13.5.2.1 Air Quality in Construction Phase

The greatest potential impact on air quality during the construction phase of the proposed road development is from construction dust emissions and the potential for nuisance dust and PM_{10}/$PM_{2.5}$ emissions. Site activities such as excavation, movement of materials, movement of vehicles along unpaved roads, and stockpiling of materials will generate some dust emissions. While construction dust tends to be deposited within 200m of a construction site, the majority of the deposition occurs within the first 50m. As this is a major scale development there is the potential for soiling impacts up to 100m from the source with standard mitigation in place (Table 13.9). There are a number of sensitive receptors, predominantly residential properties along the length of the proposed road development in close proximity to potential works areas. Due to the nature of the proposed development, potential impacts as a result of construction dust emissions will be short-term in nature. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of a dust management plan. In addition, all construction compounds will be located further than 100m from any inhabited dwelling which will reduce the risk for dust impacts. Provided the dust mitigation measures outlined in the plan (see Appendix 13.3) are adhered to, the air quality impacts during the construction phase will not be significant. These measures are summarised in Section 13.6.1.1.

Table 13.9 Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place (TII, 2011)

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

13.5.2.2 Climate in Construction Phase

The construction phase of the proposed road development will result in a number of GHG emissions from various sources. Embodied carbon is carbon dioxide emitted during the manufacture, transport and construction of building materials, together with end of life emissions. As part of the proposed road development, construction stage embodied GHG emissions are categorised under the following headings:

- Land clearance activities;
- Manufacture of materials & transport to site;
- Construction works (including excavations, construction, water usage, personnel travel and project size); and
- Construction waste products (including transport off-site).

Detailed project information including volumes of materials were obtained from Chapter 4 and from Roughan & O'Donovan. Table 13.10 details the embodied carbon emissions associated with each category. The proposed road development is expected to have a construction phase of 3 years approximately and an operational lifespan of 60 years. The predicted embodied emissions can be averaged over the full construction phase and the lifespan of the proposed road development to give the predicted annual emissions to allow for direct comparison with annual emissions and targets. Emissions have been compared against the total national GHG emissions in Ireland for 2017 (60,743,725 tonnes CO_2eq) and against Ireland's EU 2020 target of 37,942,682 tonnes CO_2eq (set out in *EU Commission Decision 2017/1471 of 10th August 2017 and amending decision 2013/162/EU to revise Member States' annual emissions allocations for the period from 2017 to 2020*).

The proposed road development will result in total construction phase emissions of 60,477 tonnes CO_2eq, this amounts to 0.03% of Ireland's national GHG emissions in 2017 or 0.05% of Ireland's 2020 target. Over the predicted 60 year lifespan the annual emissions will reach at most 0.0027% of Ireland's 2020 emissions target. The predicted impact to climate during the construction phase is short-term, negative but overall not significant.

Table 13.10 Construction Stage Greenhouse Gas Emissions

	Construction Phase Embodied Emissions (tonnes CO_2eq)
Land Clearance Activities	162
Manufacture of materials & transport to site	49,717
Construction works	10,540
Construction Waste	59
Total Construction Phase Emissions	**60,477**
Total Annual Emissions Over 3-year Construction Period	20,159
Total Annual Emissions as % of Irelands Total GHG emissions (2017 actual)	0.03%
Total Annual Emissions as % of Irelands 2020 GHG emission target	0.05%

13.5.3 Operational Phase

13.5.3.1 Local Air Quality

There is the potential for a number of emissions to the atmosphere during the operational phase of the development. In particular, the traffic-related air emissions may generate quantities of air pollutants such as NO_2, CO, benzene, PM_{10} and $PM_{2.5}$.

Traffic flow information was obtained from the traffic engineers for this project and has been used to model pollutant levels under various traffic scenarios and under sufficient spatial resolution to assess whether any significant air quality impact on sensitive receptors may occur. The traffic analysis for the proposed road development predicted Do-Minimum and Do-Something traffic figures for the proposed road development for the Opening Year of 2024 and the Design Year of 2039 using a 'High Growth' scenario which has been used for the assessment of Air Quality and Climate on a worst-case approach (refer to Chapter 5 for further details of traffic modelling).

Cumulative effects have been assessed, as required by Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (as amended by Directive 2014/52/EU) (the EIA Directive) and using the methodology of the UK DEFRA (2016; 2018). Firstly, background concentrations have been included in the modelling study. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern. Appropriate background levels were selected based on the available on-site monitoring data and data provided by the EPA (EPA, 2018; 2019) (see Section 13.4.3).

The impact of the proposed road development has been assessed by modelling emissions from the traffic flows predicted for the proposed road development. The impact of CO, benzene, NO_2, PM_{10} and $PM_{2.5}$ for the opening and design years was predicted at the nearest sensitive receptors (residential properties) to the development. This assessment allows the significance of the development, with respect to both relative and absolute impact, to be determined.

The receptors modelled represent a selection of the worst-case locations close to the proposed road. Receptors along the existing road links were also included in the assessment in order to account for the magnitude of change as a result of diverting traffic flows away from some areas. Receptors were chosen due to their close proximity (within 200m) to the road links impacted by the proposed road development.

Twenty-two sensitive residential receptors in the vicinity of the proposed road development have been assessed. Sensitive receptors have been chosen as they have the potential to be adversely impacted by the proposed road development. These receptors are detailed in Table 13.11 and are illustrated in Figure 13.1 of Volume 3 of this EIAR.

Table 13.11 Description of Sensitive Receptors

Receptor	Type	Irish National Grid Coordinates	
		Easting	Northing
A00-018 (R1)	Residential	125793	151086
A01-001 (R2)	Residential	125934	150744
A02-007 (R3)	Residential	126762	149708
A03-007(R4)	Residential	127832	149650

Receptor	Type	Irish National Grid Coordinates	
		Easting	Northing
A06-006 (R5)	Residential	130419	149322
B12-027A (R6)	Residential	135638	150652
B11-008 (R7)	Residential	133181	150340
B11-007A (R8)	Residential	131599	150917
C20-002 (R9)	Residential	131795	148793
C26-005 (R10)	Residential	135740	144968
D50-003 (R11)	Residential	136607	142253
D49-019 (R12)	Residential	135941	142075
D51-003 (R13)	Residential	138154	142657
D51-008A (R14)	Residential	138599	142431
D54-001 (R15)	Residential	140756	143299
D55-002 (R16)	Residential	141765	143659
D56-005 (R17)	Residential	141998	144501
D57-007 (R18)	Residential	142953	145728
D60-012A (R19)	Residential	146204	145870
D61-014 (R20)	Residential	146918	147004
D64-001 (R21)	Residential	149038	147655
D65-001A (R22)	Residential	151208	147960

Air Quality Modelling Assessment

Transport Infrastructure Ireland '*Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes*' (2011) detail a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the proposed road development. Results are compared against the 'Do-Minimum' scenario, which assumes that the proposed development is not in place in future years, in order to determine the degree of impact. The impact significance criteria are detailed in Tables 13.2 to 13.4.

"Do-Minimum" (DM) Scenario

NO_2

The results of the "do-minimum" assessment of annual average NO_2 concentrations in the opening and design years are shown in Appendix 13.2, Table A13.2.1 using the Highways Agency IAN 170/12 and in Table A13.2.2 using the UK Department for Environment, Food and Rural Affairs technique respectively. Concentrations are below the limit value at all locations, with levels up to 41.3% of the limit in the opening year (2024) and up to 43.3% in the design year (2039) using the more conservative IAN 170/12 method, while concentrations are 38.5% and 42.1% of the annual limit value in 2024 and 2039 using the UK Department for Environment, Food & Rural Affairs technique.

The hourly limit value for NO_2 is 200 μg/m^3 is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2

concentrations for the "do-minimum" scenario is not predicted to be exceeded in 2024 or 2039 (see Appendix 13.2 Table A13.2.3).

PM_{10}

The results of the "do-minimum" modelling assessment for PM_{10} in the opening and design years are shown in Appendix 13.2, Table A13.2.4. Concentrations are well within the annual limit value (40 μg/m^3) at all worst-case receptors. Annual average PM_{10} concentrations are predicted to be up to 39.2% of the limit value in 2024 and up to 39.6% in 2039. In addition, the 24-hour PM_{10} concentration of 50 μg/m^3 is not exceeded at any of the receptors modelled (35 exceedances are allowed per year).

$PM_{2.5}$

The results of the "do-minimum" modelling assessment for $PM_{2.5}$ in the opening and design years are shown in Appendix 13.2, Table A13.2.5. The predicted concentrations at all worst-case receptors are well below the $PM_{2.5}$ limit value of 25 μg/m^3. The annual average $PM_{2.5}$ concentration is predicted to be up to 43.9% of the limit value in 2024 and 44.4% in 2039.

CO and Benzene

The results of the modelled impact for CO and benzene in the opening and design years are shown in Appendix 13.2, Tables A13.2.6 and A13.2.7. The results for the "do-minimum" assessment are below the ambient standards at all locations. Levels of CO are predicted to be up to 32.6% of the limit value (10 μg/m^3) in 2024; with levels of benzene predicted to reach up to 5.3% of the limit value (5 μg/m^3). Future trends indicate similarly low levels of CO and benzene. Levels of both pollutants are below their respective limit values, with CO reaching up to 32.8% of the limit and benzene reaching up to 5.5% in 2039.

"Do-Something" (DS) Scenario

NO_2

The results of the assessment of the impact of the proposed road development on NO_2 in the opening and design years are shown Appendix 13.2, Table A13.2.1 for the Highways Agency IAN 170/12 and Table A13.2.2 using the UK Department for Environment, Food and Rural Affairs technique respectively. The annual average concentration is within the limit value at all worst-case receptors using both techniques. Levels of NO_2 are up to 41.2% and up to 41.1% of the annual limit value in 2024 and 2039 using the more conservative IAN technique, while concentrations are 38.7% and 40.3% of the annual limit value in 2024 and 2039 using the UK Department for Environment, Food and Rural Affairs technique. The hourly limit value for NO_2 is 200 μg/m^3 and is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded in 2024 or 2039 using either technique (Appendix 13.2, Table A13.2.3).

The impact of the proposed road development on annual mean NO_2 levels can be assessed relative to "Do-Minimum (DM)" levels in 2024 and 2039. Relative to baseline levels, some medium increases in pollutant levels are predicted as a result of the proposed road development. With regard to impacts at individual receptors, the greatest impact on NO_2 concentrations will be an increase of 9% of the annual limit value at Receptor A01-001. Thus, using the assessment criteria outlined in Tables 13.2 and 13.3, the impact of the proposed development in terms of NO_2 is negative but negligible. However, there are a number of receptors that will receive a beneficial impact with the development of the proposed road; there will be a decrease of 8.6% of the limit value at Receptor D60-012A in Adare once the proposed road development is in place and Receptor B11-007A on the N69 west of Askeaton will see a decrease of 14.8% of the annual limit value. According to the criteria in Tables 13.2 – 13.3 this results in a slight beneficial rating for Receptor B11-007 and a negligible beneficial impact at receptor D60-012A (see Table 13.11 for the location of these receptors).

Therefore, the overall impact of NO_2 concentrations as a result of the proposed road is predicted to be long-term and imperceptible.

PM_{10}

The results of the modelled impact of the proposed road development for PM_{10} in the opening and design years are shown in Appendix 13.2, Table A13.2.4. Predicted annual average concentrations at the worst-case receptors in the region of the proposed development are up to 40.5% of the limit value (40 $\mu g/m^3$) in 2024. Future trends with the proposed road development in place indicate similarly low levels of PM_{10}. Annual average PM_{10} concentrations are predicted to be up to 40.9% of the limit in 2039. Furthermore, it is not predicted that the worst-case receptors will have any exceedances of the 50 $\mu g/m^3$ 24-hour mean value in 2024 or 2039.

The impact of the proposed road development can be assessed relative to "Do-Minimum" levels in 2024 and 2039 (see Appendix 13.2, Table A13.2.4). Relative to baseline levels, some small increases in PM_{10} levels at the worst-case receptors are predicted as a result of the proposed road. The greatest increase in PM_{10} concentrations in the vicinity of the proposed road development in either 2024 or 2039 will be an increase of 2.4% of the annual limit value at Receptor D56-005 in 2039, which results in a negligible rating according to Tables 13.2 to 13.4. However, there are some receptors for which the proposed road development will result in a beneficial impact. There will be a decrease of 1.7% of the limit value at Receptor D60-012A in Adare and Receptor B11-007A on the N69 west of Askeaton will see a decrease of 2.4% of the annual limit value in 2039, this equates to a negligible rating when assessed against the significance criteria in Tables 13.2 to 13.4.

Thus, the magnitude of the changes in air quality are negligible at all receptors based on the criteria outlined in Tables 13.2 to 13.4. Therefore, the overall impact of PM_{10} concentrations as a result of the proposed road development is long-term and imperceptible.

$PM_{2.5}$

The results of the modelled impact of the proposed road development for $PM_{2.5}$ in the opening and design years are shown in Appendix 13.2, Table A13.2.5. Predicted annual average concentrations in the region of the proposed road are predicted to be up to 45.4% of the limit value in 2024 at the worst-case receptor. Future trends with the development in place indicate similarly low levels of $PM_{2.5}$. Annual average $PM_{2.5}$ concentrations are predicted to reach 45.9% of the limit in 2039, at D64-001.

The impact of the proposed road development can be assessed relative to "Do-Minimum" levels in 2024 and 2039. Relative to baseline levels, small increases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the proposed road development. The greatest increase in $PM_{2.5}$ concentrations in the region of the proposed road in either 2024 or 2039 will be an increase of 2.7% of the annual limit value at Receptor D56-005 in 2039, which results in a negligible rating according to Tables 13.2 and 13.3. However, there are some receptors for which the proposed road will result in a beneficial impact. There will be a decrease of 2.1% of the limit value at Receptor D51-008A, and a decrease of 2.7% at Receptor B11-007A in 2039, this equates to a negligible rating when assessed against the significance criteria in Tables 13.2 and 13.3.

Therefore, using the assessment criteria outlined in Tables 13.2 and 13.3, the impact of the proposed road development with regard to $PM_{2.5}$ is negligible at all of the receptors assessed. Overall, the impact of increased $PM_{2.5}$ concentrations as a result of the proposed road development is long-term and imperceptible.

CO and Benzene

The results of the modelled impact of the CO and benzene in the opening and design years are shown in Appendix 13.2, Table A13.2.6 and Table A13.2.7. Predicted pollutant concentrations with the proposed road development in place are below the ambient standards at all locations. Levels of CO are up to 31.4% of the limit value in 2024; with levels of benzene reaching 4.6% of the limit value. Future trends indicate similarly low levels of CO and benzene. Levels of both pollutants are below their respective limit values, with CO reaching up to 31.5% of the limit and benzene reaching up to 4.8% in 2039.

The impact of the proposed road development can be assessed relative to "Do-Minimum" levels in 2024 and 2039. Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the proposed road development. The greatest increase in CO and benzene concentrations in either 2024 or 2039 will be an increase of 0.88% of the limit value for CO and an increase of 0.4% of the limit value for benzene at Receptor D56-005. Any beneficial impacts as a result of the proposed road development with regard to CO and benzene are also considered imperceptible.

Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Tables 13.2 and 13.3 and applying these criteria to CO and benzene, the impact of the proposed road development in terms of CO and benzene is negligible and long-term.

Summary of Modelling Assessment

Levels of traffic-derived air pollutants for the proposed road development will not exceed the ambient air quality standards either with or without the proposed road development in place. Overall, of the 22 receptors modelled as part of the air quality assessment, 11 receptors will receive a beneficial impact in air quality due to a reduction in NO_2 concentrations. 12 receptors will experience a beneficial impact due to a reduction in concentrations of PM_{10}, $PM_{2.5}$, CO and benzene. Therefore, the proposed road development will have a beneficial impact for the slight majority of receptors modelled. However, this impact will be imperceptible. The receptors experiencing beneficial impacts are those along the existing N69 and N21. There are a total of 153 residential properties on the existing N69 between Askeaton and the M7 west of Limerick and 52 properties between Foynes and Askeaton. There are 72 residential properties along the existing N21 between Rathkeale and Adare. Not all residential properties have been included in the modelling assessment as per the UK DMRB (UK Highways Agency, 2007) and TII (2011) guidance. However, there is the potential for these properties to experience beneficial air quality impacts due to a reduction in the traffic flows along these routes as a result of the proposed road development.

Using the assessment criteria outlined in Tables 13.2 to 13.4, the impact of the development in terms of NO_2, PM_{10}, $PM_{2.5}$, CO and benzene is considered localised, imperceptible and long-term.

It should be noted that emissions predicted for future years as part of this assessment do not take account for the increased uptake in hybrid and electric vehicles in recent years and the predicted continued trend for future years. As a result, the pollutant concentrations predicted for future years are a worst-case scenario and in reality, emissions are likely to be reduced due to increased use of electric vehicles. However, the predicted worst-case impact is imperceptible in terms of air quality.

13.5.3.2 Air Quality Impact to Sensitive Ecosystems

The impact of NO_X (i.e. NO and NO_2) emissions resulting from the proposed road development at the Lower River Shannon SAC and River Shannon & River Fergus Estuaries SPA was assessed. Results for the Lower River Shannon SAC are presented in Table 13.12 and results for the River Shannon & River Fergus Estuaries SPA are presented in Table 13.13.

As part of the assessment on the Lower River Shannon SAC the road contribution from the existing N21 crossing in Adare was also included in the assessment. Ambient NO_X concentrations predicted for the opening (2024) and design (2039) years along a transect of 0 m up to 200 m within the Lower River Shannon SAC are given in Table 13.12. The road contribution to dry deposition along the transect is also given and was calculated using the methodology of TII (2011). Modelling was undertaken at the posted speed limit on the road links, 120 km/h for the proposed bridge crossing and 50 km/hr for the existing N21 crossing.

The predicted annual average NO_X level in the Lower River Shannon SAC near Islandea/Ardshanbally, Adare is above the limit value of 30 μg/m^3 for the "Do-Something" scenario in 2024 and 2039 with NO_X concentrations reaching 116% of this limit in 2024 and 132% in 2039 including background levels.

The impact of the proposed road development can be assessed relative to "Do-Minimum" levels in 2024 and 2039 (see Table 13.12). The impact of the proposed road leads to an increase in NO_X concentrations of at most 18.3 μg/m^3 in 2039 within the Lower River Shannon SAC. As the proposed road development will cause an increase of greater than 2 μg/m^3 NO_X within the SAC up to 200m from the proposed road centreline and the predicted total concentrations (including background) are above the limit value for the protection of vegetation of 30 μg/m^3, as per the guidance instructions when an exceedance occurs, the project ecologist has been consulted.

The ecologist for the proposed road development has noted that the exceedance is marginal in the view of the nature of the habitats and is unlikely to cause a noticeable effect. In addition, the predicted concentrations are in exceedance of the limit value up to 20m within the SAC, however after 20m, concentrations decrease to below the limit value of 30 μg/m^3. Concentrations have been modelled at the maximum speed limit on the proposed road of 120 km/hr, a speed at which engines are not working as efficiently and therefore have higher pollutant emissions. In reality, not all vehicles will travel at this maximum speed and with moderately reduced speeds, NO_X concentrations will be reduced. It must also be noted that the DMRB screening model does not accurately account for predicted concentrations to 2039 as it does not take into account recent trends in hybrid and electric vehicle usage and revised fleet emissions past the Euro V standards (see Section 13.8 for further details). Therefore, the concentrations stated within this report are conservative in nature and take a worst-case approach.

The road contribution to the NO_2 dry deposition rate along the 200m transect within the SAC at Islandea/Ardshanbally, Adare is also detailed in Table 13.12. The maximum increase in the NO_2 dry deposition rate is 0.74 Kg(N)/ha/yr in 2024 and

0.89 Kg(N)/ha/yr in 2039. This reaches a maximum of 18% of the critical load for inland and surface water habitats of 5 - 10 Kg(N)/ha/yr (TII, 2011).

Therefore, the overall impact of the proposed road development on the Lower River Shannon SAC is negative, long-term and not significant.

The assessment of NOx concentrations within the River Shannon & River Fergus Estuaries SPA is shown in Table 13.13. Modelling was undertaken at the posted speed limit on the road links, 100 km/h for the proposed section of the new N69 and 80 km/h on the existing section of the N69.

The predicted annual average NO_X level in the River Shannon & River Fergus Estuaries SPA at Robertstown is below the limit value of 30 μg/m^3 for the "Do-Something" scenario in 2024 and 2039 with NO_X concentrations reaching 34% of this limit in 2024 and 36% in 2039 including background levels. The proposed road development will cause a 11.52 μg/m^3 decrease in concentrations in 2024 and a 15.68 μg/m^3 decrease in concentrations in 2039 within the SPA when assessed against the Do Minimum scenario.

The road contribution to the NO_2 dry deposition rate along the 200m transect within the SPA at Robertstown is also detailed in Table 13.13. The proposed road development will result in a decrease in deposition rates at this location. The maximum decrease in the NO_2 dry deposition rate is 0.61 Kg(N)/ha/yr in 2024 and 0.80 Kg(N)/ha/yr in 2039. This reaches a maximum of 16% of the critical load for inland and surface water habitats of 5 - 10 Kg(N)/ha/yr (TII, 2011).

Overall, the impact of the proposed road development on the River Shannon & River Fergus Estuaries SPA is long-term, positive and not significant.

13.5.3.3 Impact on Regional Air Quality

The regional impact of the proposed road development on emissions of NO_X and VOCs has been assessed using the procedures of Transport Infrastructure Ireland (2011) and the UK Department for Environment, Food and Rural Affairs (2016). The results (see Table 13.14) show that the likely impact of the proposed road development on Ireland's obligations under the Targets set out by Directive EU 2016/2284 "*On the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC*" are imperceptible and long-term. For the assessment year of 2024, the predicted impact of the changes in AADT is to increase NO_X levels by 0.073% of the NO_X emissions ceiling and increase VOC levels by 0.013% of the VOC emissions ceiling to be complied with from 2020. For the assessment year of 2039, the predicted impact of the changes in AADT is to increase NO_X levels by 0.163% of the NO_X emissions ceiling and increase VOC levels by 0.019% of the VOC emissions ceiling to be complied with from 2030.

13.5.3.4 Climate

The impact of the operational phase of the proposed road development on emissions of CO_2 has also assessed using the Design Manual for Roads and Bridges screening model (see Table 13.14). The results show that the impact of the proposed development in 2024 will be to increase CO_2 emissions by 0.058% of Ireland's EU 2020 Target. In the design year of 2039, the proposed road development will increase CO_2 emissions by 0.078% of the EU 2020 Target. Thus, the impact of the proposed road development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2020 Target (EU, 2017).

Future climate change related impacts such as flooding have been accounted for when designing the proposed road development.

It should be noted that pollutant concentrations predicted for future years as part of this assessment do not take account for the increased uptake in hybrid and electric vehicles in recent years. As a result, the pollutant concentrations predicted for future years are a worst-case scenario and in reality, emissions are likely to be reduced due to increased use of electric vehicles and implementation of new government policies.

In addition, the construction of a Type 2 dual carriageway will allow for effective use of the road network. Allowing traffic to move at optimal speed and reductions in congestion will further reduce emissions and reduce the impact to climate. As part of the Route Selection stage of the proposed road development, the proposed route had one of the least negative impacts on climate and this was a key factor in the choice of this route going forward, other route options would have resulted in a greater negative impact to climate.

As part of the proposed road development planting is proposed in the form of trees and shrubs in tree lines and hedgerows along the length of the route for both screening and mitigation purposes. In total 181 ha are to be planted. Forests are an important part of the global carbon cycle and effective management at a regional scale can help to reduce GHG concentrations (IPCC, 2006). Based on a potential minimum CO_2 uptake rate of 10.85 tonnes CO_2/ha/year, the GHG emissions associated with a maximum area of planting of 181 ha has been calculated and amounts to an upper limit of 1,964 tonnes of CO_2 per year. Over the 60 year lifespan of the development this would provide for sequestration of 117,831 tonnes of CO_2. This is a beneficial impact to climate which is long-term and positive.

Therefore, the likely overall magnitude of the change on climate in the operational stage is imperceptible and long-term.

13.5.3.5 Impact from the HGV Service Area

The proposed HGV Service Area will be located on a greenfield site off the Shannon - Foynes Port access road. There is the potential for local air quality impacts at nearby sensitive receptors as a result of HGVs accessing the site. The proposed HGV service area will not cause an increase in the number of vehicles on the Shannon - Foynes Port access road. The proposed HGV service area does not meet criteria stipulated in the DMRB guidance (UK Highways Agency, 2007) and detailed in Section 13.3.2.1, which would require a detailed assessment. In addition, the guidance states that only sensitive receptors within 200m of road links need to be considered. There are no sensitive receptors within 200m of the proposed HGV service area, the closest high sensitivity (residential) receptors to the site are 220m from the site on Dernish Avenue.

Nevertheless, an assessment using the UK DMRB screening model was undertaken at the closest sensitive receptors to the site (A00-011 and A00-021) to give an indication of potential air quality impacts. For the purposes of the assessment a conservative approach was taken, and it was assumed that 100% of the HGVs accessing the port accessed the service area. This is a worst-case assumption and will provide for potential worst-case impacts. The results of the assessment show that there is an imperceptible increase in pollutant concentrations (NO_2, PM_{10}, $PM_{2.5}$, CO and benzene) as a result of the HGV service area.

Concentrations of NO_2 are at most 27% of the annual limit value of 40 µg/m^3 in 2024 and 2039. The HGV service area will cause an increase of at most 0.4% of the limit value at receptor A00-021. Concentrations of PM_{10} are 37% of the annual mean PM_{10}

limit value of 40 µg/m^3, the HGV service area will increase PM_{10} concentrations by at most 0.07%. Concentrations of $PM_{2.5}$ are similarly low, reaching at most 41% of the annual limit value of 25 µg/m^3 in either 2024 or 2039. The HGV service area will increase $PM_{2.5}$ concentrations by at most 0.08%. Concentrations of CO and benzene are also significantly below their respective limit values. Concentrations of CO are 30% of the limit value of 10 mg/m^3 and concentrations of benzene are 4% of the limit value of 5 µg/m^3.

Therefore, the impact of the proposed HGV service area on air quality can be described as long-term and imperceptible.

The traffic accessing the port and the proposed HGV service area has been included within the climate assessment detailed in Section 13.5.3.4 which resulted in an imperceptible impact on climate. It can therefore be concluded that the HGV service area in isolation would also have an imperceptible impact on climate.

Table 13.12 Assessment of NO_X Concentrations and NO_2 Dry Deposition Impact in Lower River Shannon SAC

Distance to Road Centreline (m)	NO_X Conc. (µg/m³) Opening Year (2024)			NO_X Conc. (µg/m³) Design Year (2039)			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do-Minimum	Do-Something Note 1	Increase in NO_X Conc.	Do-Minimum	Do-Something Note 1	Increase in NO_X Conc.	2024	2039
0	20.2	**34.7**	14.5	21.2	**39.5**	18.3	0.74	0.89
10	17.7	**30.7**	13.0	18.5	**34.8**	16.3	0.67	0.80
20	15.6	25.4	9.8	16.2	28.4	12.3	0.51	0.62
30	14.0	21.6	7.6	14.5	23.9	9.4	0.40	0.48
40	12.8	18.7	5.9	13.2	20.6	7.4	0.31	0.38
50	12.0	16.6	4.6	12.2	18.0	5.8	0.25	0.30
60	11.3	14.9	3.6	11.5	16.1	4.6	0.20	0.24
70	10.7	13.6	2.9	10.9	14.5	3.6	0.16	0.19
80	10.3	12.5	2.3	10.4	13.2	2.8	0.12	0.15
90	9.9	11.7	1.8	10.0	12.3	2.2	0.10	0.12
100	9.7	11.0	1.4	9.7	11.5	1.7	0.08	0.09
110	9.4	10.5	1.1	9.5	10.9	1.3	0.06	0.07
120	9.3	10.1	0.8	9.3	10.4	1.1	0.05	0.06
130	9.2	9.8	0.7	9.2	10.0	0.8	0.04	0.04
140	9.1	9.6	0.5	9.1	9.8	0.7	0.03	0.04
150	9.0	9.5	0.5	9.1	9.6	0.6	0.03	0.03
160	9.0	9.4	0.4	9.0	9.6	0.5	0.02	0.03
170	9.0	9.4	0.4	9.0	9.5	0.5	0.02	0.03
180	8.9	9.3	0.3	8.9	9.4	0.4	0.02	0.02

Distance to Road Centreline (m)	NO_X Conc. (µg/m^3) Opening Year (2024)			NO_X Conc. (µg/m^3) Design Year (2039)			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do-Minimum	Do-Something Note 1	Increase in NO_X Conc.	Do-Minimum	Do-Something Note 1	Increase in NO_X Conc.	2024	2039
190	8.9	9.1	0.3	8.9	9.2	0.3	0.01	0.02
200	8.7	9.0	0.3	8.7	9.1	0.4	0.02	0.02

Note 1 Exceedances of the 30 µg/m^3 annual limit value are highlighted in **bold**

Table 13.13 Assessment of NO_X Concentrations and NO_2 Dry Deposition Impact in River Shannon & River Fergus Estuaries SPA

Distance to Road (m)	NO_X Conc. (µg/m^3) Opening Year (2024)			NO_X Conc. (µg/m^3) Design Year (2039)			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do-Minimum	Do Something	Change in NO_X Conc. Note 1	Do-Minimum	Do Something	Change in NO_X Conc. Note 1	2024	2039
2	21.9	10.3	-11.5	26.5	10.8	-15.7	-0.61	-0.80
10	20.6	10.2	-10.4	24.7	10.6	-14.1	-0.55	-0.73
20	17.7	9.9	-7.8	20.8	10.2	-10.6	-0.42	-0.55
30	15.6	9.6	-6.0	18.0	9.9	-8.1	-0.32	-0.43
40	14.1	9.4	-4.6	15.9	9.6	-6.3	-0.25	-0.33
50	12.9	9.3	-3.7	14.4	9.4	-5.0	-0.20	-0.26
60	12.0	9.0	-3.0	13.2	9.1	-4.1	-0.16	-0.22
70	11.3	8.9	-2.4	12.2	9.0	-3.2	-0.13	-0.17
80	10.8	8.9	-1.9	11.5	8.9	-2.5	-0.10	-0.14
90	10.3	8.8	-1.5	10.9	8.9	-2.0	-0.08	-0.11
100	10.0	8.8	-1.1	10.4	8.8	-1.6	-0.06	-0.08
110	9.7	8.8	-0.9	10.0	8.8	-1.2	-0.05	-0.07
120	9.5	8.8	-0.7	9.7	8.8	-0.9	-0.04	-0.05
130	9.3	8.7	-0.5	9.5	8.8	-0.7	-0.03	-0.04
140	9.2	8.7	-0.4	9.4	8.7	-0.6	-0.03	-0.03
150	9.1	8.7	-0.4	9.3	8.7	-0.5	-0.02	-0.03
160	9.1	8.7	-0.3	9.2	8.7	-0.5	-0.02	-0.03
170	9.0	8.7	-0.3	9.2	8.7	-0.4	-0.02	-0.02
180	9.0	8.7	-0.3	9.1	8.7	-0.4	-0.01	-0.02
190	8.9	8.7	-0.2	9.0	8.7	-0.3	-0.01	-0.02
200	8.9	8.7	-0.2	8.9	8.7	-0.2	-0.01	-0.01

Note 1 Negative values denote decrease in concentrations

Table 13.14 Regional Air Quality Assessment & Operational Phase Climate Assessment

Year	Scenario	VOC	NO_X	CO_2
		(kg/annum)	**(kg/annum)**	**(tonnes/annum)**
2024	Do-Minimum	22,557	143,250	67,594
	Do-Something	29,689	192,125	89,715
2039	Do-Minimum	30,285	194,606	89,918
	Do-Something	39,932	260,957	119,638
Increment in 2024		7,132 kg	48,875 kg	22,121 tonnes
Increment in 2039		9,647 kg	66,351 kg	29,720 tonnes
Emission Ceiling (kilo Tonnes) 2020 Notes 1,2		**56.9**	**66.9**	**37,943**
Emission Ceiling (kilo Tonnes) 2030 Notes 1,2		**51.6**	**40.7**	**37,943**
Impact in 2024 (as % of 2020 Emission Ceiling)		0.013%	0.073%	0.058%
Impact in 2039 (as % of 2030 Emission Ceiling)		0.019%	0.163%	0.078%

Note 1 Targets under Directive EU 2016/2284 "*On the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC*"

Note 2 Target under *European Commission Decision 2017/1471 of 10th August 2017 and amending decision 2013/162/EU to revise Member States' annual* emissions allocations *for the period from 2017 to 2020*

13.5.4 Cumulative Impacts

Should the construction stage of the proposed road overlap with any other proposed developments within 350m based on the IAQM guidance (2014), including further development at Shannon - Foynes Port, there is the potential for cumulative dust impacts. Specifically, the Shannon – Foynes Port Company have applied for permission which involves infilling a large area to +4.44m OD. The import of fill materials and the raising of the ground level has the potential to cause dust related impacts to nearby sensitive receptors. If the construction phase coincides with that of the proposed road development, there is the potential for cumulative dust emissions. However, the dust mitigation measures outlined in the mitigation section of this chapter and detailed in Appendix 13.3 will mitigate any potential dust impacts at the nearby sensitive receptors. Provided that similar mitigation measures are in place at any other proposed site within 350m of the proposed road development then the impact of construction dust emissions is deemed short-term and imperceptible.

Cumulative impacts associated with the operational phase of the proposed road would be as a result of increased traffic emissions associated with other permitted and proposed developments in the area. The cumulative impact of traffic emissions on air quality and climate in the operational stage has been assessed in Section 13.5.3 - where information for permitted and proposed developments was available, including the development at Shannon - Foynes Port, impacts were found to be long-term and imperceptible in terms of air quality and climate.

13.6 Mitigation Measures

In order to sufficiently ameliorate the likely air quality impact, a schedule of air control measures has been formulated for both construction and operational phases associated with the proposed road development.

13.6.1 Construction Phase

13.6.1.1 Air Quality

The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. The main contractor will be responsible for the coordination, implementation and ongoing monitoring of the dust management plan. The key aspects of controlling dust include the following:

- The specification and circulation of a Dust Management Plan for the site and the identification of persons responsible for managing dust control and any potential issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust management plan can be monitored and assessed; and,
- The specification of effective measures to deal with any complaints received.

Full details of the Dust Management Plan can be found in Appendix 13.3.

At all times, the procedures within the plan will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust could be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

13.6.1.2 Climate

Construction traffic and embodied energy of construction materials are expected to be the dominant source of greenhouse gas emissions as a result of the construction phase of the proposed road development. Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions. However, due to short-term and temporary nature of these works, the impact on climate will not be significant.

Nevertheless, some site-specific mitigation measures can be implemented during the construction phase of the proposed road development to ensure emissions are reduced further. In particular, the prevention of on-site or delivery vehicles from leaving engines idling, even over short periods, will reduce emissions. Minimising waste of materials due to poor timing or over ordering on site will help to minimise the embodied carbon footprint of the site. Materials will be reused as much as possible within the extent of the sites, in addition, materials will be sourced locally where possible to reduce the embodied emissions associated with transport. A Construction Stage Traffic Management Plan will be implemented throughout the construction stage to avoid congestion and thus reduce emissions (see Chapter 4 for more details). All plant and machinery will be maintained and serviced regularly.

13.6.2 Operational Phase

13.6.2.1 Air Quality

Mitigation measures in relation to traffic-derived pollutants have focused generally on improvements in both engine technology and fuel quality. EU legislation, based on the EU sponsored Auto-Oil programmes, has imposed stringent emission standards for key pollutants (REGULATION (EC) No 715/2007) for passenger cars which was complied with in 2009 (Euro V) and 2014 (Euro VI). Current emission standards which took effect in 2017 are Euro 6c and Euro $6d_{temp}$.

As outlined in the TII guidance (2011), the guidance states that "for the purpose of the EIS, it should be assumed that pollutant concentrations will decline in future years, as a result of various initiatives to reduce vehicle emissions both in Europe and in Ireland" (Page 52). A range of legislation in Europe over the period 1992 – 2013 has significantly reduced the allowable steady cycle emissions of both NO_X and PM from road vehicles with NO_X emissions from HDV (Heavy Diesel Vehicles) reduced by a factor of 20 and PM by a factor of 36 over this period (Euro I to Euro VI). In relation to LDV (Light Diesel Vehicles) the reduction of NO_X and PM from road vehicles has also been significant with NO_X emissions from LDV reducing by a factor of 12 and PM by a factor of 40 over this period (Euro I to Euro VI). Although actual on-road emission reductions will be less dramatic, significant reductions in vehicle-related NO_X and PM emissions are to be expected over the next 5-10 years as the fleet replacement occurs.

The Climate Action Plan 2019 (Government of Ireland, 2019) has outlined a number of actions to reduce the use of petrol/diesel vehicles and promote the uptake of electric vehicles in order to achieve the target of 500,000 electric vehicles on the road by 2030. The measures proposed include changes to VRT and motor tax to allow for this to be calculated based on CO_2eq, therefore higher emitting vehicles will pay increased tax rates, thus incentivising the purchase of lower emitting vehicles. VRT relief and Benefit in Kind exemptions as well as a vehicle scrappage scheme are among other measures proposed. In addition, as part of Budget 2020, it is planned to introduce a NO_X emissions levy to all passenger cars from January 2020. The levy will be charged on a NO_X mg per kilometre basis. Overall, these measures will reduce pollutant levels in future years thus improving air quality.

Emissions of pollutants from road traffic can be controlled most effectively by either diverting traffic away from heavily congested areas or ensuring free flowing traffic through good traffic management plans and the use of automatic traffic control systems (UK DEFRA, 2016, 2018). The proposed road development will facilitate this change by bypassing heavily congested areas such as Adare village and the new road design will allow for vehicles to travel at optimal speeds.

13.6.2.2 Climate

Improvements in air quality and climate related emissions are likely over the next few years as a result of the on-going comprehensive vehicle inspection and maintenance program, fiscal measures to encourage the use of alternatively fuelled vehicles and the introduction of cleaner fuels.

CO_2 emissions for the average new car fleet were reduced to 120 g/km by 2012 through EU legislation on improvements in vehicle motor technology and by an increased use of biofuels. This measure has reduced CO_2 emissions from new cars by an average of 25% in the period from 1995 to 2008/2009 whilst 15% of the necessary effort towards the overall climate change target of the EU has been met by this measure alone (DEHLG, 2007).

Additional measures included in the National Climate Change Strategy (DEHLG, 2000, 2006, 2007) include: (1) VRT and Motor Tax rebalancing to favour the purchase of more fuel-efficient vehicles with lower CO_2 emissions; (2) continuing the Mineral Oils Tax Relief II Scheme and introduction of a biofuels obligation scheme; (3) implementation of a national efficient driving awareness campaign, to promote smooth and safe driving at lower engine revolutions; and (4) enhancing the existing mandatory vehicle labelling system to provide more information on CO_2 emission levels and on fuel economy.

Ireland has developed strategies for implementing the Paris Agreement which aims to limit global temperature rise to below 2^oC above pre-industrial levels. The National Mitigation Plan (DCCAE, 2017) sets out objectives for achieving a reduction in GHG emissions and transitioning the four key sectors (power generation, built environment, transport and agriculture) to decarbonisation. Policy measures are included to manage GHG emissions in order to achieve the national transition objective. The goal is to achieve decarbonisation by 2050, with additional measures added to the plan as time progresses in line with emerging and developing technologies. In relation to decarbonising the transport sector, Ireland has set a target that all new cars and vans sold in Ireland will be zero carbon emissions or zero emission capable by 2030, targets are also included for public transport buses and trains. The Climate Action Plan 2019 (Government of Ireland, 2019) states that the uptake in electric vehicles needs to be increased to achieve the 2030 target. To facilitate this the electric vehicle charging network is to be developed further as well as other incentives to encourage the purchase of electric vehicles such as car scrappage schemes.

The Renewable Energy Directive specifies a legally binding 10% renewable energy in transport target to be achieved by all Member States by 2020, with the main driver of achieving this in Ireland being the Biofuels Obligations Scheme (DCCAE, 2017). The Climate Action Plan 2019 (Government of Ireland, 2019) intends to raise the blend of biofuels in road transport to 10% in petrol and 12% in diesel. The Limerick City and County Council Draft Climate Adaptation Strategy 2019 – 2024 (2019) also outlines measures to deal with and reduce the effects of climate change.

In addition, the proposed road development has been designed to reduce congestion in local areas and facilitate improved driving conditions and optimal driving speeds.

The UK Highways Agency guidance document (UK Highways Agency, 2007) states that emissions tend to be higher under stop-start driving conditions, i.e. in congestion. Therefore, by reducing congestion through implementation of the proposed road development, emissions will be reduced which is beneficial towards climate.

With the implementation of the aforementioned measures carbon emissions should be greatly reduced in future years thus benefitting climate.

13.6.3 Monitoring

Monitoring of construction dust deposition at nearby sensitive receptors (residential dwellings) during the construction phase of the proposed road development is recommended to ensure mitigation measures are working satisfactorily. This can be carried out using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2m above ground level. The TA Luft limit value is 350 mg/(m^2.day) during the monitoring period between 28 - 32 days.

There is no monitoring recommended for the operational phase of the development as impacts to air quality and climate are predicted to be insignificant.

13.7 Residual Impacts

13.7.1 Construction Phase

13.7.1.1 Air Quality

Following the implementation of the dust minimisation measures detailed in the mitigation section of this Chapter and Appendix 13.3, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

13.7.1.2 Climate

Due to the size and nature of the construction activities with appropriate mitigation measures, CO_2 and N_2O emissions during construction will have an imperceptible impact on climate.

13.7.2 Operational Phase

The results of the air dispersion modelling study indicate that the residual impacts of the proposed road development on air quality and climate is predicted to be imperceptible with respect to the operational phase for the long and short term.

13.8 Difficulties Encountered

The UK DMRB screening model (UK Highways Agency, 2007) is the recommended tool by TII (2011) for assessing potential air quality impacts from road schemes. The DMRB model was last updated in 2007 and accounts for modelled years up to 2025. The model does account for improvements in the national fleet in future years but does not account for this to 2039. Vehicle emission standards up to Euro V are included but since 2017, Euro 6d standards are applicable for the new fleet. As a result of this predictions to 2039 are not as accurately reflected within the DMRB model and are conservative in nature. Therefore, it is possible that with the implementation of new climate change related legislation developed in recent years and the increased uptake in hybrid and electric vehicle use that pollutant concentrations in 2039 could be lower than those detailed in this report. However, a worst-case approach has been adopted for this assessment in order to be conservative.

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