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30 YEARS

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

Environmental Impact Assessment Report
Development at Waterford Airport

Volume 2 – Chapter 10 – Air Quality and Climate

Prepared for: Waterford City & County Council in Partnership with Waterford Regional Airport PLC

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10. AIR QUALITY AND CLIMATE

10.1 Introduction

AWN Consulting was instructed by Fehily Timoney, on behalf of Waterford City & County Council, in partnership with Waterford Regional Airport PLC, to conduct an air modelling study to assess the impact to ambient air quality and climate from proposed upgrade works at Waterford Airport to facilitate medium range jet aircraft. Currently the Airport can facilitate only turbo-prop passenger aircraft and private jets.

The contribution of emissions from both Do-Nothing aviation traffic and proposed increased aviation traffic from the airport to ambient air quality was assessed and the location of the worst-case ground level concentrations were identified. In addition, the impact on air quality due to increased road traffic associated with the airport extension will also be assessed.

This report describes the outcome of this study. The study consists of the following components:

- Review of emissions data and other relevant information needed for the modelling study;
- Summary of background NO_2, SO_2 and CO concentrations;
- Dispersion modelling of released substances under the Do-Something scenario:
- Presentation of predicted ground level concentrations of released substances;
- Review of the impact of the extension with respect to climate and ecological impacts;
- Evaluation of the significance of predicted concentrations, including consideration of whether these ground level concentrations are likely to exceed the relevant ambient air quality limit values.

Information supporting the conclusions has been detailed in the following sections. The assessment methodology and study inputs are presented in Section 10.2. The dispersion modelling results, assessment of climate impacts and assessment of the impact on nearby sensitive ecological receptors are presented in Section 10.6. The model formulation is detailed in Appendix 10.1.

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10.1.1 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 (Framework Convention on Climate Change 1999 and Framework Convention on Climate Change 1997). For the purposes of the European Union 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 (Framework Convention on Climate Change 2012).

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 (COP25) took place in Madrid, Spain from the 2nd to the 13th of December 2019 and focussed on advancing the implementation of the Paris Agreement. The Paris Agreement was established at COP21 in Paris in 2015 and is an important milestone in terms of international climate change agreements. The Paris Agreement is currently ratified by 187 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 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress has also been made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, on 23/24 October 2014, agreed the "2030 Climate and Energy Policy Framework" (European Council 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas 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 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 32% for the share of renewable energy consumed in the EU in 2030.

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) was enacted by the Oireachtas (the Act) (Oireachtas 2015). The purpose of the Act was to enable Ireland '*to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050*' (3.(1) of No. 46 of 2015). This is referred to in the Act as the '*national transition objective*'.

The Act makes provision for a national mitigation plan, and a national adaptation framework. The mitigation plan, referred to as the '*national low carbon transition and mitigation plan'*, which is required to be submitted to Government for approval every five years, outlines a range of objectives:

- To specify the manner in which it is proposed to achieve the national transition objective;
- Specify the policy measures required to manage GHG emissions and the removal of GHGs at a level that is appropriate for furthering the achievement of the national transition objective;
- Take into account any existing obligations of the State under the law of the European Union (EU) or any international agreement;
- Specify the sectoral mitigation measures for the purposed of reducing GHG emissions and enabling the achievement of the national transition objectives.

The adaptation plan, referred to as the '*national climate change adaptation framework*', which is required to be submitted to Government for approval every five years, outlines a range of objectives:

- To specify the national strategy for the adaptation measures in different sectors which reduces the vulnerability of the State to the negative effects of climate change and to avail of the positive effects of climate change that may occur;
- Take into account any existing obligations of the State under the law of the European Union (EU) or any international agreement.

In addition, the Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The 'Climate Action Plan' (CAP), published in June 2019, outlines the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The CAP also details the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas.

10.1.2 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. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC (see Table 10.1). The ambient air quality standards applicable for NO_2, PM_{10}, $PM_{2.5}$, benzene, SO_2 and CO are outlined in this Directive.

Table 10-1: Air Quality Standards 2011 (Based on Directive 2008/50/EC)

Pollutant	Regulation Note 1	Limit Type	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 μg/m^3 NO_2
		Annual limit for protection of human health	40 μg/m^3 NO_2
		Critical level for protection of vegetation	30 μg/m^3 NO + NO_2
Sulphur Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 μg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 μg/m^3
		Annual & Winter critical level for the protection of ecosystems	20 μg/m^3
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 PM_{10}
		Annual limit for protection of human health	40 μg/m^3 PM_{10}
$PM_{2.5}$	2008/50/EC	Annual limit for protection of human health	25 μg/m^3 $PM_{2.5}$

Pollutant	Regulation Note 1	Limit Type	Value
Benzene	2008/50/EC	Annual limit for protection of human health	5 µg/m^3
Carbon Monoxide	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
Note 2 EU 2008/50/EC states - 'Stage 2 — indicative limit value to be reviewed by the Commission in 2013 in the light of further information on health and environmental effects, technical feasibility and experience of the target value in Member States'.

10.1.3 Gothenburg protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. 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 and 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). The data available from the EPA (EPA 2019a) indicated that Ireland complied with the emissions ceilings for all pollutants. 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. 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 $PM_{2.5}$.

10.2 Methodology

10.2.1 Aircraft Dispersion Modelling

The United States Environmental Protection Agency (USEPA) approved AERMOD dispersion model (Version 19191) has been used to predict the ground level concentrations (GLC) of compounds emitted from the principal emission sources on-site. The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources and has replaced ISCST3 (USEPA 1995) as the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain (USEPA 1998, 2000, 2019a). The model has more advanced algorithms and gives better agreement with monitoring data in extensive validation studies (USEPA 1999 2000, Schulman et al. 2000, Paine, R & Lew, F 1997a 1997b). An overview of the AERMOD dispersion model is outlined in Appendix 10.1.

The modelling incorporated the following features:

- Three receptor grids were created at which concentrations would be modelled. Receptors were mapped with sufficient resolution to ensure all localised "hot-spots" were identified without adding unduly to processing time. The receptor grids were based on Cartesian grids with the site at the centre. An outer grid extended to 10,000 m with the site at the centre and with concentrations calculated at 250 m intervals. A smaller denser grid extended to 4,500 m from the site with concentrations calculated at 50 m intervals. Further grids at 250 m spacing were also placed along the approach flight path. Boundary receptor locations were also placed along the boundary of the site, at 25 m intervals. All receptors have been modelled at 1.8 m to represent breathing height.

- All on-site buildings and significant process structures were mapped into the computer to create a three-dimensional visualisation of the site and its emission points. Buildings and process structures can influence the passage of airflow over the emission stacks and draw plumes down towards the ground (termed building downwash). The stacks themselves can influence airflow in the same way as buildings by causing low pressure regions behind them (termed stack tip downwash). Both building and stack tip downwash were incorporated into the modelling.

- Detailed terrain has been mapped into the model using SRTM data with 30m resolution. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP (USEPA 2019b).

- Hourly-sequenced meteorological information has been used in the model. Meteorological data over a five-year period (Johnstown Castle 2014 - 2018) was used in the model (see Figure 10.1).

- AERMOD incorporates a meteorological pre-processor AERMET (USEPA 2019c). The AERMET meteorological pre-processor requires the input of surface characteristics, including surface roughness (z0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc.) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and albedo and to a distance of 1km for surface roughness in line with USEPA recommendations.

The source and emission data, including aircraft codes, emission rates and flight paths have been incorporated into the models for the two emission scenarios (Do-Nothing Emissions Scenario and Do-Something Emissions Scenario).

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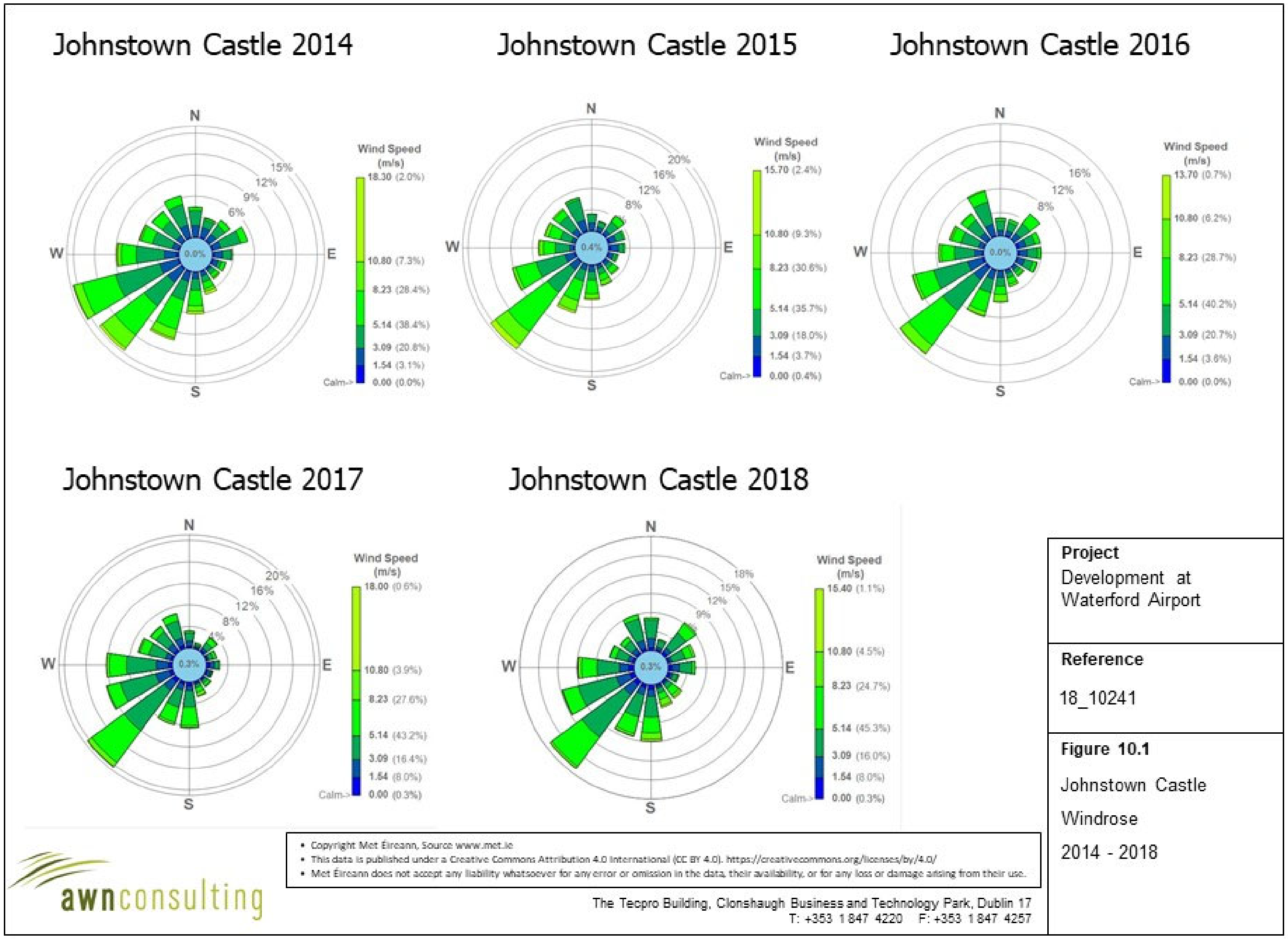

Figure 10-1: Johnstown Castle Met Data (2014 – 2018)

10.2.1.1 AERMOD

The AERMOD air dispersion model has a terrain pre-processor AERMAP which was used to map the physical environment in detail over the receptor grid. The digital terrain input data used in the AERMAP pre-processor was SRTM data. This data was run to obtain for each receptor point the terrain height and the terrain height scale. The terrain height scale is used in AERMOD to calculate the critical dividing streamline height, H_{crit}, for each receptor. The terrain height scale is derived from the Digital Elevation Model (DEM) files in AERMAP by computing the relief height of the DEM point relative to the height of the receptor and determining the slope. If the slope is less than 10%, the program goes to the next DEM point. If the slope is 10% or greater, the controlling hill height is updated if it is higher than the stored hill height. In areas of complex terrain, such as the current region, AERMOD models the impact of terrain using the concept of the dividing streamline (H_c). As outlined in the AERMOD model formulation (EPA 2020) a plume embedded in the flow below H_c tends to remain horizontal; it might go around the hill or impact on it. A plume above H_c will ride over the hill. Associated with this is a tendency for the plume to be depressed toward the terrain surface, for the flow to speed up, and for vertical turbulent intensities to increase.

AERMOD model formulation states that the model "captures the effect of flow above and below the dividing streamline by weighting the plume concentration associated with two possible extreme states of the boundary layer (horizontal plume and terrain-following). The relative weighting of the two states depends on: 1) the degree of atmospheric stability; 2) the wind speed; and 3) the plume height relative to terrain. In stable conditions, the horizontal plume "dominates" and is given greater weight while in neutral and unstable weighted" (USEPA 2019a). AERMOD also has the capability of modelling both unstable (convective) conditions and stable (inversion) conditions. The stability of the atmosphere is defined by the sign of the sensible heat flux. Where the sensible heat flux is positive, the atmosphere is unstable whereas when the sensible heat flux is negative the atmosphere is defined as stable. The sensible heat flux is dependent on the net radiation and the available surface moisture (Bowen Ratio). Under stable (inversion) conditions, AERMOD has specific algorithms to account for plume rise under stable conditions, mechanical mixing heights under stable conditions and vertical and lateral dispersion in the stable boundary layer.

10.2.1.2 Meteorological Data

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA (USEPA 2019c). A primary requirement is that the data used should have a data capture of greater than 90% for all parameters. Johnstown Castle meteorological station, which is located approximately 40 km north-east of the site and a similar distance inland, collects data in the correct format and has a data collection rate of greater than 90%. Meteorological data over a five-year period (Johnstown Castle, 2014 – 2018) was used in the model (see Figure 10.1).

10.2.1.3 Process Emissions

Air traffic emissions of CO, SO_2 and NO_2 at the worst case off site locations have been modelled using the USEPA approved AERMOD dispersion model in conjunction with the *European Monitoring and Evaluation Programme (EMEP) / European Economic Area (EEA) Air Pollutant Emission Inventory Guidebook 2016* (updated July 2017) and associated database (EMEP 2017). Helicopter emissions were also included with process emissions calculated using the *Guidance on the Determination of Helicopter Emissions* (Swiss Confederation, 2015). These guidance documents and database list the emission concentrations for a large variety of aircraft and provide average emission values for the landing/take-off (LTO) cycle of aircraft. These emissions are expressed in kg per LTO cycle, it is assumed that each LTO cycle is 27 minutes as per the default database. This LTO cycle time is a conservative estimation due to the size of Waterford Airport and shorter taxi period compared to larger busier airports. It is during this LTO cycle that ground level air quality impacts will occur. Data for the Do-Nothing and Do-Something number of aircraft are shown in Table 10.2 which is multiplied by the emissions per LTO cycle for each aircraft type and summed to generate the total emissions per annum.

As the time of each section of the LTO cycle (taxi, take off, climb-out, approach and landing) are known the emissions can be calculated as a percentage of the total LTO cycle emissions and expressed as $g/m^2/s$.

Emissions are assumed to occur over a 14 hour period each day (8am to 10pm) which is slightly longer than the actual operational period.

Approach emissions are calculated at a height of 544 m above ground level and extend 9 km outwards from the airport. Emissions for take-off and landing are assumed to occur from 302 m above ground level, decreasing in 20m intervals over a 6km distance as they approach the runway during the climb-out phase. The landing and take-off phases occur on the 1.7 km runway at an average release height of 12 m. Emissions for the taxi period occur at ground level.

The information used in the dispersion model for the aircraft is shown in Table 10.2. These figures are based on projected "Year 5" or 2025, which are the highest volume future projections available.

Table 10-2: Aircraft volumes and Emission rates for Do-Nothing and Do-Something scenarios

Number of Aircraft Annually	B737 Medium Passenger Jet	C525 Business jet	C441 Multi Engine Piston	PA28 Single Engine Training Craft	S91 or EC135 Helicopter	Total
Do-Nothing	0	85	1,676	15,684	1,598	19,043
Do-Something	2,240	85	1,676	15,684	1,598	21,283
Annual Emissions (kg)						
Do-Nothing NO_X	-	43	570	674	3,068	4,355
Do-Something NO_X	22,400	43	570	674	3,068	26,755
Do-Nothing CO	-	719	1,675	222,343	26,180	250,918
Do-Something CO	14,109	719	1,675	222,343	26,180	265,027
Do-Nothing SO_X	-	9	96	196	733	1,033
Do-Something SO_X	1,406	9	96	196	733	2,440
Emission	**Do-Nothing Scenario**			**Do-Something Scenario**		
	NO_2 ($g/m^2/sec$)	**CO ($g/m^2/sec$)**	**SO_2 ($g/m^2/sec$)**	**NO_2 ($g/m^2/sec$)**	**CO ($g/m^2/sec$)**	**SO_2 ($g/m^2/sec$)**
Taxi	6.9E-06	4.0E-04	1.6E-06	4.2E-05	4.2E-04	3.9E-06
Take off	9.7E-08	5.6E-06	2.3E-08	5.9E-07	5.9E-06	5.4E-08
Climb out	4.1E-08	2.4E-06	9.8E-09	2.5E-07	2.5E-06	2.3E-08
Approach	4.8E-08	2.8E-06	1.1E-08	2.9E-07	2.9E-06	2.7E-08
TOTAL	7.1E-06	4.1E-04	1.7E-06	4.3E-05	4.3E-04	4.0E-06

10.2.2 Road Traffic Modelling

10.2.2.1 Construction Phase Road Traffic Emissions

Increased traffic emissions associated with site vehicles and HGVs can also impact air quality during construction. The traffic data for the construction phase of the extension has been reviewed in line with the DMRB assessment criteria outlined below. The UK DMRB guidance (UK Highways Agency, 2007; 2019) states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed extension and should be included in the local air quality assessment:

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

None of the road links impacted by the proposed extension during construction meet the above criteria and therefore road traffic impacts can be scoped out of a construction phase air quality assessment

10.2.2.2 Local Air Quality Assessment – Impact from Road Traffic (DMRB Assessment)

The air quality assessment has been carried out following procedures described in the publications by the EPA (2015; 2017) and using the methodology outlined in the guidance documents published by the UK Highways Agency (2019) and UK Department of Environment Food and Rural Affairs (DEFRA) (2016; 2018). Transport Infrastructure Ireland (TII) reference the use of the UK Highways Agency and 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.

In 2019 the UK Highways Agency DMRB air quality guidance was revised with LA 105 Air Quality replacing a number of key pieces of guidance (HA 207/07, IAN 170/12, IAN 174/13, IAN 175/13, part of IAN 185/15). This revised document outlines a number of changes for air quality assessments in relation to road shemes or developments which impact on traffic. Previously the DMRB air quality spreadsheet was used for the majority of assessments in Ireland with detailed modelling only required if this screening tool indicated compliance issues with the EU air quality standards. Guidance from Transport Infrastructure Ireland (TII, 2011) recommends the use of the UK Highways Agency DMRB spreadsheet tool for assessing the air quality impacts from road schemes. However, the DMRB spreadsheet tool was last revised in 2007 and accounts for modelled years up to 2025. Vehicle emission standards up to Euro V are included but since 2017, Euro 6d standards are applicable for the new fleet. In addition, the model does not account for electric or hybrid vehicle use. Therefore, this a somewhat outdated assessment tool. The LA 105 guidance document states that the DMRB spreadsheet tool may still be used for simple air quality assessments where there is unlikely to be a breach of the air quality standards. Due to its use of a "dirtier" fleet, vehicle emissions would be considered to be higher than more modern models and therefore any results will be conservative in nature and will provide a worst-case assessment.

The 2019 UK Highways Agency DMRB air quality guidance was revised with LA 105 Air Quality stating that modelling should be conducted for NO_2 for the base, opening and design years for both the do minimum (do nothing) and do something scenarios. Modelling of PM_{10} is only required for the base year to demonstrate that the air quality limit values in relation to PM_{10} are not breached. Where the air quality modelling indicates exceedances of the PM_{10} air quality limits in the base year then PM_{10} should be included in the air quality model in the do minimum and do something scenarios. Modelling of $PM_{2.5}$ is not required as there are currently no issues with compliance with regard to this pollutant. The modelling of PM_{10} can be used to show that the project does not impact on the $PM_{2.5}$ limit value as if compliance with the PM_{10} limit is achieved then compliance with the $PM_{2.5}$ limit will also be achieved. Historically modelling of carbon monoxide (CO) and benzene (Bz) was required however, this is no longer needed as concentrations of these pollutants have been monitored to be significantly below their air quality limit values in recent years, even in urban centres (EPA, 2019b). The key pollutant reviewed in this assessment is NO_2. Concentrations of PM_{10} and $PM_{2.5}$ have also been modelled to indicate that there are no potential air quality compliance issues associated with the proposed extension. Modelling of operational NO_2, PM_{10} and $PM_{2.5}$ concentrations has been conducted for the base year (2020) as well as the do minimum and do something scenarios for the opening year (2021) and design year (2025).

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 Highways Agency guidance LA 150 (2019) states the following scoping criteria shall be used to determine whether the air quality impacts of a project can be scoped out or require an assessment based on the changes between the do something traffic (with the project) compared to the do minimum traffic (without the project):

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

The above scoping criteria has been used in the Do-Nothing assessment to determine the road links required for inclusion in the modelling assessment (Table 10-3). Sensitive receptors within 200m of impacted road links are included within the modelling assessment. Pollutant concentrations are calculated at these sensitive receptor locations to determine the impact of the proposed extension in terms of air quality. The guidance states a proportionate number of representative receptors which are located in areas which will experience the highest concentrations or greatest improvements as a result of the proposed extension are to be included in the modelling (UK Highways Agency, 2019). The TII guidance (2011) defines sensitive receptor locations as: residential housing, schools, hospitals, places of worship, sports centres and shopping areas, i.e. locations where members of the public are likely to be regularly present. Two sensitive receptors (residential properties on the R708) were included in the modelling assessment. These two receptors were chosen based on their proximity to the roadway and therefore potential for impact.

The following model inputs are required to complete the assessment using the DMRB spreadsheet tool: road layouts, receptor locations, annual average daily traffic movements (AADT), percentage heavy goods vehicles (%HGV), annual average traffic speeds and background concentrations. 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 extension 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, which can be applied to any project that causes a change in traffic flows. The degree of impact is determined based on both the absolute and relative impact of the proposed extension. The TII significance criteria have been adopted for the proposed extension and are detailed in Table 10-26 and Table 10-27. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40 µg/m^3).

Table 10-3: Traffic Data used in the Air Modelling Assessment

Road Name	Speed (kph)	Base	Do Nothing	Do Something	Do Nothing	Do Something
		2020	2021		2035	
R708	80	2,588 (1.5%)	2,577 (1.5%)	2,688 (1.3%)	2,784 (3.4%)	3,659 (5.4%)

Note 1: Percentage HGV in brackets

Update to NO_2 Projections using DMRB

In 2011 the UK DEFRA published research (Highways England, 2013) on the long-term trends in NO_2 and NO_X for roadside monitoring sites in the UK. This study marked a 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 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 for predicted 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.

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 diesel vehicles and some regenerative particle traps on HGV's the proportion of NO_X emitted as NO_2, rather than NO is increasing. With the correct conditions (presence of sunlight and O_3) emissions in the form of NO, have the potential to be converted to NO_2.

Transport Infrastructure Ireland states the recommended method for calculating 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*" (TII, 2011). The TII guidelines recommend the use of DEFRAs 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 non-urban UK" traffic mix option was used.

10.2.2.3 Climatic Factors / Regional Emissions

The UK Highways Agency has published an updated DMRB guidance document in relation to climate impact assessments *LA 114 Climate* (UK Highways Agency 2019). The following scoping criteria are used to determine whether a detailed climate assessment is required for a proposed project:

1. Are construction GHG emissions (or GHG-emitting activity), compared to the baseline scenario (i.e. when compared to GHG emissions and energy use associated with existing maintenance activities), increasing by >1%?
2. During operation, will roads meet or exceed any of the following criteria?
   a) a change of more than 10% in AADT;
   b) a change of more than 10% to the number of heavy duty vehicles; and
   c) a change in daily average speed of more than 20 km/hr.

If the answer to any of the above criteria is 'yes' then a further assessment is required. The impact of the Do-Something scheme at a national / international level has been determined using the procedures given by Transport Infrastructure Ireland (2011) and the methodology provided in Annex D in the UK Design Manual for Roads and Bridges (UK Highways Agency, 2007). 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 (see Table 10-3).

10.2.2.4 Ecological Assessment

For routes that pass within 2 km of a designated area of conservation (either Irish or European designation) the TII requires consultation with an Ecologist (2011). However, in practice the potential for impact to an ecological site is highest within 200m of a road and when significant changes in AADT (>5%) occur. Only sites that are sensitive to nitrogen deposition should be included in the assessment.

TII's *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (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 shall be conducted:

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

There are no designated sites within 200m of any of the road links impacted by the proposed extension and therefore this assessment is not required.

10.3 Existing Environment

10.3.1 Air Quality

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities (EPA 2019b, 2020c). The most recent annual report on air quality "Air Quality Monitoring Annual Report 2018" (EPA 2019b), details the range and scope of monitoring undertaken throughout Ireland. As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), 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 is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000 is defined as Zone D. In terms of air monitoring, the area of Waterford Airport is categorised as Zone D (EPA 2019b).

NO_2 monitoring was carried out at two rural Zone D locations in 2018, Emo and Kilkitt and an urban area of Castlebar (EPA 2019b, 2020c). The NO_2 annual average in 2018 for both rural sites was 3 µg/m^3 with the results for the urban station averaging 8 µg/m^3. Hence long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 µg/m^3. The average results over the last five years at a range of rural Zone D locations suggest an upper average of no more than 3 µg/m^3 as a background concentration as shown in Table 10.3. Based on the above information a conservative estimate of the background NO_2 concentration in the region of the Airport is 4 µg/m^3.

The Ozone Limiting Method (OLM) was used to model NO_2 concentrations. The OLM is a regulatory option in AERMOD which calculates ambient NO_2 concentrations by applying a background ozone concentration and an in-stack NO_2/NO_x ratio to predicted NO_x concentrations. An in-stack NO_2/NO_x ratio of 0.1 and a background ozone concentration of 60 µg/m^3 were used for modelling. In relation to the annual averages, the ambient background concentration is added directly to the process concentration. With regard to short-term peak concentrations of NO_2 a value of twice the annual mean background concentration was added to the process concentration.

Table 10-4: Annual Mean NO_2 Concentrations in Zone D Locations 2014 - 2018 (µg/m^3)

Year	Enniscorthy	Kilkitt	Emo	Castlebar
2014	13	3	3	8
2015	9	2	3	8
2016	10	3	4	9
2017	-	2	3	7
2018	-	3	3	8
Average	11	3	3	8

Continuous PM_{10} monitoring was carried out at two rural Zone D locations from 2014 - 2018, Claremorris and Kilkitt. These showed an upper average limit of no more than 10 µg/m^3. Levels range from 8 - 12 µg/m^3 over the five-year period with no exceedances of the 24-hour limit value of 50 µg/m^3 in 2018 (35 exceedances are permitted per year) (EPA, 2019b). Based on the EPA data, a conservative estimate of the current background PM_{10} concentration in the region of the proposed extension is 11 µg/m^3.

Average $PM_{2.5}$ levels in Claremorris over the period 2014 – 2018 ranged from 5 – 6 µg/m^3, with a $PM_{2.5}/PM_{10}$ ratio ranging from 0.5 – 0.6 (EPA, 2019b). Based on this information, a conservative ratio of 0.6 was used to generate an existing $PM_{2.5}$ concentration in the region of the extension of 6.6 µg/m^3.

Long-term SO_2 monitoring was carried out at the Zone D location of Kilkitt in 2018. The SO_2 annual average measured 2.3 µg/m^3 in 2018 (EPA 2019b). Previous monitoring from 2014 – 2018 at three locations (Kilkitt, Shannon Estuary and Enniscorthy) indicated annual averages ranging from 1.6 – 3.9 µg/m^3. The Shannon Estuary location has a 5 year average of 2.2 µg/m^3. Based on the above information a conservative estimate of the background SO_2 concentration in the region of the Airport is 2.5 µg/m^3. The average 99.2th%ile of 24-hour mean background at rural zone D sites indicates an average SO_2 concentration of 5.4 µg/m^3 in the region of the Airport. While, the average rural zone D background for the 99.7th%ile of hourly SO_2 concentration in the region of the Airport is 5.4 µg/m^3.

When calculating the short-term peak results, concentrations cannot be combined by directly adding the annual background level to the modelling results. Guidance from the UK DEFRA (UK Defra, 2016a) and EPA (EPA 2020a) advises that for SO_2 an estimate of the maximum combined pollutant concentrations can be obtained as shown below:

SO_2 - The 99.2th%ile of total 24-hour SO_2 is equal to the maximum of either A or B below:

a) 99.2th%ile of 24-hour mean background SO_2 + (2 x annual mean process contribution SO_2)
b) 99.2th%ile 24-hour mean process contribution SO_2 + (2 x annual mean background contribution SO_2)

SO_2 - The 99.7th%ile of total 1-hour SO_2 is equal to the maximum of either A or B below:

a) 99.7th%ile hourly background SO_2 + (2 x annual mean process contribution SO_2)
b) 99.7th%ile hourly process contribution SO_2 + (2 x annual mean background contribution SO_2)

Monitoring for CO is not currently conducted at Zone D sites. In the absence of data from representative locations in Zone D monitoring data for the Zone C location in Portlaoise was used to inform background concentrations in the region of the Airport. CO concentrations in Portlaoise, between 2014 and 2018, are significantly below the 10 mg/m^3 limit value. Maximum 8-hour concentrations range from 1.2 mg/m^3 – 2.8 mg/m^3 over the period 2014 – 2018, with an average of 2.1 mg/m^3. Based on these results a background 8-hour CO concentration of 2.4 mg/m^3 has been estimated for the region of the Airport.

In terms of benzene, there is no annual mean concentration in the Zone D. However, monitoring of benzene occurred at the Zone C monitoring location of Kilkenny Seville Lodge for 2018 was 0.16 µg/m^3. This is well below the limit value of 0.15 µg/m^3. Between 2014 - 2018 annual mean concentrations at the Zone D site ranged from 0.09 – 0.2 µg/m^3. Based on this EPA data a conservative estimate of the current background benzene concentration in the region of the airport is 0.52 µg/m^3.

10.3.2 Climate

Climatic impacts occur on a national scale rather than a localised level. If significant emissions occur they will have the potential to impact Ireland's commitments and targets under various EU Climate Agreements and other international agreements.

Ireland has signed up to several Climate agreements including the '2030 Climate and Energy Policy Framework' which aims to reduce GHG emissions by 40% compared with 1990 levels by 2030.

Data published in 2020 (EPA 2020b) predicts that Ireland will exceed its 2018 annual limit set under the EU's Effort Sharing Decision (ESD), 406/2009/EC1 by 5.59 Mt. For 2018, total national greenhouse gas emissions are estimated to be 60.93 million tonnes carbon dioxide equivalent (Mt CO_2eq). This is 0.1% lower (0.07 Mt CO_2eq) than emissions in 2017. The sector with the highest emissions is agriculture at 33.9% of the total followed by transport at 20.1%. Greenhouse gas emissions from the transport sector increased by 1.6% in 2018.

It is now clear that Ireland will struggle to meet Regulation (EU) 2018/842 which has set binding annual greenhouse gas emission reductions from 2012 to 2030. Several important changes to legislation have been enacted including the Climate Action Plan 2019 and the Draft General Scheme of the Climate Action (Amendment) Bill 2019 (in January 2020), Ireland's declaration of a climate and biodiversity emergency in May 2019 and the European Parliament's approval of a resolution declaring a climate and environment emergency in Europe in November 2019. Thus, the baseline environment should be considered a sensitive environment for the assessment of impacts.

The EU agreed in 2014 to limit the scope of aviation in the EU ETS to flights within the EEA to support the planned extension of a global Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) by the International Civil Aviation Organisation (ICAO). The CAP notes that CORSIA will come into effect in 2021. Its aim is to stabilise global aviation emissions at 2020 levels by requiring airlines to offset any emissions growth after 2020 by purchasing eligible emission units generated by projects that reduce emissions in other sectors. As Ireland is a member of ICAO, Irish aircraft operators will have to offset any emissions growth after 2020 by purchasing eligible emission units, i.e. pay full carbon price.

10.4 Do Nothing Scenario

10.4.1 Aircraft Air Quality – Do-Nothing NO_2

The NO_2 modelling results for the Do-Nothing operation of the airport are detailed in Table 10-5. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for NO_2. Emissions from the Airport lead to an ambient NO_2 concentration which is 11% of the maximum 1-hour limit value (measured as a 99.8th%ile) and 2.5% of the annual limit value at the worst-case off-site receptor for the worst-case years modelled (2017). When background concentrations are included this rises to 15% of the maximum 1-hour limit value (measured as a 99.8th%ile) and 12% of the annual limit value at the worst-case off-site receptor.

The geographical variations in ground level NO_2 concentrations (without background) beyond the Airport boundary for the worst-case year modelled are illustrated as concentration contours in Figure 10.2 which shows Do-Nothing scenario predicted annual mean NO_2 concentrations (2017).

Table 10-5: Modelled NO_2 Concentrations for Do-Nothing Scenario (µg/m^3)

Scenario / Year	Averaging Period	Process Contribution (µg/m^3)	Background (µg/m^3)	Predicted Emission Concentration - PEC (µg/Nm^3)	Standard (µg/Nm^3) Note 1	PEC as a % of Standard
Do-Nothing Scenario / 2014	Annual mean	0.58	4	4.58	40	11%
	99.8th%ile of 1-hr Means	15.00	8	23.0	200	11%
Do-Nothing Scenario / 2015	Annual mean	0.81	4	4.81	40	12%
	99.8th%ile of 1-hr Means	19.67	8	27.7	200	14%
Do-Nothing Scenario / 2016	Annual mean	0.84	4	4.84	40	12%
	99.8th%ile of 1-hr Means	20.01	8	28.0	200	14%
Do-Nothing Scenario / 2017	Annual mean	0.99	4	4.99	40	12%
	99.8th%ile of 1-hr Means	22.13	8	30.1	200	15%
Do-Nothing Scenario / 2018	Annual mean	0.92	4	4.92	40	12%
	99.8th%ile of 1-hr Means	19.88	8	27.9	200	14%

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

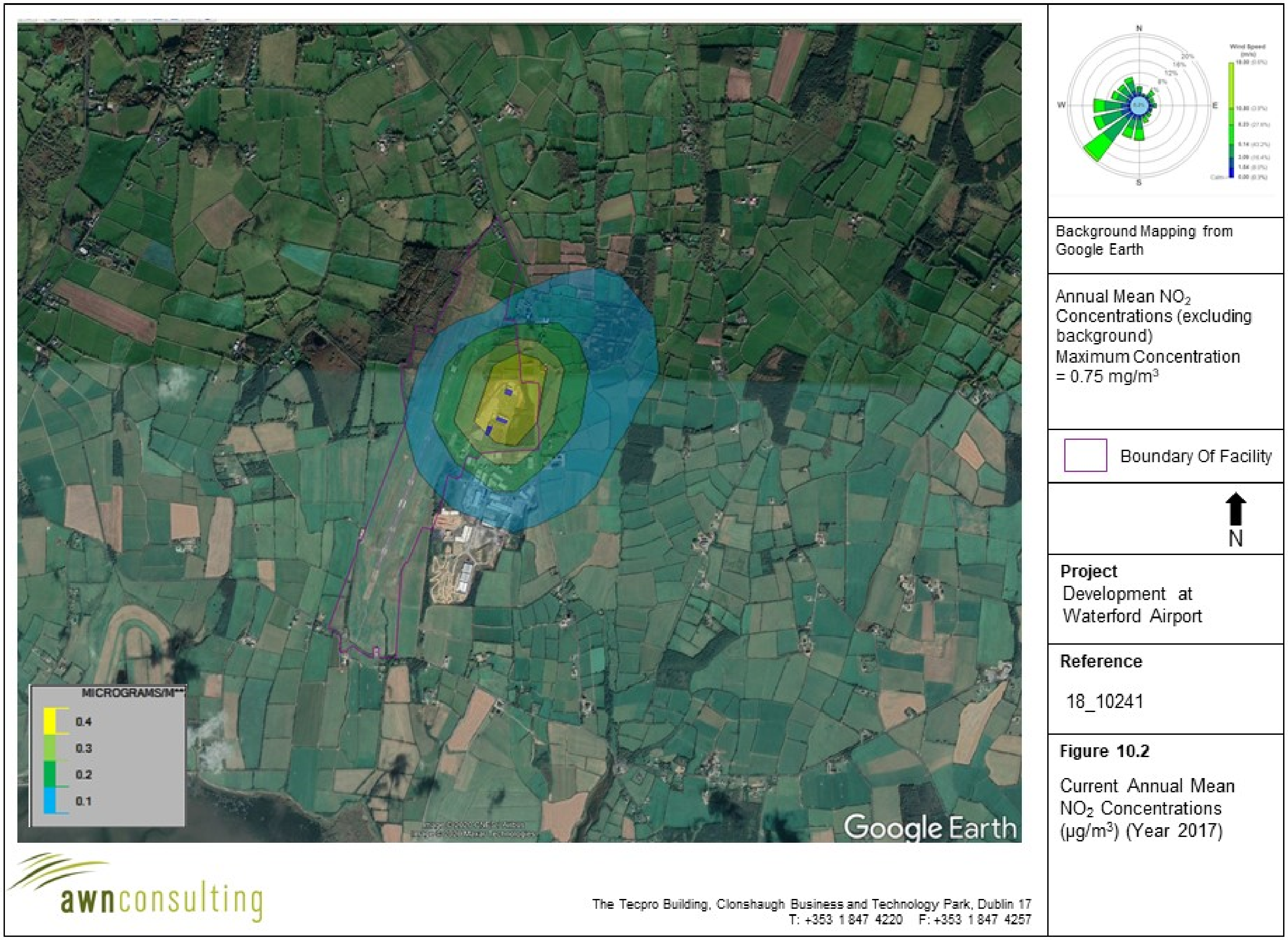

Figure 10-2: Do-Nothing Annual Mean NO_2 Concentrations

10.4.2 Air Quality – Do-Nothing SO_2

The SO_2 modelling results for the Do-Nothing scenario are detailed in Table 10-6. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for SO_2. Emissions from the Airport lead to an ambient SO_2 concentration which is 1% of the maximum 1-hour limit value (measured as a 99.7th%ile) and 1.6% of the maximum 24-hour limit value (measured as a 99.2nd%ile) at the worst-case off-site receptor for the worst-case year modelled. When background concentrations are included this rises to 3% of the 1-hour limit value (measured as a 99.7th%ile) and 5% of the 24-hour limit value (measured as a 99.2nd%ile) at the worst-case off-site receptor.

The geographical variations in ground level SO_2 concentrations (without background) beyond the Airport boundary for the worst-case year modelled are illustrated as concentration contour in Figure 10.3. This shows the maximum predicted 24-Hour SO_2 concentrations (as a 99.2nd percentile) for the existing scenario (2018).

Table 10-6: Modelled SO_2 Concentrations for Do-Nothing Scenario (µg/m^3)

Scenario / Year	Averaging Period	Process Contribution (µg/m^3)	Background (µg/m^3) Note 1	Predicted Emission Concentration - PEC (µg/Nm^3)	Standard (µg/Nm^3) Note 2	PEC as a % of Standard
Do-Nothing Scenario / 2014	99.2nd%ile of 24-hr Means	1.14	2.50	6.1	125	5%
	99.7th%ile of 1-hr Means	4.54	2.50	9.5	350	3%
Do-Nothing Scenario / 2015	99.2nd%ile of 24-hr Means	0.98	2.50	6.0	125	5%
	99.8th%ile of 1-hr Means	4.43	2.50	9.4	350	3%
Do-Nothing Scenario / 2016	99.2nd%ile of 24-hr Means	1.30	2.50	6.3	125	5%
	99.8th%ile of 1-hr Means	4.67	2.50	9.7	350	3%
Do-Nothing Scenario / 2017	99.2nd%ile of 24-hr Means	1.27	2.50	6.3	125	5%
	99.8th%ile of 1-hr Means	5.48	2.50	10.5	350	3%
Do-Nothing Scenario / 2018	99.2nd%ile of 24-hr Means	1.31	2.50	6.3	125	5%
	99.8th%ile of 1-hr Means	4.83	2.50	9.8	350	3%

Note 1 Short-term Emission Concentrations calculated according to UK DEFRA guidance
Note 2 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

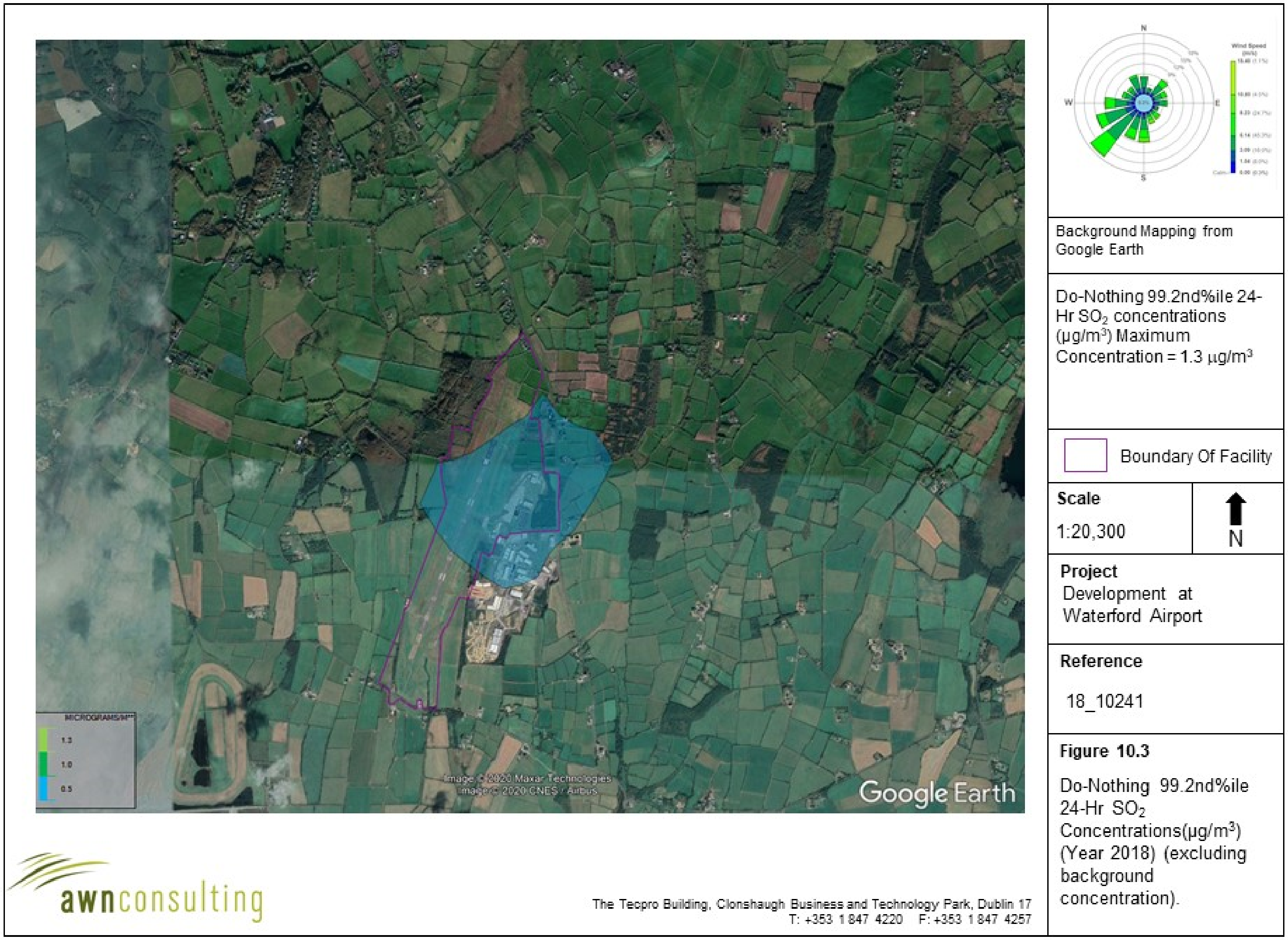

Figure 10-3: Do-Nothing 24-Hour SO_2 Concentrations (as 99.2nd percentile)

10.4.2.1 Aircraft Air Quality – Do-Nothing CO

The CO modelling results for the Do-Nothing operation of the airport are detailed in Table 10-7. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for CO. Emissions from the Airport lead to an ambient CO concentration which is 8% of the maximum 8-hour average (2016). When background concentrations are included this rises to 32% of the maximum 8-hour average at the worst-case off-site receptor.

The geographical variations in ground level CO concentrations (without background) beyond the Airport boundary for the worst-case year modelled are illustrated as concentration contours in Figure 10.4. This shows maximum predicted 8-hour CO concentrations for the Do-Nothing scenario (2016).

Table 10-7: Modelled CO Concentrations for Do-Nothing Scenario (µg/m³)

Scenario / Year	Averaging Period	Process Contribution (mg/m³)	Background (mg/m³)	Predicted Emission Concentration - PEC (mg/Nm³)	Standard (mg/Nm³) Note 1	PEC as a % of Standard
Do-Nothing Scenario / 2014	Maximum 8-hour average	0.53	2.4	2.93	10	29%
Do-Nothing Scenario / 2015	Maximum 8-hour average	0.72	2.4	3.12	10	31%
Do-Nothing Scenario / 2016	Maximum 8-hour average	0.78	2.4	3.18	10	32%
Do-Nothing Scenario / 2017	Maximum 8-hour average	0.62	2.4	3.02	10	30%
Do-Nothing Scenario / 2018	Maximum 8-hour average	0.64	2.4	3.04	10	30%

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

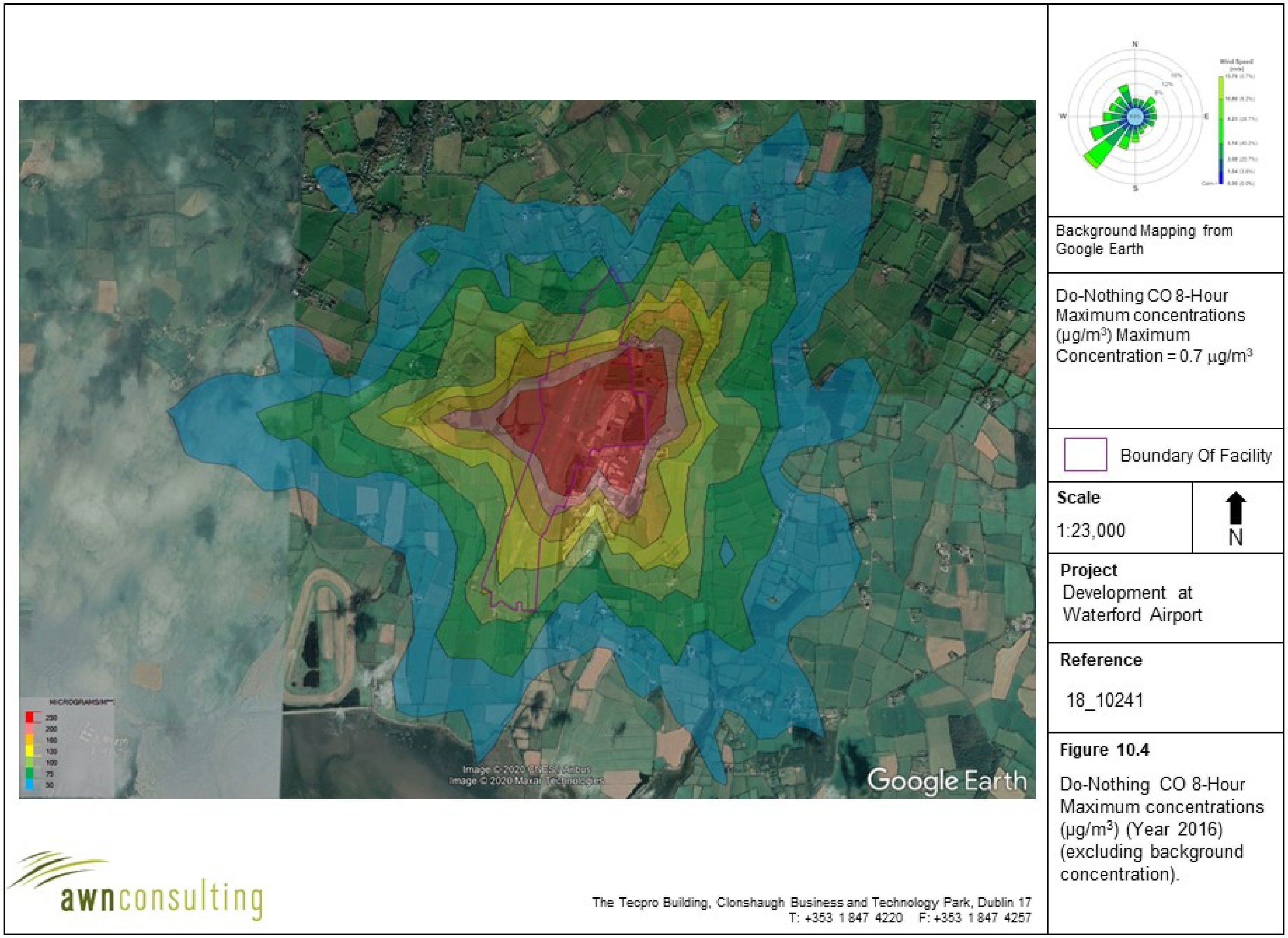

Figure 10-4: Do-Nothing Maximum 8-Hour CO Concentrations

10.4.3 Do-Nothing Aircraft Impact of NO_x and SO_2 Emissions on Sensitive Ecosystems

The EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the "Habitats Directive") requires an Appropriate Assessment to be carried out where there is likely to be a significant impact upon a European protected site. Such sites include Natural Heritage Areas (NHA), Special Areas of Conservation (SAC), Special Protection Areas (SPA), National Parks, Nature Reserves, Refuges for Fauna, Refuges for Flora, Wildfowl Sanctuaries, Ramsar Sites, Biogenetic Reserves and UNESCO Biosphere Reserves.

The impact of the Do-Nothing emissions of NO_x and SO_2 from Waterford Airport on ambient ground level concentrations within the Tramore Dunes and Backstrand SAC and SPA was assessed using AERMOD. Annual limit values for both pollutants are specified within EU Directive 2008/50/EC for the protection of ecosystems and vegetation. Annual average concentrations for both pollutants were predicted at receptors located within the SAC / SPA boundary from the emission points for the worst-case year for annual average concentrations (2017).

The NO_x modelling results for the Do-Nothing scenario are detailed in Table 10-8. The results indicate that the ambient ground level concentrations are below the relevant air quality standard for NO_x for the protection of ecosystems. Emissions from the Airport for the Do-Nothing Scenario lead to an ambient NOx concentration which is 0.09% of the annual limit value at the worst-case location within the SAC / SPA. When background concentrations are included this rises to 37% of the annual limit value at the worst-case location.

Table 10-8: Modelled NO_x Do-Nothing Concentrations within the SAC / SPA's

Pollutant/ Scenario / Year	Averaging Period	Process Contribution (µg/m³)	Annual Mean Background (µg/m³)	Predicted Emission Concentration - PEC (µg/Nm³)	Standard (µg/Nm³) Note 1	PEC as a % of Standard
Do-Nothing Scenario / 2017	Annual Mean	0.03	11	11.03	30	37%

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

The SO_2 modelling results for the Do-Nothing scenario are detailed in Table 10-9. The results indicate that the ambient ground level concentrations are below the relevant air quality standard for SO_2 for the protection of vegetation for the Do-Nothing Scenario. Emissions from the Airport for the Do-Nothing Scenario lead to an ambient SO_2 concentration which is 0.03% of the annual limit value at the worst-case location within the SAC / SPA. When background concentrations are included this rises to 13% of the annual limit value at the worst-case location. The annual mean SO_2 results for the Do-Nothing Scenario indicate that the ambient ground level concentrations including background do not exceed the relevant air quality standard for SO_2 at the worst-case location within the SAC / SPA.

Table 10-9: Modelled SO_x Do-Nothing Concentrations within the SAC / SPA's

Pollutant/ Scenario / Year	Averaging Period	Process Contribution (µg/m³)	Annual Mean Background (µg/m³)	Predicted Emission Concentration - PEC (µg/Nm³)	Standard (µg/Nm³) Note 1	PEC as a % of Standard
Do-Nothing Scenario / 2017	Annual Mean	0.0061	2.5	2.51	20	13%

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

10.4.4 Climate – Do-Nothing Regional Impact

There are a number of greenhouse gas emissions to atmosphere during the Do-Nothing operation of the Airport. Road traffic, aviation and space heating of buildings may give rise to CO_2 and N_2O emissions.

The regional impact of the currently operational Waterford Airport on emissions of NOx has been assessed using the procedures of EMEP/EEA Air Pollutant Emission Inventory Database and comparing them to Ireland's emission targets. It is calculated that the Do-Nothing annual NO_2 emissions from the airport are at 12,803 kg. The results show that the likely contribution of the Do-Nothing airport activities on Ireland's obligations under the Targets set out by EU Directive 2016/2284 "*On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC*" are imperceptible and long-term. For the worst-case future assessment year of 2025, the predicted impact of the Do-Nothing operations at the Airport is to contribute to NOx levels by 0.01% of the NO_x emissions ceiling of 40.7 kt NOx to be complied with from 2030.

The regional impact of the proposed Waterford Airport expansion on emissions of CO_2 were also assessed using the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016. The results show that Do-Nothing operations at Waterford Airport contribute 0.016% of CO_2 emissions compared to Ireland's EU 2030 Target. However as noted in Section 10.3.2 as Ireland is a member of ICAO, Irish aircraft operators will have to offset any emissions growth after 2030 by purchasing eligible emission units, i.e. pay full carbon price.

10.4.5 Road Traffic – Do-Nothing Impact

The Do-nothing scenario is contained within Section 10.6.6. TII Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (TII 2011) detail a methodology for determining air quality impact significance criteria for road schemes and has been adopted for this assessment, as is best practice. The degree of impact is determined based on both the absolute and relative impact of the proposed extension. Results are compared against the 'Do-Nothing' scenario, which assumes that the proposed extension is not in place in future years, in order to determine the degree of impact.

10.5 Potential Impacts – Construction

The greatest potential impact on air quality during the construction phase of the proposed extension is from construction dust emissions and the potential for nuisance dust and PM_{10}/$PM_{2.5}$ emissions (Table 10-10). While construction dust tends to be deposited within 200m of a construction site, the majority of the deposition occurs within the first 50m. There are a small number sensitive receptors, predominantly residential properties in close proximity to the site boundary however due to the large landholding of the airport these are mostly greater than 200m from construction areas. There are a small number of closer receptors which have the potential to have short term, slight adverse impacts. However, these impacts can be easily mitigated and with mitigation measures in place it is predicted that potential impacts can be reduced to short term and negligible.

There is the potential for a number of greenhouse gas emissions to the atmosphere during the construction phase of the extension. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions. However, due to the scale of the project it is predicted that the construction phase GHG impacts will be negligible and short-term.

Construction traffic related impacts have been scoped out in Section 10.2.2.

Table 10-10: 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

10.6 Potential Impacts – Operation

10.6.1 Air Quality – Do-Something NO_2

The NO_2 modelling results for the Do-Something operational scenario are detailed in Table 10.11. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for NO_2. Emissions from the aircraft lead to an ambient NO_2 concentration which is 36% of the maximum 1-hour limit value (measured as a 99.8th%ile) and 14% of the annual limit value at the worst-case off-site receptor for the worst-case years modelled (2017). When background concentrations are included this rises to 40% of the maximum 1-hour limit value (measured as a 99.8th%ile) and 24% of the annual limit value at the worst-case off-site receptor.

The geographical variations in ground level NO_2 concentrations (without background) beyond the Airport boundary for the worst-case year modelled are illustrated as concentration contours in Figures 10.5 which shows the Do-Something scenario predicted annual mean NO2 concentrations (2017).

Table 10-11: Modelled NO_2 Concentrations for Do-Something Scenario (µg/m³)

Scenario / Year	Averaging Period	Process Contribution (µg/m³)	Background (µg/m³)	Predicted Emission Concentration - PEC (µg/Nm³)	Standard (µg/Nm³) Note 1	PEC as a % of Standard
Do-Something Scenario / 2014	Annual mean	4.39	4	8.39	40	21%
	99.8^{th}%ile of 1-hr Means	70.99	8	79.0	200	39%
Do-Something Scenario / 2015	Annual mean	4.73	4	8.73	40	22%
	99.8^{th}%ile of 1-hr Means	70.93	8	78.9	200	39%
Do-Something Scenario / 2016	Annual mean	4.82	4	8.82	40	22%
	99.8^{th}%ile of 1-hr Means	71.16	8	79.2	200	40%
Do-Something Scenario / 2017	Annual mean	5.70	4	9.70	40	24%
	99.8^{th}%ile of 1-hr Means	72.61	8	80.6	200	40%
Do-Something Scenario / 2018	Annual mean	5.32	4	9.32	40	23%
	99.8^{th}%ile of 1-hr Means	71.07	8	79.1	200	40%

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

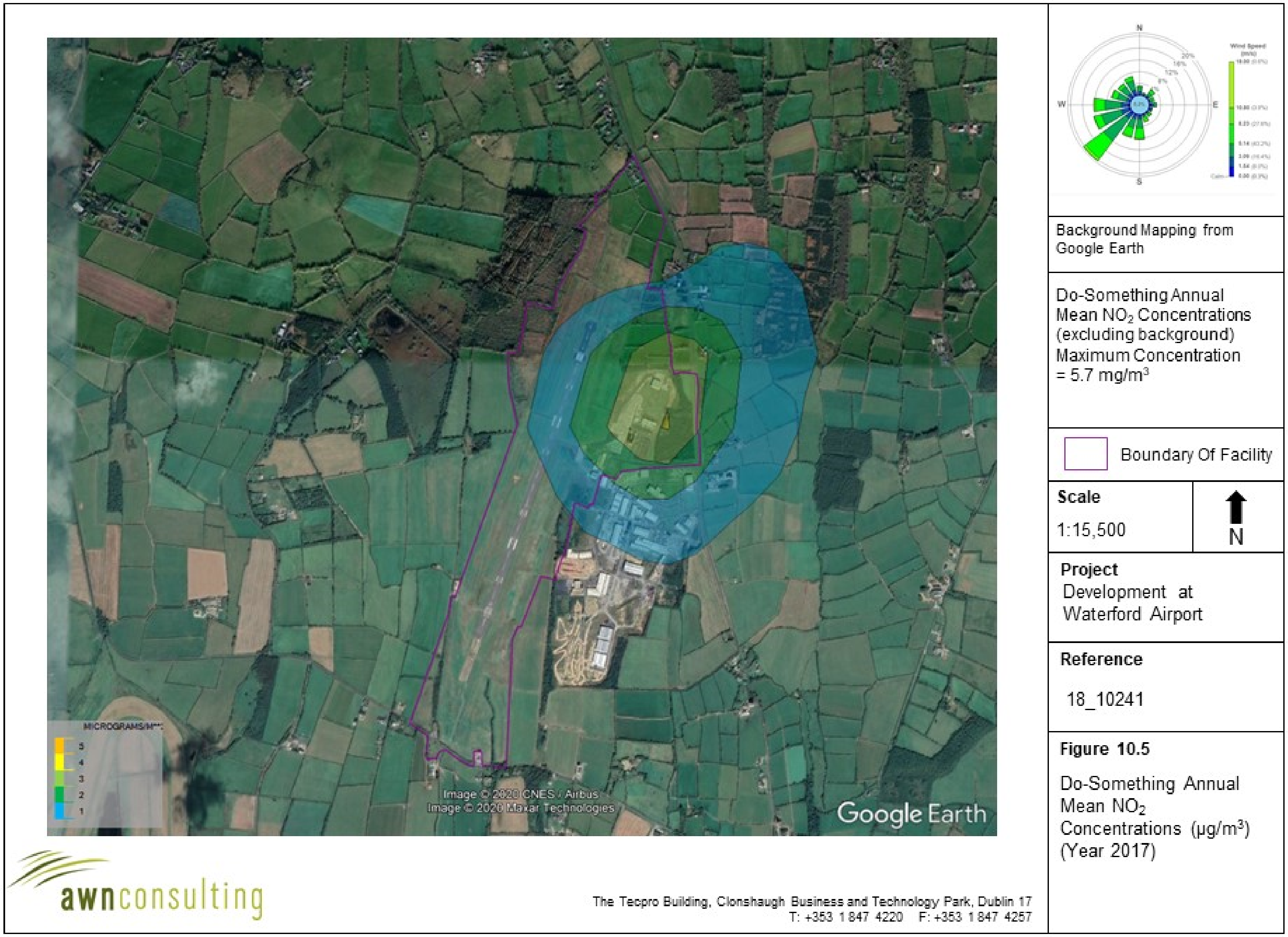

Figure 10-5: Do-Something Annual Mean NO_2

10.6.2 Air Quality – Do-Something SO_2

The SO_2 modelling results for the Do-Something Scenario are detailed in Table 10.11. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for SO_2. Emissions from the Do-Something additional flights lead to an ambient SO_2 concentration which is 3% of the maximum 1-hour limit value (measured as a 99.7th%ile) and 2% of the maximum 24-hour limit value (measured as a 99.2nd%ile) at the worst-case off-site receptor for the worst-case year modelled (2018). When background concentrations are included this rises to 6.6% of the 1-hour limit value (measured as a 99.7th%ile) and 6.4% of the 24-hour limit value (measured as a 99.2nd%ile) at the worst-case off-site receptor.

The geographical variations in ground level SO_2 concentrations (without background) beyond the Airport boundary for the worst-case year modelled are illustrated as concentration contour in Figure 10.6. This shows the predicted 24-Hour SO_2 concentrations (as a 99.2nd percentile) for the Do-Something scenario (2018).

Table 10-12: Modelled SO_2 Concentrations for Do-Something Scenario (µg/m^3)

Scenario / Year	Averaging Period	Process Contribution (µg/m^3)	Background (µg/m^3) Note 1	Predicted Emission Concentration - PEC (µg/Nm^3)	Standard (µg/Nm^3) Note 2	PEC as a % of Standard
Do-Something Scenario / 2014	99.2nd%ile of 24-hr Means	2.67	2.50	7.7	125	6%
	99.7th%ile of 1-hr Means	10.77	2.50	15.8	350	5%
Do-Something Scenario / 2015	99.2nd%ile of 24-hr Means	2.31	2.50	7.3	125	6%
	99.8th%ile of 1-hr Means	10.55	2.50	15.6	350	4%
Do-Something Scenario / 2016	99.2nd%ile of 24-hr Means	2.07	2.50	7.1	125	6%
	99.8th%ile of 1-hr Means	11.17	2.50	16.2	350	5%
Do-Something Scenario / 2017	99.2nd%ile of 24-hr Means	3.01	2.50	8.0	125	6%
	99.8th%ile of 1-hr Means	12.93	2.50	17.9	350	5%
Do-Something Scenario / 2018	99.2nd%ile of 24-hr Means	3.10	2.50	8.1	125	6%
	99.8th%ile of 1-hr Means	18.20	2.50	23.2	350	7%

Note 1 Short-term Emission Concentrations calculated according to UK DEFRA guidance
Note 2 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

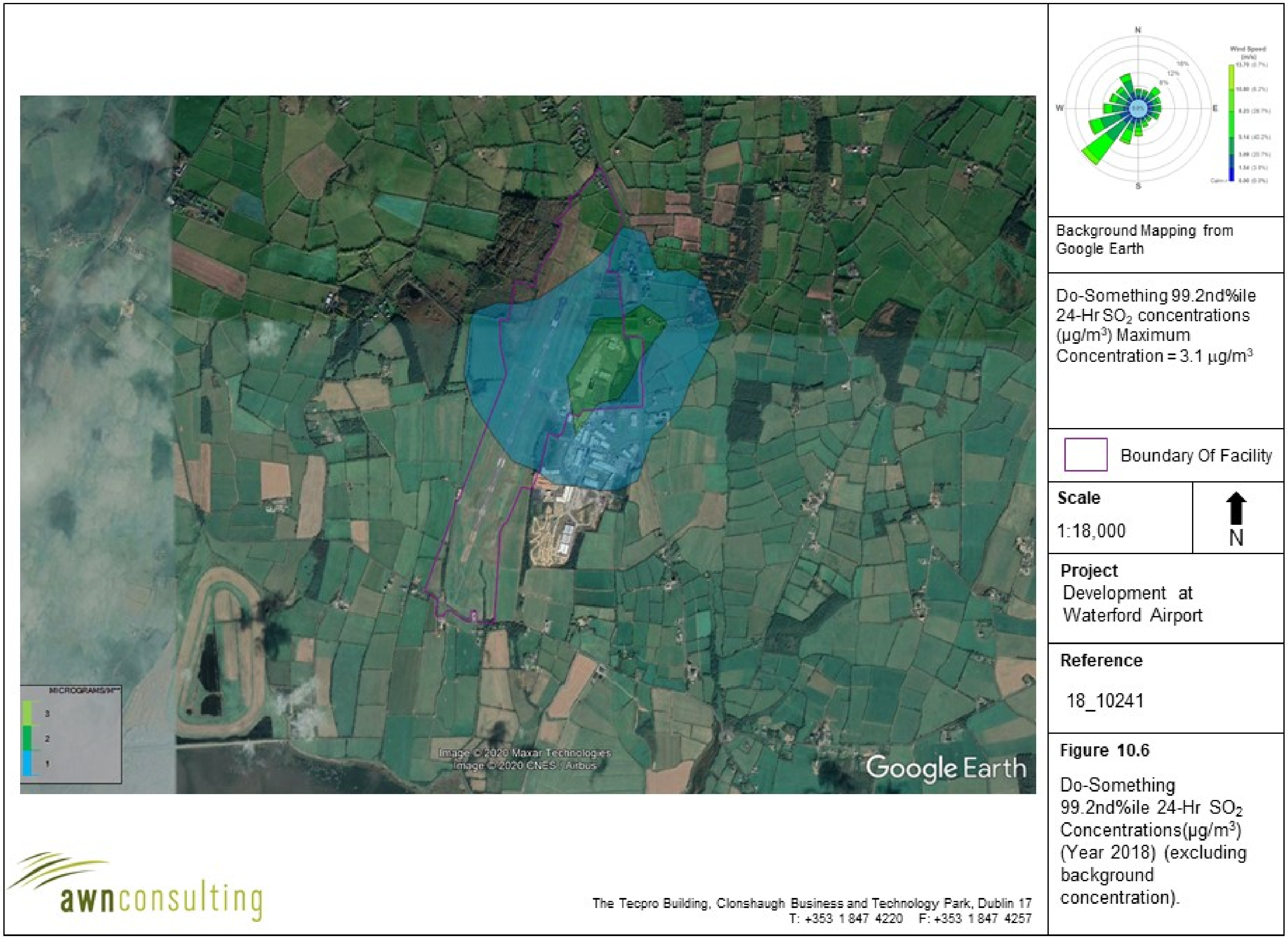

Figure 10-6: Do-Something 24-Hour SO_2 Concentrations (as a 99.2^{nd} percentile)

10.6.3 Air Quality – Do-Something CO

The CO modelling results for the Do-Something operation of the airport are detailed in Table 10.12. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for CO. Emissions from the Airport lead to an ambient CO concentration which is 10% of the maximum 8-hour average (2017). When background concentrations are included this rises to 34% of the maximum 8-hour average at the worst-case off-site receptor.

The geographical variations in ground level CO concentrations (without background) beyond the Airport boundary for the worst-case years modelled are illustrated as concentration contours in Figure 10.7. This shows the maximum 8-hour CO concentrations for the Do-Something scenario (2017).

Table 10-13: Modelled CO Concentrations for Do-Something Scenario (μg/m^3)

Scenario / Year	Averaging Period	Process Contribution (mg/m^3)	Background (mg/m^3)	Predicted Emission Concentration - PEC (mg/Nm^3)	Standard (mg/Nm^3) Note 1	PEC as a % of Standard
Do-Something Scenario / 2014	Maximum 8-hour average	0.63	2.4	3.03	10	30%
Do-Something Scenario / 2015	Maximum 8-hour average	0.76	2.4	3.16	10	32%
Do-Something Scenario / 2016	Maximum 8-hour average	0.82	2.4	3.22	10	32%
Do-Something Scenario / 2017	Maximum 8-hour average	0.97	2.4	3.37	10	34%
Do-Something Scenario / 2018	Maximum 8-hour average	0.67	2.4	3.07	10	31%

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

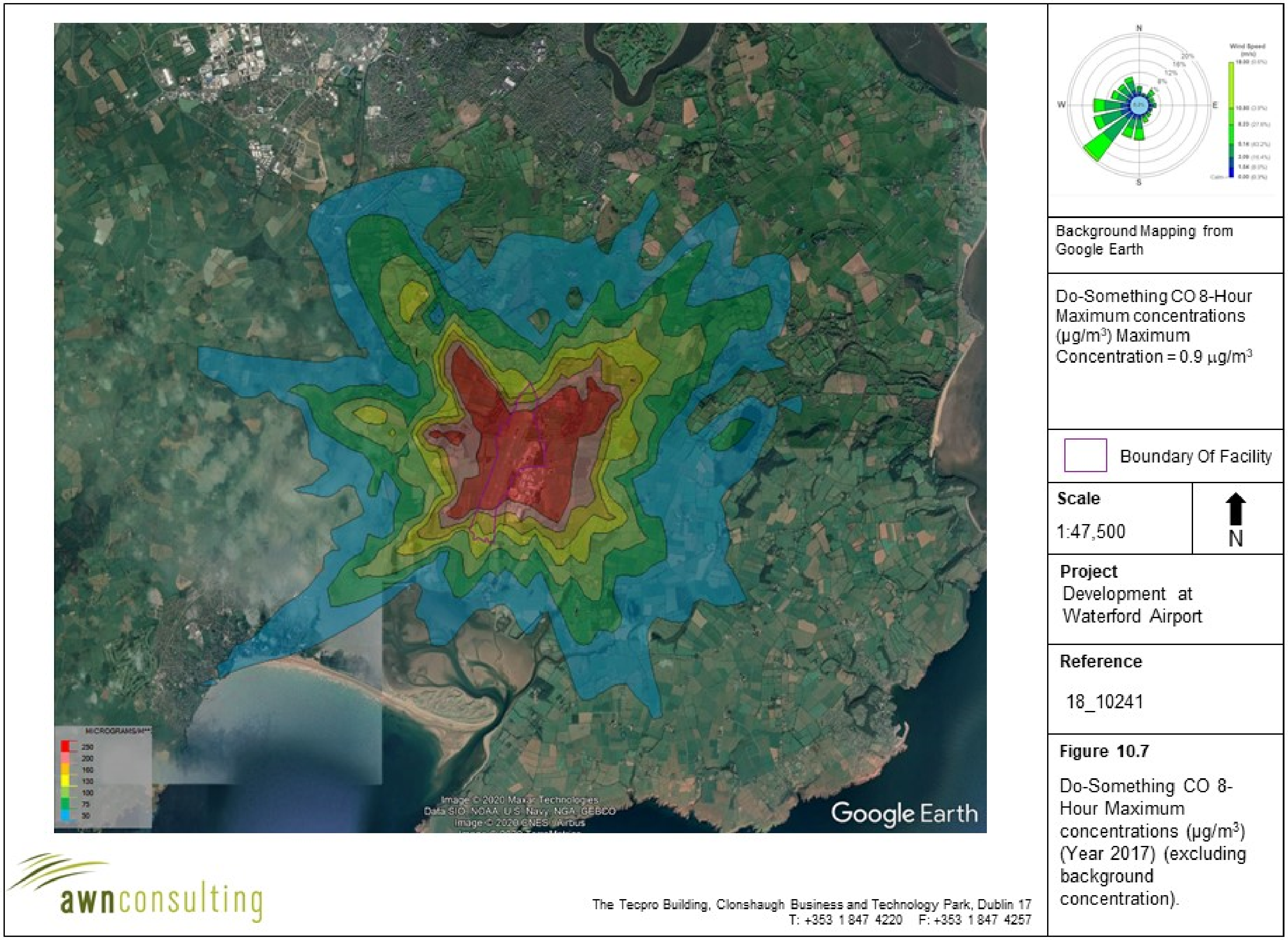

Figure 10-7: Do-Something Annual Mean CO Concentrations

10.6.4 Impact of NO_x and SO_2 Emissions on Sensitive Ecosystems

The impact of the emissions of NO_x and SO_2 from the expansion of Waterford Airport on ambient ground level concentrations within the Tramore Dunes and Backstrand SAC and SPA was assessed using AERMOD. Annual limit values for both pollutants are specified within EU Directive 2008/50/EC for the protection of ecosystems and vegetation. Annual average concentrations for both pollutants were predicted at receptors located within the SAC / SPA boundary from the emission points for the worst-case year for annual average concentrations (2017).

The NO_x modelling results for the Do-Something Scenario is detailed in Table 10.13. The results indicate that the ambient ground level concentrations are below the relevant air quality standard for NO_x for the protection of ecosystems. Emissions for the Do-Something Scenario lead to annual NO_x concentrations within the SAC which are 0.59% of the annual limit value at the worst-case location within the SAC / SPA's. Ambient NOx concentrations including background reach 37% the annual limit value at the worst-case location within the SAC / SP's for Do-Something Scenario.

Table 10-14: Modelled NO_x Do-Something Concentrations within the SAC / SPA's

Pollutant/ Scenario / Year	Averaging Period	Process Contribution (µg/m^3)	Annual Mean Background (µg/m^3)	Predicted Emission Concentration - PEC (µg/Nm^3)	Standard (µg/Nm^3) Note 1	PEC as a % of Standard
Do-Something Scenario / 2017	Annual Mean	0.18	11	11.18	30	37%

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

The NO_x modelling results for the Do-Something Scenario is detailed in Table 10.14. The results indicate that the ambient ground level concentrations are below the relevant air quality standard for SO_2 for the protection of vegetation for the Do-Something Scenario. Emissions from the Airport for the Do-Something Scenario lead to an ambient SO_2 concentration which are 0.09% of the annual limit value at the worst-case location within the SAC / SPA. When background concentrations are included this rises to 13% of the annual limit value at the worst-case location. The annual mean SO_2 results for Do-Something Scenario indicate that the ambient ground level concentrations including background do not exceed the relevant air quality standard for SO_2 at the worst-case location within the SAC / SPA.

Table 10-15: Modelled SO_x Do-Something Concentrations within the SAC / SPA's

Pollutant/ Scenario / Year	Averaging Period	Process Contribution (µg/m³)	Annual Mean Background (µg/m³)	Predicted Emission Concentration - PEC (µg/Nm³)	Standard (µg/Nm³) Note 1	PEC as a % of Standard
Do-Something Scenario / 2018	Annual Mean	0.02	2.5	2.52	20	13%

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

10.6.5 Climate – Do-Something Regional Impact

The regional impact of the Waterford Airport expansion on emissions of NO_x has been assessed using the procedures of EMEP/EEA Air Pollutant Emission Inventory Database and comparing them to Irelands emission targets. It is predicted that the annual NO_2 emissions from the airport will be 21,081 kg with the Do-Something additional flights. The results (see Table 10-16) show that the likely impact of the proposed extension on Ireland's obligations under the EU Directive 2016/2284 "*On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC*" are imperceptible. For the worst-case future assessment year of 2025, the predicted impact of the Do-Nothing operations at the Airport is to contribute to NOx levels by 0.055% of the NO_x emissions ceiling to be complied with from 2030 of 40.7 kt.

The regional impact of the Do-Something Waterford Airport expansion on emissions of CO_2 was also assessed using the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016. The results show that proposed extension of operations at Waterford Airport contribute 0.016% of CO_2 emissions compared to Ireland's EU 2030 Target, increasing total emissions from the airport to 0.019% compared to Ireland's EU 2030 Target. However as noted in Section 10.3.2 as Ireland is a member of ICAO, Irish aircraft operators will have to offset any emissions growth after 2030 by purchasing eligible emission units, i.e. pay full carbon price.

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

Table 10-16: Regional Air Quality Assessment

Year	Scenario	NO_x (kg/annum)	CO_2 (tonnes/annum)
2025	Do Nothing	4,355	1,104
	Do Something	26,755	6,378
Increment in 2025		22,400 kg	5,274 tonnes
Emission Ceiling (kilo Tonnes) 2030		40.7 Note 1	32,860 Note 1
Impact (%)		0.055%	0.016 %

Note 1 Target under Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013

10.6.6 Road Traffic – Impacts

10.6.6.1 Local Air Quality

TII Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (TII, 2011) detail a methodology for determining air quality impact significance criteria for road schemes and has been adopted for this assessment, as is best practice. The degree of impact is determined based on both the absolute and relative impact of the Do-Something extension. Results are compared against the 'Do-Nothing' scenario, which assumes that the Do-Something extension is not in place in future years, in order to determine the degree of impact.

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

Traffic flow information was obtained from the traffic engineers for this project. This traffic data 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.

NO2

The results of the assessment of the impact of the Do-Something extension on NO2 in the opening and design years are shown Table 10-17 for the Highways Agency IAN 170/12 and Table 10-18 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 NO2 are 10% in 2021 and 9% in 2025 of the annual limit value using the more conservative IAN technique, while concentrations are 9% and 8% of the annual limit value in 2021 and 2025 using the UK Department for Environment, Food and Rural Affairs technique. The hourly limit value for NO2 is 200 µg/m3 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 NO2 concentration is not predicted to be exceeded in 2021 or 2025 using either technique (Table 10-19)

The impact of the Do-Something extension on annual mean NO_2 levels can be assessed relative to "Do Nothing (DN)" levels in 2021 and 2025. Relative to baseline levels, some imperceptible increases in pollutant levels are predicted as a result of the Do-Something extension. With regard to impacts at individual receptors, the greatest impact on NO_2 concentrations will be an increase of 1.1% of the annual limit value at receptor R2. Thus, using the assessment criteria outlined in Tables 10-25 and Table 10-26, the impact of the Do-Something extension in terms of NO_2 is negligible. Therefore, the overall impact of NO_2 concentrations as a result of the Do-Something extension is long-term and imperceptible at all of the receptors assessed.

PM_{10}

The results of the modelled impact of the Do-Something extension for PM_{10} in the opening and design years are shown in Table 10-20. Predicted annual average concentrations at the worst-case receptor in the region of the extension are 28% of the limit value in 2021 and in 2025. It is predicted that the worst-case receptors will not experience any days of exceedance of the 50 µg/m^3 24-hour mean value in 2021 or 2025, either with or without the Do-Something extension in place.

The impact of the Do-Something extension can be assessed relative to "Do Nothing" levels in 2021 and 2025 (see Table 10-20). Relative to baseline levels, some imperceptible increases in PM_{10} levels at the worst-case receptors are predicted as a result of the Do-Something extension. The greatest impact on PM_{10} concentrations in the region of the Do-Something extension in either 2021 or 2025 will be an increase of 1% of the annual limit value at receptor R2. Thus, the magnitude of the changes in air quality are negligible at all receptors based on the criteria outlined in Tables 10-25 and Table 10-26. Therefore, the overall impact of PM_{10} concentrations as a result of the Do-Something extension is long-term and imperceptible.

$PM_{2.5}$

The results of the modelled impact of the Do-Something extension for $PM_{2.5}$ in the opening and design years are shown in Table 10-21. Predicted annual average concentrations in the region of the Do-Something extension are 27% of the limit value in 2021 and 2025 at all worst-case receptors.

The impact of the extension can be assessed relative to "Do Nothing" levels in 2021 and 2025 (see Table 10-21). Relative to baseline levels, imperceptible increases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the Do-Something extension. Neither of the two receptors assessed will experience an increase in concentrations of over 0.13% of the limit value in 2021 and 2025. Therefore, using the assessment criteria outlined in Tables 10-25 and Table 10-26, the impact of the Do-Something extension with regard to $PM_{2.5}$ is negligible at the two receptors assessed. Overall, the impact of increased $PM_{2.5}$ concentrations as a result of the Do-Something extension 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 Table 10-22 and

Table 10-23 respectively. Predicted pollutant concentrations with the Do-Something extension in place are below the ambient standards at all locations. Levels of CO are 24% of the limit value in 2021 and 2025; with levels of benzene reaching 10% of the limit value in 2021 and 11% in 2025. Future trends indicate similarly low levels of CO and benzene.

The impact of the Do-Something extension can be assessed relative to "Do Nothing" levels in 2021 and 2025. Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the Do-Something extension. The greatest impact on CO and benzene concentrations will be an increase of 0.02% of the CO limit and 0.03% of the benzene limit value at receptor R2. Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Tables 10-25 and Table 10-26 and applying these criteria to CO and benzene, the impact of the Do-Something extension in terms of CO and benzene is long-term and imperceptible.

Summary of Traffic Air Quality Modelling Assessment

Levels of traffic-derived air pollutants from the Do-Something extension will not exceed the ambient air quality standards either with or without the Do-Something extension in place. Using the assessment criteria outlined in Tables 10-25 and Table 10-26, the impact of the extension in terms of NO_2, PM_{10}, $PM_{2.5}$, CO and benzene is long-term, localised negative and imperceptible.

10.6.6.2 Regional Air Quality Impact

The regional impact of the Do-Something development on emissions of NO_X and VOCs has been assessed using the procedures of TII (TII 2011) and the UK Department for Environment, Food and Rural Affairs (2018). The results (see Table 10-24) show that the likely impact of the Do-Something 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 opening year 2021, the predicted impact of the changes in AADT is to increase NO_x levels by 0.00024% of the NO_x emissions ceiling and increase VOC levels by 0.000046% of the VOC emissions ceiling to be complied with in 2020. For the design year 2021 the predicted impact of the changes in AADT is to increase NO_x levels by 0.00134% of the NO_x emissions ceiling and increase VOC levels by 0.00018%of the VOC emissions ceiling to be complied with in 2025.

Therefore, the impacts on regional air quality during the operational stage of the Do-Something development are predicted to be long-term and imperceptible.

10.6.6.3 Climate

The impact of the Do-Something development on emissions of CO_2 impacting climate was also assessed using the Design Manual for Roads and Bridges screening model (see Table 10-24). The results show that the impact of the Do-Something development will be to increase CO_2 emissions by 0.000164% of Ireland's EU Target in the opening year of 2021 and by 0.000601% in the design year of 2025. Thus, the impact of the Do-Something development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2030 Target (European Parliament and Council of Europe 2018).

Therefore, the impacts on climate from road traffic during the operational stage of the Do-Something development are predicted to be long-term and imperceptible.

Table 10-17: Annual Mean NO_2 Concentrations (µg/m^3) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Impact Opening Year (2021)					Impact Design Year (2025)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	3.6	3.6	0.04	Imperceptible	Negligible Increase	3.5	3.6	0.17	Imperceptible	Negligible Increase
2	3.9	4.0	0.12	Imperceptible	Negligible Increase	3.8	4.2	0.46	Small	Small Increase

Table 10-18: Annual Mean NO_2 Concentrations (µg/m^3) (using UK Department for Environment, Food and Rural Affairs Technical Guidance)

Receptor	Impact Opening Year (2021)					Impact Design Year (2025)				
	DM	DS	DS-DM	DM	DS	DM	DM	DS	Magnitude	DM
1	3.5	3.5	0.04	Imperceptible	Negligible Increase	3.0	3.2	0.15	Imperceptible	Negligible Increase
2	3.8	3.9	0.12	Imperceptible	Negligible Increase	3.3	3.7	0.40	Small	Small Increase

Table 10-19: 99.8th percentile of daily maximum 1-hour for NO_2 concentrations (µg/m^3)

Receptor	1-Hour 99.8th%ile NO_2 Concentrations (µg/m^3)							
	IAN 170/12 V3 Long Term NO_2 Trend Projections Technique				Defra's Technical Guidance Technique			
	Impact Opening Year (2021)		Impact Design Year (2025)		Impact Opening Year (2021)		Impact Design Year (2025)	
	DM	DS	DM	DS	DM	DS	DM	DS
1	12.5	12.7	12.1	12.7	12.5	12.7	12.1	12.7
2	13.6	14	13.2	14.8	13.6	14	13.2	14.8

Table 10-20: Annual Mean PM_{10} Concentrations (µg/m^3)

Receptor	Impact Opening Year (2021)					Impact Design Year (2025)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	11.0	11.0	0.00	Imperceptible	Negligible Increase	11.0	11.1	0.02	Imperceptible	Negligible Increase
2	11.1	11.1	0.01	Imperceptible	Negligible Increase	11.1	11.2	0.05	Imperceptible	Negligible Increase

Table 10-21: Annual Mean $PM_{2.5}$ Concentrations (µg/m^3)

Receptor	Impact Opening Year (2021)					Impact Design Year (2025)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	6.62	6.6	0.00	Imperceptible	Negligible Increase	6.6	6.6	0.01	Imperceptible	Negligible Increase
2	6.66	6.7	0.01	Imperceptible	Negligible Increase	6.7	6.7	0.03	Imperceptible	Negligible Increase

Table 10-22: Maximum 8-hour CO Concentrations (mg/m^3)

Receptor	Impact Opening Year (2021)					Impact Design Year (2025)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	2.40	2.40	0.000	Imperceptible	Negligible Increase	2.40	2.40	0.001	Imperceptible	Negligible Increase
2	2.40	2.40	0.000	Imperceptible	Negligible Increase	2.40	2.41	0.002	Imperceptible	Negligible Increase

Table 10-23: Annual Mean Benzene Concentrations (µg/m³)

Receptor	Impact Opening Year (2021)					Impact Design Year (2025)				
	DM	DS	DS-DM	Magnitude	Description	DM	DS	DS-DM	Magnitude	Description
1	0.52	0.52	0.000	Imperceptible	Negligible Increase	0.52	0.52	0.001	Imperceptible	Negligible Increase
2	0.52	0.53	0.000	Imperceptible	Negligible Increase	0.53	0.53	0.002	Imperceptible	Negligible Increase

Table 10-24: Regional Air Quality & Climate Assessment

Year	Scenario	VOC (kg/annum)	NOX (kg/annum)	CO_2 (tonnes/annum)
2021	Do Nothing	147	631	357
	Do Something	173	793	419
2025	Do Nothing	151	647	370
	Do Something	247	1192	598
Increment in 2027		26.3 kg	162.1 kg	62.2 Tonnes
Increment in 2037		95.9 kg	545 kg	228.2 Tonnes
Emission Ceiling (kilo Tonnes) 2020		56.9 Note 1	66.9 Note 1	37,943 Note 2
Emission Ceiling (kilo Tonnes) 2030		51.6 Note 1	40.7 Note 1	32,860 Note 3
Impact in 2021 (%)		0.0000461 %	0.000242 %	0.000164 %
Impact in 2025 (%)		0.0001858 %	0.00134 %	0.000601 %

Note 1 Targets under 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"

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

Note 3 Target under Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013

10.7 Cumulative Impacts

Levels of road traffic-derived air pollutants from the Do-Something extension will not exceed the ambient air quality standards either with or without the Do-Something extension in place. Using the assessment criteria outlined in Tables 10-25 and Table 10-26, the impact of the extension in terms of NO2, PM10, PM2.5, CO and benzene is long-term, localised negative and imperceptible. There is not considered to be a cumulative impact due to road and aircraft impacts on local sensitive receptors.

The nearest IPC licensed source is 6.7km from Waterford Airport, this is outside the area of perceptible modelled impacts for the Airport as shown in the contour plots in section 10.6. There are no other significant sources of pollutants in the area.

Should the construction phases of Waterford Airport and any other permitted developments coincide, it is predicted that once appropriate mitigations are put in place during the construction for the above schemes, impacts will not be significant. The cumulative impact of other permitted developments and airport expansion area also predicted to cause insignificant impacts during the operational phase with respect to local air quality for the long and short term due to limited size of the area of impact from the airport.

10.8 Mitigation Measures

10.8.1 Construction Phase

The greatest potential impact on air quality during the construction phase is from construction dust emissions, $PM_{10}/PM_{2.5}$ emissions and the potential for nuisance dust.

In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of a dust minimisation plan. Additional mitigation measures recommended in the Institute of Air Quality Management document '*Guidance on the Assessment of Dust from Demolition and Construction*' (2014) for sensitive receptors have been included. Provided the dust minimisation measures outlined in the Plan (see Appendix 10.2) and construction management plan are adhered to, the air quality impacts during the construction phase should be not be significant.

In summary the measures which will be implemented will include:

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic.
- Any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.
- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates.
- Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust.
- Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.

- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

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

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.

10.8.2 Operational Phase

In general mitigation measures in relation to road 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 6dtemp.

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 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.

The EU agreed in 2014 to limit the scope of aviation in the EU ETS to flights within the EEA to support the planned development of a global Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) by the International Civil Aviation Organisation (ICAO). The CAP notes that CORSIA will come into effect in 2021. Its aim is to stabilise global aviation emissions at 2020 levels by requiring airlines to offset any emissions growth after 2020 by purchasing eligible emission units generated by projects that reduce emissions in other sectors. As Ireland is a member of ICAO, Irish aircraft operators will have to offset any emissions growth after 2020 by purchasing eligible emission units, i.e. pay full carbon price. This will offset CO_2 impacts due to the operational phase of the extension.

In addition, emissions of pollutants from aircraft traffic can be controlled most effectively by ensuring free flowing of aircraft traffic and reductions in idling and taxi times with engines running. This can be implemented through good flight traffic management.

10.9 Residual Impacts

A summary of residual impacts is show in Table 10.25. When the dust minimisation measures detailed in the mitigation section of this Chapter and construction management plan are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors, which are as close as 10m from the airport boundary to the south or 50m from the airport boundary to the north east of the site.

Worst-case predicted ambient concentrations can be compared with the relevant ambient air quality standards to assess the compliance of the Do-Something Airport Extension with ambient air quality standards. The worst-case locations are significantly below limit values for all pollutants assessed. Transport Infrastructure Ireland guidance document '*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*' (TII 2011) detail a methodology for determining air quality impact significance criteria for road schemes. This criteria for impact utilised in this assessment to determine the degree of impact based on both the absolute and relative impact of the Do-Something Airport Extension. Although not designed for Airports the impacts on sensitive receptors due to increased pollutant concentrations are designed for the protection of human health and therefore the magnitude of impact is transferable to a different source.

Therefore, the Transport Infrastructure Ireland significance criteria have been adopted for the Do-Something extension and are detailed in Tables 10-25 and Table 10-26, resulting in a slight adverse impact. However, this guidance is based on the impact at sensitive receptors such as residential properties rather than at the worst case off site locations as outlined in Section 10.6. If the impact at the worst case impacted sensitive receptor is calculated the magnitude of increase in concentrations (as per Table 10-26) between the Do-Nothing and Do-Something decreases from a large increase in NO_2 of 6.16 $\mu g/m^3$ (0.46 $\mu g/m^3$ from road traffic and 5.7 $\mu g/m^3$ from aircraft) to a small increase in NO_2 of 0.62 $\mu g/m^3$ (0.46 $\mu g/m^3$ from road traffic and 0.16 $\mu g/m^3$ from aircraft)

Levels of road traffic-derived air pollutants from the Do-Something extension will not exceed the ambient air quality standards either with or without the Do-Something extension in place. Using the assessment criteria outlined in '*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*' (TII 2011) and Tables 10-25 and Table 10-26, the impact of the Do-Something extension in terms of NO_2, PM_{10}, $PM_{2.5}$, CO and benzene is long-term, localised negative and imperceptible. There is not considered to be a cumulative impact due to road and aircraft impacts on local sensitive receptors.

Results of the road and aircraft dispersion modelling studies indicate that the residual impacts of the Do-Something extension on air quality and climate are predicted to be negative, not significant and long-term with respect to the operational phase local air quality assessment at the nearest residential receptor.

Table 10-25: Summary of Impacts

Phase	Pollutant	Extent	Duration	Impact with Mitigation Measured at Nearest Sensitive Receptor
Construction	Dust/Particulates	Local	Short term	Negative / Imperceptible
	Greenhouse gases	Regional	Short term	Negative / Imperceptible
	NO_2	Local	Short term	Negative / Imperceptible
	SO_2	Local	Short term	Negative / Imperceptible
	CO	Local	Short term	Negative / Imperceptible

Phase	Pollutant	Extent	Duration	Impact with Mitigation Measured at Nearest Sensitive Receptor
Operational	Dust/Particulates	Local	Long term	Negative / Imperceptible
	Greenhouse gases	Regional	Long term	Negative / Negligible
	NO_2	Local	Long term	Negative / Negligible
	SO_2	Local	Long term	Negative / Negligible
	CO	Local	Long term	Negative / Negligible
	Benzene	Local	Long term	Negative / Imperceptible

Table 10-26: 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 $\mu g/m^3$	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥ 4 $\mu g/m^3$	Increase / decrease >4 days	Increase / decrease ≥ 2.5 $\mu g/m^3$
Medium	Increase / decrease 2 - < 4 $\mu g/m^3$	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 $\mu g/m^3$
Small	Increase / decrease 0.4 - < 2 $\mu g/m^3$	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 $\mu g/m^3$
Imperceptible	Increase / decrease < 0.4 $\mu g/m^3$	Increase / decrease <1 day	Increase / decrease < 0.25 $\mu g/m^3$

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

Table 10-27: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration		
	Small	Moderate	Large
Increase with Scheme			
Above Objective/Limit Value with Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Substantial adverse
Just Below Objective/Limit Value with Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Moderate adverse
Below Objective/Limit Value with Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight adverse	Slight adverse
Well Below Objective/Limit Value with Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight adverse
Decrease with Scheme			
Above Objective/Limit Value with Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Substantial beneficial
Just Below Objective/Limit Value with Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Moderate beneficial
Below Objective/Limit Value with Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight beneficial	Slight beneficial
Well Below Objective/Limit Value with Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight beneficial

Note 1 Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible
Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

10.10 References

Climate Change Advisory Committee (CCAC) (2019) Climate Change Advisory Committee Annual Review

DEHLG (2004) National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010

DCCAE (2017) National Mitigation Plan

DCCAE (2018) National Adaptation Framework - Planning for a Climate Resilient Ireland

DCCAE (2019) Climate Action Plan 2019

EMEP (2017) EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 (updated July 2017) and Database

European Council (2014) Conclusions on 2030 Climate and Energy Policy Framework, SN 79/14

Environmental Protection Agency (2019a) Ireland's Transboundary Gas Emissions 1990 –2030

Environmental Protection Agency (2019b) Air Quality Monitoring Report 2018 (& previous annual reports)

Environmental Protection Agency (2019c) Ireland's Final Greenhouse Gas Emissions 1990 – 2017

Environmental Protection Agency (2019d) GHG Emissions Projections Report - Ireland's Greenhouse Gas Emissions Projections 2018 - 2040

EPA (2020a) Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)

European Parliament and Council of Europe (2018) Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013

Environmental Protection Agency (2020b) Ireland's Final Greenhouse Gas emissions 1990 – 2018

Environmental Protection Agency (2020c) EPA website Available at: http://www.epa.ie/whatwedo/monitoring/air/

ERM (1998) Limitation and Reduction of CO_2 and Other Greenhouse Gas Emissions in Ireland

FCCC (1999) Ireland - Report on the in-depth review of the second national communication of Ireland

Met Éireann (2020) Met Eireann website: https://www.met.ie/

Paine, R & Lew, F. "Consequence Analysis for Adoption of PRIME: an Advanced Building Downwash Model" Prepared for the EPRI, ENSR Document No. 2460-026-450 (199a7).

Paine, R & Lew, F. "Results of the Independent Evaluation of ISCST3 and ISC-PRIME" Prepared for the EPRI, ENSR Document No. 2460-026-3527-02 (1997b).

Schulman, L.L; Strimaitis, D.G.; Scire, J.S. (2000) Development and evaluation of the PRIME plume rise and building downwash model. Journal of the Air & Waste Management Association, 50, 378-390.

Swiss Confederation (2015) Guidance on the Determination of Helicopter Emissions Reference: COO.2207.111.2.2015750 Edition 2

Transport Infrastructure Ireland (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes (Rev. 2, Transport Infrastructure Ireland, 2009)

Transport Infrastructure Ireland (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes

USEPA (1995) User's Guide for the Industrial Source Complex (ISC3) Dispersion Model

USEPA (1998) Human Health Risk Assessment Protocol, Chapter 3: Air Dispersion and Deposition Modelling, Region 6 Centre for Combustion Science and Engineering

USEPA (1999) Comparison of Regulatory Design Concentrations: AERMOD vs. ISCST3 vs. CTDM PLUS

USEPA (2000) Seventh Conference on Air Quality Modelling (June 2000) Vol I & II

USEPA (2000) Estimating Exposure to Dioxin-Like Compounds Volume IV, Chapter 3 Evaluating Atmospheric Releases of Dioxin-Like Compounds from Combustion Sources (Draft)

USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1

USEPA (2019a) AERMOD Description of Model Formulation

USEPA (2019b) AERMAP Users Guide

USEPA (2019c) User's Guide to the AERMOD Meteorological Preprocessor (AERMET)

USEPA (2016) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1

UK Department of the Environment, Transport and Roads (1998) Preparation of Environmental Statements for Planning Projects That Require Environmental Assessment - A Good Practice Guide, Appendix 8 - Air & Climate

UK DEFRA (2001) DMRB Model Validation for the Purposes of Review and Assessment

UK DEFRA (2018) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM.TG (16)

UK DEFRA (2016) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. PG (16)

UK DEFRA (2019) NOx to NO2 Conversion Spreadsheet (Version 7.1)

UK DEFRA (2018) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM.TG(16)

UK Highways Agency (2007) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 - HA207/07 (Document & Calculation Spreadsheet)

UK Highways Agency (2019) UK Design Manual for Roads and Bridges (DMRB), Volume 11, Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 LA 105 Air quality

UK Highways Agency (2019) UK Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 14 LA 114 Climate

UK Department of the Environment, Transport and Roads (UK DETR) (1998) Preparation of Environmental Statements for Planning Projects That Require Environmental Assessment - A Good Practice Guide, Appendix 8 - Air & Climate

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