8.0 AIR QUALITY & CLIMATE

This chapter assesses the likely air quality and climate impacts, if any, associated with the residential development at Newtown, Drogheda, Co. Louth.

8.1 Background Information

8.1.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table 8.1 and Appendix 8.1).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC, which has set limit values for NO_2, PM_{10}, $PM_{2.5}$, benzene and CO (see Table 8.1). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions (see Appendix 8.1).

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

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

Table 8.1 Air Quality Standards Regulations

8.1.2 Dust Deposition Guidelines

The concern from a health perspective is focussed on particles of dust which are less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$) and the EU ambient air quality standards outlined in Table 8.1 have set ambient air quality limit values for PM_{10} and $PM_{2.5}$.

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Furthermore, no specific criteria have been stipulated for nuisance dust in respect of this development.

With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust)[1] sets a maximum permissible emission level for dust deposition of 350 mg/(m^2*day) averaged over a one year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Health & Local Government[2] apply the Bergerhoff limit of 350 mg/(m^2*day) to the site boundary of quarries. This limit value can also be implemented with regard to dust impacts from construction of the proposed development.

8.1.3 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[3,4]. For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, in June 1998, Ireland agreed to limit the net growth of the six GHGs under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012[5,6]. The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP24) took place in Katowice, Poland from the 4th to the 14th December 2018 and focussed on advancing the implementation of the Paris Agreement. The Paris Agreement was established at COP21 in Paris in 2015 and is an important milestone in terms of international climate change agreements. The Paris Agreement was agreed by over 200 nations and has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 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 was also made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, in October 2014, agreed the "2030 Climate and Energy Policy Framework"(7). 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 27% for the share of renewable energy consumed in the EU in 2030.

8.1.4 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% on 2005 levels), 65 kt for NO_X (49% reduction on 2005 levels), 43 kt for VOCs (25% reduction on 2005 levels), 108 kt for NH_3 (1% reduction on 2005 levels) and 10 kt for $PM_{2.5}$ (18% reduction on 2005 levels).

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005(8,9). Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X(10). 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 – 2029 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (85% below 2005 levels), for NO_X (69% reduction), for VOCs (32% reduction), for NH_3 (5% reduction) and for $PM_{2.5}$ (41% reduction).

8.2 **Assessment Methodology**

8.2.1 Local Air Quality Assessment

The air quality assessment has been carried out following procedures described in the publications by the EPA[11-14] and using the methodology outlined in the guidance documents published by the UK DEFRA[15-17]. The assessment of air quality was carried out using a phased approach as recommended by the UK DEFRA[18]. The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. In the current assessment, an initial scoping of possible key pollutants was carried out and the likely location of air pollution "*hot-spots*" identified. An examination of recent EPA and Local Authority data in Ireland[19,20] has indicated that SO_2 and smoke are unlikely to be exceeded at the majority of locations within Ireland and thus these pollutants do not require detailed monitoring or assessment to be carried out. However, the analysis did indicate potential issues in regards to nitrogen dioxide (NO_2), PM_{10} and $PM_{2.5}$ at busy junctions in urban centres[19,20]. Benzene, although previously reported at quite high levels in urban centres, has recently been measured at several city centre locations to be well below the EU limit value[19,20]. Historically, CO levels in urban areas were a cause for concern. However, CO concentrations have decreased significantly over the past number of years and are now measured to be well below the limits even in urban centres[20]. The key pollutants reviewed in the assessments are NO_2, PM_{10}, $PM_{2.5}$, benzene and CO, with particular focus on NO_2 and PM_{10}.

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

- The Existing Baseline scenario, for model verification;
- Opening Year Do-Nothing scenario (DN), which assumes the retention of present site usage with no development in place;
- Opening Year Do-Something scenario (DS), which assumes the proposed development in place;
- Design Year Do-Nothing scenario (DN), which assumes the retention of present site usage with no development in place; and
- Design Year Do-Something scenario (DS), which assumes the proposed development in place.
  The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model[18] (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet[21] (Version 6.1, October 2017), and following guidance issued by the TII[22], UK Highways Agency[18], UK DEFRA[15-17] and the EPA[11-14].

The TII guidance[22] states that the assessment must progress to detailed modelling if:

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

The UK DMRB guidance[18], on which the TII guidance was based, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment:

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

Concentrations of key pollutants are calculated at sensitive receptors that have the potential to be affected by the proposed development. For road links which are deemed to be affected by the proposed development and within 200 m of the chosen sensitive receptors inputs to the air dispersion model consist of: road layouts, receptor locations, annual average daily traffic movements (AADT), percentage heavy goods vehicles, annual average traffic speeds and background concentrations. The UK DMRB guidance states that road links at a distance of greater than 200 m from a sensitive receptor will not influence pollutant concentrations at the receptor. Using this input data the model predicts the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case road contributions are then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the proposed development with these ambient air quality standards. The TII *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*[22] detail a methodology for determining air quality impact significance criteria for road schemes and this 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 development. The TII significance criteria have been adopted for the proposed development and are detailed in Appendix 8.2 Table A1 to Table A3. 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). However, the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

8.2.2 Regional Air Quality Assessment (including Climate)

The impact of the proposed development at a national / international level has been determined using the procedures given by Transport Infrastructure Ireland[22] and the methodology provided in Annex 2 in the UK Design Manual for Roads and Bridges[18]. 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 and can be applied to any development that causes a change in traffic flows. The inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds.

8.2.3 Conversion of NO_X to NO_2

NO_x ($NO + NO_2$) is emitted by vehicles exhausts. The majority of emissions are in the form of NO, however, with greater diesel vehicles and some regenerative particle traps on HGV's the proportion of NOx 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 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*"[(22)]. The TII guidelines recommend the use of DEFRAs NO_x to NO_2 calculator[(21)] which was originally published in 2009 and is currently on version 6.1. This calculator (which can be downloaded in the form of an excel spreadsheet) accounts for the predicted availability of O_3 and proportion of NO_x emitted as NO for each local authority across the UK. O_3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO_2 or PM_{10}.

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

8.2.4 Ecological Sites

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[(22)]. However, in practice the potential for impact to an ecological site is highest within 200 m of the proposed development and when significant changes in AADT (>5%) occur.

Transport Infrastructure Ireland's *Guidelines for Assessment of Ecological Impacts of National Road Schemes*[(23)] and *Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities*[(24)] provide details regarding the legal protection of designated conservation areas.

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

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

The Boyne Estuary SPA (site code 004080) , Boyne Coast and Estuary pNHA (site code 001957) and River Boyne and River Blackwater SAC (site code 002299) are located within 200m of a number of road links which will be directly impacted by the proposed development. As such an assessment of the impact with regards to nitrogen deposition was conducted. Dispersion modelling and prediction was carried out at typical traffic speeds at this location. Ambient NOx concentrations were predicted for the opening and design years along a transect of up to 200 m within the pNHA, SPA and SAC. The road contribution to dry deposition along the transect was also calculated using the methodology outlined in Appendix 9 of the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*[22].

8.2.5 Odour Assessment

8.2.5.1 Characteristics of Odour

Odours are sensations resulting from the reception of a stimulus by the olfactory sensory system, which consists of two separate subsystems: the olfactory epithelium and the trigeminal nerve. The olfactory epithelium, located in the nose, is capable of detecting and discriminating between many thousands of different odours and can detect some of them in concentrations lower than those detectable by currently available analytical instruments[25]. The function of the trigeminal nerve is to trigger a reflex action that produces a painful sensation. It can initiate protective reflexes such as sneezing to interrupt inhalation. The olfactory system is extremely complex and peoples' responses to odours can be variable. This variability is the result of differences in the ability to detect odour; subjective acceptance or rejection of an odour due to past experience; circumstances under which the odour is detected and the age, health and attitudes of the human receptor.

Odour Intensity and Threshold

Odour intensity is a measure of the strength of the odour sensation and is related to the odour concentration. The odour threshold refers to the minimum concentration of an odorant that produces an olfactory response or sensation. This threshold is normally determined by an odour panel consisting of a specified number of people, and the numerical result is typically expressed as occurring when 50% of the panel correctly detect the odour. This odour threshold is given a value of one odour unit and is expressed as 1 OU_E/m^3. The odour threshold is not a precisely determined value, but depends on the sensitivity of the odour panellists and the method of presenting the odour stimulus to the panellists. An odour detection threshold relates to the minimum odorant concentration required to perceive the existence of the stimulus, whereas an odour recognition threshold relates to the minimum odorant concentration required to recognise the character of the stimulus. Typically, the recognition threshold exceeds the detection threshold by a factor of 2 to 10[25,26].

Odour Character

The character of an odour distinguishes it from another odour of equal intensity. Odours are characterised on the basis of odour descriptor terms (e.g. putrid, fishy, fruity etc.). Odour character is evaluated by comparison with other odours, either directly or through the use of descriptor words.

Hedonic Tone

The hedonic tone of an odour relates to its pleasantness or unpleasantness. When an odour is evaluated in the laboratory for its hedonic tone in the neutral context of an olfactometric presentation, the panellist is exposed to a stimulus of controlled intensity and duration. The degree of pleasantness or unpleasantness is determined by each panellist's experience and emotional associations. The responses among panellists may vary depending on odour character; an odour pleasant to many may be declared highly unpleasant by some.

Adaptation

Adaptation, or Olfactory Fatigue, is a phenomenon that occurs when people with a normal sense of smell experience a decrease in perceived intensity of an odour if the stimulus is received continually. Adaptation to a specific odorant typically does not interfere with the ability of a person to detect other odours. Another phenomenon known as habituation or occupational anosmia occurs when a worker in an industrial situation experiences a long-term exposure and develops a higher threshold tolerance to the odour.

8.2.5.2 Odour Guidelines

The exposure of the population to a particular odour consists of two factors; the concentration and the length of time that the population may perceive the odour. By definition, 1 OU_E/m^3 is the detection threshold of 50% of a qualified panel of observers working in an odour-free laboratory using odour-free air as the zero reference (the selection criteria result in the qualified panel being more sensitive to a particular odorant than the general population). The recognition threshold is generally about five times this concentration (5 OU_E/m^3) and the concentration at which the odour may be considered a nuisance is between 5 and 10 OU_E/m^3 based on hydrogen sulphide (H_2S)(37). Clarkson and Misslebrook(27) proposed that a "faint odour" was an acceptable threshold criterion for the assessment of odour as a nuisance. Historically, it has been generally accepted that odour concentrations of between 5 and 10 OU_E/m^3 would give rise to a faint odour only, and that only a distinct odour (concentration of >10 OU_E/m^3) could give rise to a nuisance(28). However, this criterion has generally been based on waste water treatment plants where the source of the odour is generally hydrogen sulphide. In 1990, a survey of the populations surrounding 200 industrial odour sources in the Netherlands showed that there were no justifiable complaints when 98th percentile compliance with an odour exposure standard of a "faint odour" (5-10 OU_E/m^3) was achieved(29).

DEFRA(30,31) in the UK has published detailed guidance on appropriate odour threshold levels based in part on the offensiveness of the odour. The potential odour source in relation to the proposed development is related to an Irish Water Waste Water Treatment Plant (WWTP) which is included in Table 8.2. As shown in Table 8.2, a WWTP is listed with a ranking of 17 (median) and 16.1 (mean) in terms of pleasantness.

DEFRA has also detailed installation-specific exposure criteria based on the "annoyance potential"(30) which is defined as "the likelihood that a specific odorous mixture will give reasonable cause for annoyance in an exposed population". Industrial sources have been ranked into three categories based on their relative offensiveness which are "low", "medium" and "high" and exposure criteria assigned to each category (as shown in Table 8.3). The relevant exposure criteria vary from 1.5 OU_E/m^3 for highly odorous sources to 6.0 OU_E/m^3 for the least offensive odours. Due to the potential offensiveness of the WWTP odours to the proposed development, the worst case exposure criteria for the facility is used. An odour exposure criteria of 1.5 OU_E/m^3 which is expressed as a 98th%ile and based on one hour means over a one-year period can be assigned to the WWTP.

Environmental Odour Industrial Source	**Ranking UK Median**	**Ranking UK Mean**	**Ranking Dutch Mean**
Bread Factory	1	2.5	1.7
Coffee Roaster	2	3.9	4.6
Chocolate Factory	3	4.6	5.1
Beer Brewery	6	7.7	8.1
Fragrance & Flavour Factory	8	8.5	9.8
Charcoal Production	8	9.2	9.4
Green Fraction composting	9	10.3	14
Fish smoking	9	10.5	9.8
Frozen Chips production	10	11	9.6
Sugar Factory	11	11.3	9.8
Car Paint Shop	12	11.7	9.8
Livestock odours	12	12.6	12.8
Asphalt	13	12.7	11.2
Livestock Feed Factory	15	14.2	13.2
Oil Refinery	14	14.3	13.2
Car Park Bldg	15	14.4	8.3
Wastewater Treatment	**17**	**16.1**	**12.9**
Fat & Grease Processing	18	17.3	15.7
Creamery/milk products	10	17.7	-
Pet Food Manufacture	19	17.7	-
Brickworks (burning rubber)	18	17.8	-
Slaughter House	19	18.3	17.0
Landfill	20	18.5	14.1

Table 8.2 Ranking Table For Various Industrial Sources [30]

Industrial Sectors	Relative Offensiveness of Odour	Indicative Criterion
Rendering Fish Processing Oil Refining Creamery WWTP Fat & Grease Processing	**High**	1.5 OU_E/m^3 as a 98^{th}%ile of hourly averages at the worst-case sensitive receptor
Intensive Livestock Rearing Food Processing (Fat Frying) Paint-spraying Operations Asphalt Manufacture	Medium	3.0 OU_E/m^3 as a 98^{th}%ile of hourly averages at the worst-case sensitive receptor
Brewery Coffee Roasting Bakery Chocolate Manufacturing Fragrance & Flavouring	Low	6.0 OU_E/m^3 as a 98^{th}%ile of hourly averages at the worst-case sensitive receptor

Table 8.3 Indicative Odour Standards Based On Offensiveness Of Odour (30)

8.3 Receiving Environment

8.3.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels)(32). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Dublin Airport, which is located approximately 33 km south of the site. Dublin Airport met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Figure 8.1). For data collated during five representative years (2013 - 2017), the predominant wind direction is westerly to south-westerly with a mean wind speed of 5.3 m/s over the period 2005 - 2018.

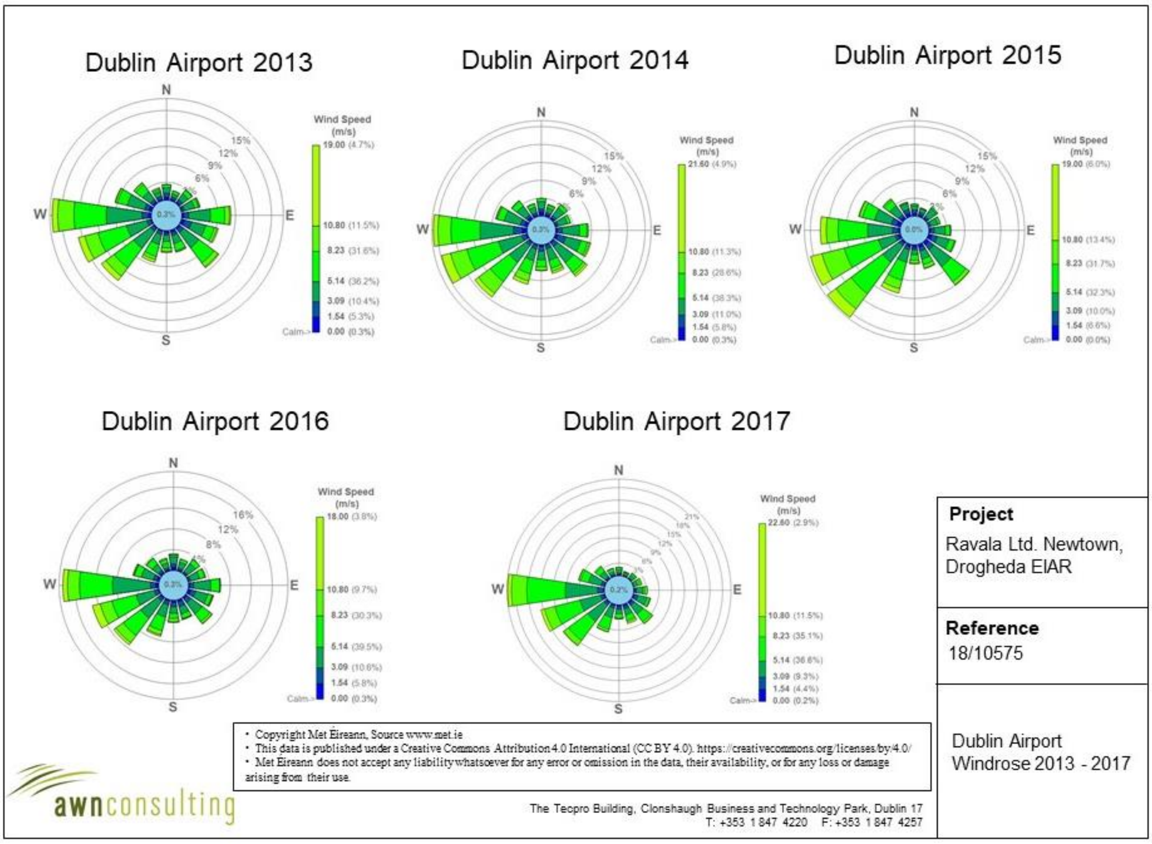

Figure 8.1 Dublin Airport Windrose 2013 – 2017

8.3.2 Trends in Air Quality

Air quality is variable and subject to both significant spatial and temporal variation. In relation to spatial variations in air quality, concentrations generally fall significantly with distance from major road sources[18]. Thus, residential exposure is determined by the location of sensitive receptors relative to major roads sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction.

In assessing baseline air quality, two tools are generally used: ambient air monitoring and air dispersion modelling. In order to adequately characterise the current baseline environment through monitoring, comprehensive measurements would be required at a number of key receptors for PM_{10}, NO_2 and benzene. In addition, two of the key pollutants identified in the scoping study (PM_{10} and NO_2) have limit values which require assessment over time periods varying from one hour to one year. Thus, continuous monitoring over at least a one-year period at a number of locations would be necessary in order to fully determine compliance for these pollutants. Although this study would provide information on current air quality it would not be able to provide predictive information on baseline conditions[16], which are the conditions which prevail just prior to opening in the absence of the development. Hence the impacts of the development were fully assessed by air dispersion modelling[16] which is the most practical tool for this purpose. The baseline environment has also been assessed using modelling, since the use of the same predictive technique for both the 'do-nothing' and 'do-something' scenario will minimise errors and allow an accurate determination of the relative impact of the development.

In 2011 the UK DEFRA published research[33] 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.

8.3.3 Baseline Air Quality

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is "*Air Quality In Ireland 2017 – Indicators of Air Quality*"[19]. The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments[21].

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes[19]. 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 and assessment, the proposed development site is within Zone C[20] . The long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

NO_2 monitoring was carried out at three Zone C locations in recent years, Kilkenny, Portlaoise and Mullingar[19]. The NO_2 annual average in 2017 for Kilkenny and Portlaoise was 5 $\mu g/m^3$ and 11 $\mu g/m^3$ respectively. Hence long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 $\mu g/m^3$. The average results over the last five years at a range of Zone D locations suggests an upper average of no more than 12 $\mu g/m^3$ as a background concentration as shown in Table 8.4. Based on the above information, a conservative estimate of the current background NO_2 concentration, for the region of the development in 2019 is 12 $\mu g/m^3$.

Long term NO_X monitoring has been carried out at a three Zone C locations in recent years: Mullingar, Kilkenny and Portlaoise. Annual mean concentrations of NO_X at the monitoring sites over the period 2013 – 2017 ranged from 6 - 27 $\mu g/m^3$, suggesting an upper average over the five year period of no more than 19 $\mu g/m^3$ as a background concentration. An appropriate estimate for the current background NO_X concentration in the region of the proposed development is 19 $\mu g/m^3$.

Station	Averaging Period Notes 1, 2	Year				
		2013	2014	2015	2016	2017
Kilkenny	Annual Mean NO_2 (µg/m^3)	4	5	5	7	5
	Max 1-hr NO_2 (µg/m^3)	90	57	70	51	58
Portlaoise	Annual Mean NO_2 (µg/m^3)	-	16	10	11	11
	Max 1-hr NO_2 (µg/m^3)	-	74	84	86	80
Mullingar	Annual Mean NO_2 (µg/m^3)	6	4	-	-	-
	Max 1-hr NO_2 (µg/m^3)	68	53	-	-	-

Note 1 Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

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

Table 8.4 Trends In Zone C Air Quality - Nitrogen Dioxide (NO_2)

Long-term PM_{10} monitoring was carried out at the urban Zone C locations of Galway, Ennis and Portlaoise in recent years. The average annual mean concentrations measured at Ennis and Portlaoise in 2017 were 16 µg/m^3 and 10 µg/m^3 respectively (Table 8.5). In addition, there were at most 12 exceedances over the five year period (in Ennis) of the 24 hour limit value of 50 µg/m^3 measured as a 90.4th percentile (i.e. it must not be exceeded more than 35 times per year). The average results over the last five years at a range of Zone C locations suggests an upper average of no more than 19 µg/m^3 as a background concentration. Based on the above information a conservative estimate of the current background PM_{10} concentration for the region of the development in 2019 is 19 µg/m^3.

Station	Averaging Period Notes 1, 2	Year				
		2013	2014	2015	2016	2017
Galway	Annual Mean PM_{10} (µg/m^3)	21	15	15	15	-
	24-hr Mean > 50 µg/m^3 (days)	11	0	2	3	-
Ennis	Annual Mean PM_{10} (µg/m^3)	20	21	18	17	16
	24-hr Mean > 50 µg/m^3 (days)	8	8	10	12	9
Portlaoise	Annual Mean PM_{10} (µg/m^3)	-	-	12	12	10
	24-hr Mean > 50 µg/m^3 (days)	-	-	1	1	0

Note 1 Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

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

Table 8.5 Trends In Trends In Zone D Air Quality - PM_{10}

The results of $PM_{2.5}$ monitoring at Ennis for the period 2013 - 2017 indicated an average $PM_{2.5}$/PM_{10} ratio ranging from 0.60 – 0.76. Based on this information, a conservative ratio of 0.8 was used to generate a current background $PM_{2.5}$ concentration of 15.2 µg/m^3.

In terms of benzene, monitoring data for the Zone C location of Kilkenny for the period 2014 – 2017 showed an upper average concentration of no more than 0.2 µg/m^3, which is significantly below the 5 µg/m^3 limit value. Based on this monitoring data a conservative estimate of the current background concentration in the region of the development is 0.2 µg/m^3.

With regard to CO, annual averages at the Zone C monitoring station in Portlaoise over the 2015 – 2017 period, gave an annual mean concentration of no more than 0.4 mg/m^3. Based on this EPA data, a conservative estimate of the current background CO concentration in the region of the development is 0.4 mg/m^3.

8.4 Characteristics of the Proposed Development

The site is located in Drogheda, in the Newtown area. The site is predominantly surrounded by green fields to the north and east and residential developments to the south. There is a train station to the south west and a waste water treatment plant (WWTP) to the north east. A full description of the development can be found in Chapter 3.

When considering a development of this nature, the potential air quality and climate impact on the surroundings must be considered for each of two distinct stages:

A. construction phase, and;

B. operational phase.

During the construction stage the main source of air quality impacts will be as a result of fugitive dust emissions from site activities. Emissions from construction vehicles and machinery have the potential to impact climate. The primary sources of air and climatic emissions in the operational context are deemed long term and will involve the change in traffic flows or congestion in the local areas which are associated with the development. The impact of odour as a result of the nearby WWTP has also been qualitatively assessed as part of the operational phase.

The following describes the primary sources of potential air quality and climate impacts which have been assessed as part of this EIAR.

8.5 Potential Impact of the Proposed Development

8.5.1 Construction Stage

8.5.1.1 Air Quality

The greatest potential impact on air quality during the construction phase of the proposed development is from construction dust emissions and the potential for nuisance dust and $PM_{10}/PM_{2.5}$ emissions. The proposed development can be considered moderate in scale and therefore there is the potential for significant dust soiling 50m from the source[22] (Table 8.6). 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 number of sensitive receptors, predominantly residential properties in close proximity to the site to the direct south and north west. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of a dust minimisation plan. Provided the dust minimisation measures outlined in the plan (see Appendix 8.3) are adhered to, the air quality impacts during the construction phase will not be significant. These measures are summarised in Section 8.6.

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

Table 8.6 Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place

8.5.1.2 Climate

There is the potential for a number of greenhouse gas emissions to atmosphere during the construction of the development. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions. However, the impact on the climate is considered to be imperceptible in the short and long term.

8.5.1.3 Human Health

Best practice mitigation measures are proposed for the construction phase of the proposed development which will focus on the pro-active control of dust and other air pollutants to minimise generation of emissions at source. The mitigation measures that will be put in place during construction of the proposed development will ensure that the impact of the development complies with all EU ambient air quality legislative limit values which are based on the protection of human health. Therefore, the impact of construction of the proposed development is likely to be negative, short-term and imperceptible with respect to human health.

8.5.2 Operational Stage

8.5.2.1 Local Air Quality

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

Traffic flow information was obtained from Waterman Moylan, the consulting engineers on this project and has been used to model pollutant levels under various traffic scenarios and under sufficient spatial resolution to assess whether any significant air quality impact on sensitive receptors may occur.

Cumulative effects have been assessed, as recommended in the EU Directive on EIA (Council Directive 97/11/EC) and using the methodology of the UK DEFRA[15,16]. Firstly, background concentrations[19] have been included in the modelling study. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern[19]. Appropriate background levels were selected based on the available monitoring data provided by the EPA[19] (see Section 8.3.3). The modelling scenarios include for the cumulative impact of other developments in the vicinity of the proposed development, where such information is available.

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

The receptors modelled represent the worst-case locations close to the proposed development and were chosen due to their close proximity (within 200 m) to the road links impacted by proposed development. The worst case traffic data is shown in Table 8.7, the links which satisfied the assessment criteria detailed in Section 8.2.1 are marked with an asterix (*) and were included in the local air quality assessment. Three sensitive receptors (R1 – R3) in the vicinity of the proposed development have been assessed. Sensitive receptors have been chosen as they have the potential to be adversely impacted by the development, these receptors are detailed in Figure 8.2.

Road Name	Average speed (km/h)	% HGV	Base Year (2018)	Opening Year (2022)		Design Year (2037)	
				Do Nothing	Do Something	Do Nothing	Do Something
R167 (S)*⁺	40	10%	15646	16,366	18,361	18,243	20,238
Dublin Rd (R132 E)*⁺	40	10%	18,834	19,701	20,700	21,961	22,960
Barrack Street	40	10%	1,381	1,444	1,444	1,610	1,610
Dublin Rd (R132 W)⁺	40	10%	14,422	15,086	15,731	16,816	17,461
Left turn slip⁺	40	10%	3,414	3,571	3,939	3,981	4,349
Shop Street	40	10%	16,794	17,567	18,025	19,582	20,041
South Quay (R150)*⁺	40	10%	5,419	5,668	8,066	6,318	8,716
R167 (Bridge N)*⁺	40	10%	15,646	16,366	18,359	18,243	20,236
Marsh Rd (W)⁺	40	10%	5,242	5,483	6,097	6,112	6,726
Marsh Rd (E)	40	10%	3,954	4,136	4,288	4,610	4,762
Mill Rd⁺	40	10%	1,912	2,000	2,455	2,229	2,684
Marsh Rd (E)⁺	40	10%	4,963	5,191	5,765	5,787	6,360
Marsh Rd (W)*⁺	40	10%	4,963	5,191	7,491	5,787	8,086
Site Location⁺	40	10%	0	0	2,872	0	2,872

*indicates road links used in local air quality assessment

⁺ indicates road links used in air quality assessment for designated sites

Table 8.7 Traffic Data Used in Modelling Assessment

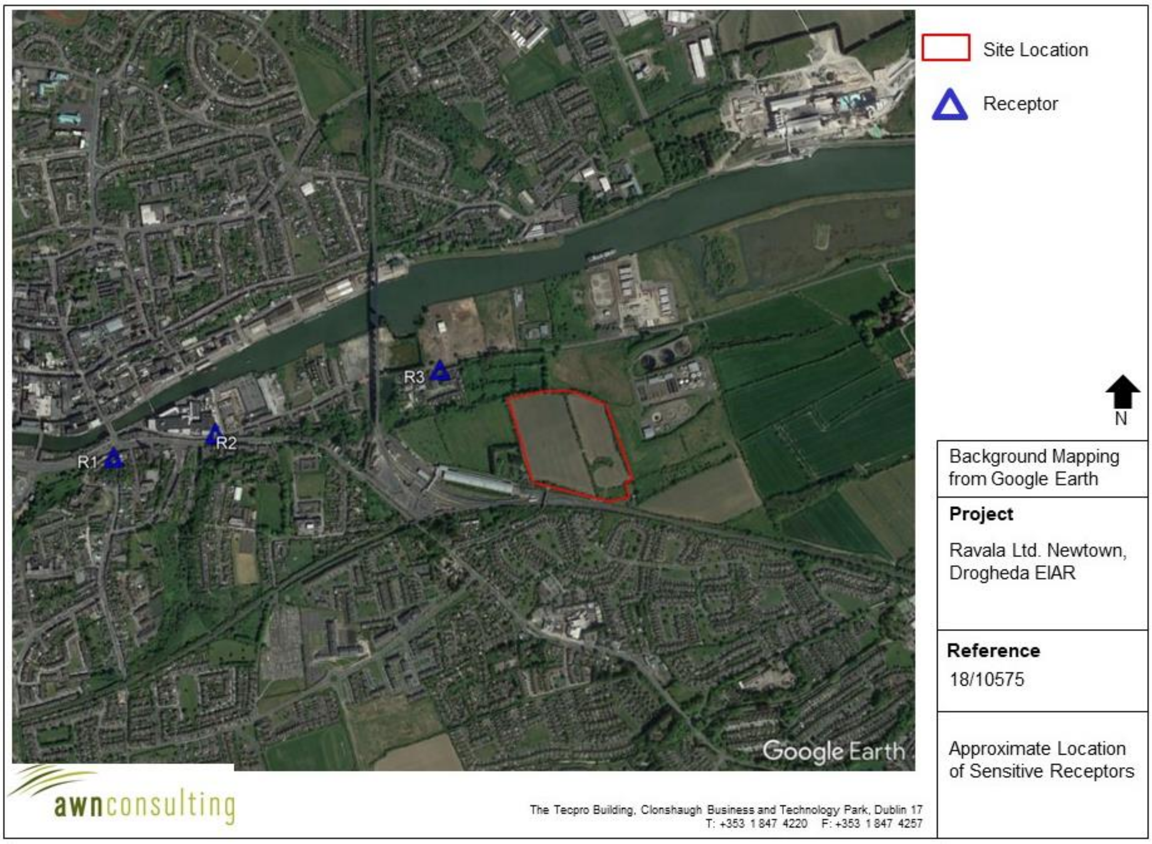

Figure 8.2 Approximate Location of Sensitive Receptors used in Local Air Quality Modelling Assessment

8.5.2.2 Modelling Assessment

Transport Infrastructure Ireland *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes*[22] 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 development. Results are compared against the 'Do-Nothing' scenario, which assumes that the proposed development is not in place in future years, in order to determine the degree of impact.

NO_2

The results of the assessment of the impact of the proposed development on NO_2 in the opening year 2022 and design year 2037 are shown Table 8.8 for the Highways Agency IAN 170/12 and Table 8.9 using the UK Department for Environment, Food and Rural Affairs technique respectively. The annual average concentration is in compliance with the limit value at all worst-case receptors using both techniques. Levels of NO_2 are 56.5% of the annual limit value in 2022 using the more conservative IAN technique, while concentrations are 53% of the annual limit value in 2022 using the UK Department for Environment, Food and Rural Affairs technique. Concentrations in the design year of 2037 are also low, with NO_2 levels reaching 55% of the annual limit value using the more conservative IAN technique. The hourly limit value for NO_2 is 200 $\mu g/m^3$ and is expressed as a 99.8^{th} percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded using either technique in 2022 or 2037 (Table 8.10).

The impact of the proposed development on annual mean NO_2 levels can be assessed relative to "Do Nothing (DN)" levels in 2022 and 2037. Relative to baseline levels, some small increases in pollutant levels are predicted as a result of the proposed development. With regard to impacts at individual receptors, the greatest impact on NO_2 concentrations will be an increase of 4% of the annual limit value at Receptor 2. Thus, using the assessment criteria outlined in Appendix 8.2 Tables A1 – A2, the impact of the proposed development in terms of NO_2 is negligible. Therefore, the overall impact of NO_2 concentrations as a result of the proposed development is long-term and imperceptible at all of the receptors assessed.

PM_{10}

The results of the modelled impact of the proposed development for PM_{10} in the opening year 2022 and design year 2037 are shown in Table 8.11. Predicted annual average concentrations at the worst-case receptor in the region of the development are at most 52% of the limit value in 2022 and 2037. The 24-hour mean limit value of 50 $\mu g/m^3$ is expressed as a 90.4^{th} percentile (i.e. it must not be exceeded more than 35 times per year). It is predicted that the worst case receptors (R1 and R2) will experience 4 days of exceedances either with or without the proposed development. The proposed development will cause an increase of one day exceedance from 2 to 3 days at Receptor 3, however, 35 days of exceedance are permitted per year (Table 8.12).

Relative to baseline levels, some imperceptible increases in PM_{10} levels at the worst-case receptors are predicted as a result of the proposed development. The greatest impact on PM_{10} concentrations in the region of the proposed development will be an increase of 0.67% of the annual limit value at Receptor 2. Thus, the magnitude of the changes in air quality are negligible at all receptors based on the criteria outlined in Appendix 8.2, Tables A1 – A3. Therefore, the overall impact of PM_{10} concentrations as a result of the proposed development is long-term and imperceptible.

$PM_{2.5}$

The results of the modelled impact of the proposed development for $PM_{2.5}$ are shown in Table 8.13. Predicted annual average concentrations in the region of the proposed development are 66% of the limit value in 2022 and 2037 at the worst-case receptor.

Relative to baseline levels, imperceptible increases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the proposed development. None of the receptors assessed will experience an increase in concentrations of over 0.7% of the limit value. Therefore, using the assessment criteria outlined in Appendix 8.2, Tables A1 – A2, the impact of the proposed development with regard to $PM_{2.5}$ is negligible at all of the receptors assessed. Overall, the impact of increased $PM_{2.5}$ concentrations as a result of the proposed development is long-term and imperceptible.

CO and Benzene

The results of the modelled impact of CO and benzene are shown in Table 8.14 and Table 8.15 respectively. Predicted pollutant concentrations with the proposed development in place are below the ambient standards at all locations. Levels of CO are 25.1% of the limit value in 2022 with levels of benzene reaching 6.5% of the limit value. CO concentrations in the design year 2037 reach 25.4% of the limit value and concentrations of benzene reach 6.7% of the limit.

Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the proposed development. The greatest impact on CO and benzene concentrations will be an increase of 0.7% of the CO limit and 0.3% of the benzene limit value at Receptor 2. Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Appendix 8.2 and applying these criteria to CO and benzene, the impact of the proposed development in terms of CO and benzene is negligible, long-term and imperceptible.

Summary of Local Air Quality Modelling Assessment

Levels of traffic-derived air pollutants from the proposed development will not exceed the ambient air quality standards either with or without the proposed development in place. Using the assessment criteria outlined in Appendix 8.2, Tables A1 – A3, the impact of the development in terms of PM_{10}, $PM_{2.5}$, CO, NO_2 and benzene is negligible, long-term, localised negative and imperceptible.

8.5.2.3 Regional Air Quality Impact

The regional impact of the proposed development on emissions of NO_X and VOCs has been assessed using the procedures of Transport Infrastructure Ireland[22] and the UK Department for Environment, Food and Rural Affairs[16]. The results (see Table 8.16) show that the likely impact of the proposed 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 2022, the predicted impact of the changes in AADT is to increase NO_x levels by 0.00072% of the NO_x emissions ceiling and increase VOC levels by 0.00024% of the VOC emissions ceiling to be complied with in

2020. Impacts in the design year of 2037 are also predicted to be low, with NOx levels increasing by 0.0012% of the NOx emissions ceiling and VOC levels increasing by 0.0028% of the VOC emissions ceiling to be complied with in 2035.

Therefore, the likely overall magnitude of the changes on air quality in the operational stage of the proposed development is imperceptible, long-term and not significant.

8.5.2.4 *Air Quality Impact on Sensitive Ecosystems*

The impact of NO_X (i.e. NO and NO_2) emissions resulting from the traffic associated with the proposed development at the Boyne Coast and Estuary pNHA, Boyne Estuary SPA and River Boyne and River Blackwater SAC was assessed. The traffic data, which satisfied the assessment criteria outlined in Section 8.2.4 and used in the modelling assessment is detailed in Table 8.7. Ambient NO_X concentrations were predicted for the opening and design years along a transect of up to 200m and are given in Table 8.17 for the pNHA, Table 8.18 for the SPA and Table 8.19 for the SAC. The road contribution to dry deposition along the transect is also given and was calculated using the methodology of TII(22).

The predicted annual average NO_X level in the Boyne Coast and Estuary pNHA is below the limit value of 30 µg/m^3 for the "Do Something" scenario with the proposed development in place, with NO_X concentrations reaching 69% of the limit value in the opening year 2022 and 70% of this limit in the design year of 2037, including background levels.

The predicted annual average NO_X level in the Boyne Estuary SPA is also below the limit value of 30 µg/m^3 for the "Do Something" scenario with the proposed development in place, with NO_X concentrations reaching 95% of the limit in 2022 and 98% of the limit in 2037, including background levels.

The predicted annual average NO_X level in the River Boyne and River Blackwater SAC is above the limit value with the proposed development in place; NO_X concentrations reach 135% of the limit in 2022 and 140% of the limit in 2037 (including background levels). However, concentrations of NO_X are above the limit value for the "Do Nothing" scenario, without the proposed development. The proposed development causes an 7% increase in NOx concentrations.

The impact of the proposed development can be assessed relative to "Do Nothing" levels, the impact of the proposed development leads to an increase in NO_X concentrations of at most 0.52 µg/m^3 within the Boyne Coast and Estuary pNHA and by 6.11 µg/m^3 within the Boyne Estuary SPA. In terms of the River Boyne and River Blackwater SAC, NOx concentrations will increase by at most 2.3 µg/m^3. Appendix 9 of the TII guidelines(22) state that where the scheme or development is expected to cause an increase of more than 2 µg/m^3 and the predicted concentrations (including background) are close to, or exceed the standard, then the sensitivity of the habitat to NO_X should be assessed by the project ecologist and this has been done. Concentrations within the SAC and SPA are predicted to increase by 2 µg/m^3 or more and the predicted concentrations are also above or close to the standard, as such it was necessary for the sensitivity of the habitat to NO_X to be assessed by an ecologist.

The sensitivity of the habitats to NOx was assessed by the project ecologist and impacts were determined to be insignificant as according to the ecologist:

"*the SAC/SPA are intertidal habitats with sparse terrestrial vegetation. No evidence exists that air pollution in the form of NOx is affecting the conservation objectives for the habitats or species using these areas".*

The contribution to the NO_2 dry deposition rate along the 200m transect within the pNHA is also detailed in Table 8.17. The maximum increase in the NO_2 dry deposition rate is 0.02 Kg(N)/ha/yr. The maximum increase in the NO_2 dry deposition rate within the SPA is 0.32 Kg(N)/ha/yr (Table 8.18) and within the SAC is 0.115 Kg(N)/ha/yr (Table 8.19). In all cases this is well below the critical load for inland and surface water habitats of 5 - 10Kg(N)/ha/yr(22).

It can be determined that the impact from air quality on the designated sites is long-term, negative but overall not significant.

8.5.2.5 Odour

Due to the proximity of the Waste Water Treatment Plant (WWTP) to the east of the site, the potential odour impacts on the proposed development have been qualitatively assessed. The plant is registered under the EPA (register no. D0041-01) and is operated by Irish Water. According to Table 8.3 there is a high annoyance potential in relation to odours from the WWTP. The EPA carry out site inspections on licenced sites in response to odour complaints from the public and site inspection reports are available on the EPA website(34). There are two site inspection reports in relation to odour complaints available, site inspections were carried out on 10/02/2017 and 05/07/2018 respectively. Both inspections were in response to a number of on-going complaints from receptors in close proximity to the WWTP, particularly Wheaton Hall, Foxhill, Woodford, Cairnes Court and McGraths Lane. All complaints refer to foul, sewage, rotten-egg like odours in the area which, according to the 2018 report were most persistent at night.

The receptors specified in the EPA reports are to the direct south and south-east of the proposed development which would indicate that if odour issues are occurring here, they would likely occur at the proposed development also. However, the predominant wind direction in the region is westerly to south-westerly (see Figure 8.1) which would indicate that dispersal of any potential odours from the WWTP would be away from the proposed development and the sensitive receptors to the south the majority of the time. Issues would only likely occur when the wind was blowing from its non-prevailing direction. In addition, the odour exposure criteria (1.5 OU_E/m^3 for WWTP, see Table 8.3) is expressed as a 98^{th} percentile of hourly means at the worst-case sensitive receptor and is averaged over a one-year period – this allows a total of 175 exceedances per year before it is considered an issue.

Overall, there is the potential for odour impacts to occur during the operational phase of the proposed development as a result of the nearby WWTP. These impacts would be considered negative and brief in nature as they are unlikely to last for prolonged periods of time. However, it is the overall responsibility of Irish Water, the operators of the WWTP to ensure no odour nuisance impacts are occurring at any nearby sensitive receptors such as the proposed development.

8.5.2.6 Climate

The impact of the proposed development on emissions of CO_2 impacting climate were also assessed using the Design Manual for Roads and Bridges screening model (see Table 8.16). The results show that the impact of the proposed development in the opening year 2022 will be to increase CO_2 emissions by 0.00059% of Ireland's EU 2020 Target. The impact in the design year of 2037 is equally low with CO_2 emissions increasing by 0.00062% of the EU 2020 Target. Thus, the impact of the proposed development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2020 Target(7).

Therefore, the likely overall magnitude of the changes on climate in the operational stage of the proposed development is imperceptible, negative, long-term and not significant.

8.5.2.7 Human Health

Air dispersion modelling of operational traffic emissions was undertaken to assess the impact of the development with reference to EU ambient air quality standards which are based on the protection of human health. As demonstrated by the modelling results, emissions as a result of the proposed development are compliant with all National and EU ambient air quality limit values and, therefore, will not result in a significant impact on human health.

8.5.3 Do-Nothing Impact

The Do Nothing scenario includes retention of the current site without the proposed residential development in place. In this scenario, ambient air quality at the site will remain as per the baseline and will change in accordance with trends within the wider area (including influences from potential new developments in the surrounding area, changes in road traffic, etc).

The Do Nothing scenario for the operational phase has been assessed in Section 8.5.2.

8.5.4 Cumulative Assessment

Should the construction phase of the proposed development coincide with the construction of any other permitted developments within 350m of the site including development permitted under P.A. Ref. 17/387 then there is the potential for cumulative dust impacts to the nearby sensitive receptors. The dust mitigation measures outlined in Appendix 8.3 should be applied throughout the construction phase of the proposed development, with similar mitigation measures applied for other permitted developments which will avoid significant cumulative impacts on air quality. With appropriate mitigation measures in place, the predicted cumulative impacts on air quality and climate associated with the construction phase of the proposed development are deemed short-term and not significant.

If additional residential or commercial developments are proposed in the future, in the vicinity of the proposed development, this has the potential to add further additional vehicles to the local road network. However, as the traffic impact for the proposed development has an imperceptible impact on air quality, it is unlikely that other future developments of similar scale would give rise to a significant impact during the construction and operational stages of those projects. Future projects of a large scale would need to conduct an EIA to ensure that no significant impacts on air quality will occur as a result of those developments.

Receptor	Impact Opening Year 2022					Impact Design Year 2037				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	21.8	22.5	0.69	Small	Small Increase	21.1	21.7	0.66	Small	Small Increase
2	21.1	22.6	1.55	Small	Small Increase	20.5	22.0	1.54	Small	Small Increase
3	14.0	15.4	1.37	Small	Small Increase	13.6	15.0	1.45	Small	Small Increase

Table 8.8 Annual Mean NO_2 Concentrations (µg/m^3) (using IAN 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Impact Opening Year 2022					Impact Design Year 2037				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	20.6	21.2	0.65	Small	Small Increase	19.2	19.8	0.60	Small	Small Increase
2	19.8	21.3	1.46	Small	Small Increase	18.6	20.0	1.40	Small	Small Increase
3	12.8	14.0	1.25	Small	Small Increase	11.5	12.7	1.22	Small	Small Increase

Table 8.9 Annual Mean NO_2 Concentrations (µg/m^3) (using Defra's Technical Guidance)

Receptor	IAN 170/12 V3 Long Term NO_2 Trend Projections Technique				Defra's Technical Guidance Technique			
	Opening Year 2022		Design Year 2037		Opening Year 2022		Design Year 2037	
	DN	DS	DN	DS	DN	DS	DN	DS
1	76.4	78.8	73.7	76.0	76.4	78.8	73.7	76
2	73.7	79.2	71.7	77.1	73.7	79.2	71.7	77.1
3	49.1	53.9	47.5	52.6	49.1	53.9	47.5	52.6

Table 8.10 1 Hour 99.8th%ile NO_2 Concentrations (µg/m^3)

Receptor	Impact Opening Year 2022					Impact Design Year 2037				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	20.5	20.7	0.12	Imperceptible	Negligible Increase	20.7	20.8	0.12	Imperceptible	Negligible Increase
2	20.4	20.7	0.27	Imperceptible	Negligible Increase	20.5	20.8	0.27	Imperceptible	Negligible Increase
3	19.2	19.4	0.22	Imperceptible	Negligible Increase	19.2	19.4	0.22	Imperceptible	Negligible Increase

Table 8.11 Annual Mean PM_{10} Concentrations (µg/m^3)

Receptor	Opening Year 2022		Design Year 2037	
	DN	DS	DN	DS
1	4	4	4	4
2	4	4	4	4
3	2	3	3	3

Table 8.12 No. Days with PM_{10} Concentration > 50 µg/m^3

Receptor	Impact Opening Year 2022					Impact Design Year 2037				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	16.4	16.5	0.10	Imperceptible	Negligible Increase	16.5	16.6	0.09	Imperceptible	Negligible Increase
2	16.3	16.5	0.21	Imperceptible	Negligible Increase	16.4	16.7	0.22	Imperceptible	Negligible Increase
3	15.3	15.5	0.17	Imperceptible	Negligible Increase	15.4	15.6	0.18	Imperceptible	Negligible Increase

Table 8.13 Annual Mean $PM_{2.5}$ Concentrations (µg/m^3)

Receptor	Impact Opening Year 2022					Impact Design Year 2037				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	2.48	2.51	0.031	Imperceptible	Negligible Increase	2.50	2.53	0.029	Imperceptible	Negligible Increase
2	2.44	2.51	0.068	Imperceptible	Negligible Increase	2.47	2.54	0.068	Imperceptible	Negligible Increase
3	2.13	2.18	0.056	Imperceptible	Negligible Increase	2.14	2.19	0.055	Imperceptible	Negligible Increase

Table 8.14 Maximum 8-hour CO Concentrations (mg/m^3)

Receptor	Impact Opening Year 2022					Impact Design Year 2037				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	0.31	0.32	0.013	Imperceptible	Negligible Increase	0.32	0.34	0.012	Imperceptible	Negligible Increase

2	0.30	0.32	0.017	Imperceptible	Negligible Increase	0.32	0.33	0.017	Imperceptible	Negligible Increase
3	0.23	0.24	0.012	Imperceptible	Negligible Increase	0.23	0.24	0.012	Imperceptible	Negligible Increase

Table 8.15 Annual Mean Benzene Concentrations (µg/m³)

Year	**Scenario**	**VOC (kg/annum)**	**NO_X (kg/annum)**	**CO_2 (tonnes/annum)**
2022	Do Nothing	515	1794	842
	Do Something	652	2269	1065
2037	Do Nothing	574	2001	941
	Do Something	717	2499	1175
Increment in 2022		136.4 kg	475.1 kg	223 Tonnes
Increment in 2037		142.9 kg	497.9 kg	234.1 Tonnes
Emission Ceiling (kilo Tonnes) 2020		**56.8**	**66.2**	**37,943**
Emission Ceiling (kilo Tonnes) 2035		**51.5**	**40.2**	**37,943**
Impact in 2022 (%)		0.00024 %	0.00072 %	0.00059 %
Impact in 2037 (%)		0.00028 %	0.00124 %	0.00062 %

Table 8.16 Regional Air Quality and Climate Impact Assessment

Distance to Road (m)	NO_X Concentration (μg/m^3) Opening Year (2022)			NO_X Concentration (μg/m^3) Design Year (2037)			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do Nothing	Do Something	Impact - Increase in Concentrations	Do Nothing	Do Something	Impact - Increase in Concentrations	2022	2037
2	20.12	20.64	0.52	20.54	21.06	0.52	0.028	0.027
12	19.60	20.04	0.44	19.96	20.40	0.44	0.024	0.024
22	18.84	19.18	0.33	19.12	19.45	0.34	0.019	0.018
32	18.31	18.56	0.26	18.52	18.77	0.26	0.015	0.014
42	17.91	18.11	0.20	18.07	18.27	0.20	0.012	0.011
52	17.61	17.77	0.16	17.74	17.90	0.16	0.009	0.008
62	17.37	17.50	0.12	17.47	17.60	0.12	0.007	0.007
72	17.19	17.29	0.10	17.27	17.37	0.10	0.006	0.005
82	17.04	17.12	0.08	17.10	17.18	0.08	0.004	0.004
92	16.92	16.98	0.06	16.97	17.03	0.06	0.003	0.003
102	16.83	16.88	0.05	16.87	16.92	0.05	0.003	0.003
112	16.76	16.79	0.04	16.79	16.82	0.04	0.002	0.002
122	16.70	16.73	0.03	16.72	16.75	0.03	0.002	0.002
132	16.66	16.68	0.02	16.68	16.70	0.02	0.001	0.001
142	16.63	16.65	0.02	16.65	16.66	0.02	0.001	0.001
152	16.61	16.63	0.02	16.62	16.64	0.02	0.001	0.001
162	16.60	16.62	0.01	16.61	16.63	0.01	0.001	0.001
172	16.59	16.61	0.01	16.61	16.62	0.01	0.001	0
182	16.58	16.59	0.01	16.59	16.60	0.01	0.001	0
192	16.56	16.57	0.01	16.57	16.58	0.01	0	0
200	16.55	16.56	0.01	16.56	16.56	0.01	0	0

Table 8.17 Air Quality Impact on Boyne Coast and Estuary pNHA

Distance to Road (m)	NO_X Conc. (µg/m³) Opening Year (2022)			NO_X Conc. (µg/m³) Design Year (2037)			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do Nothing	Do Something	Impact - Increase in Concentrations	Do Nothing	Do Something	Impact - Increase in Concentrations	2022	2037
2	22.64	28.45	5.81	23.35	29.46	6.11	0.313	0.317
12	21.74	26.71	4.97	22.35	27.57	5.22	0.268	0.272
22	20.47	24.23	3.76	20.93	24.89	3.95	0.205	0.209
32	19.56	22.45	2.90	19.91	22.96	3.04	0.158	0.161
42	18.89	21.15	2.26	19.16	21.54	2.38	0.124	0.126
52	18.38	20.15	1.78	18.59	20.46	1.87	0.098	0.1
62	17.98	19.38	1.40	18.15	19.62	1.47	0.078	0.079
72	17.67	18.77	1.10	17.80	18.96	1.16	0.061	0.063
82	17.42	18.28	0.87	17.52	18.43	0.91	0.048	0.05
92	17.22	17.90	0.68	17.30	18.01	0.71	0.038	0.039
102	17.06	17.59	0.53	17.12	17.68	0.56	0.03	0.03
112	16.94	17.35	0.41	16.99	17.42	0.43	0.023	0.024
122	16.84	17.16	0.32	16.88	17.22	0.34	0.018	0.018
132	16.77	17.03	0.26	16.80	17.07	0.27	0.014	0.015
142	16.72	16.93	0.21	16.75	16.97	0.22	0.012	0.012
152	16.69	16.87	0.18	16.71	16.90	0.19	0.009	0.011
162	16.67	16.84	0.16	16.69	16.87	0.17	0.009	0.01
172	16.66	16.81	0.15	16.68	16.84	0.16	0.008	0.008
182	16.63	16.76	0.13	16.65	16.78	0.13	0.007	0.007
192	16.61	16.71	0.10	16.62	16.73	0.11	0.006	0.006
200	16.59	16.67	0.08	16.60	16.68	0.08	0.004	0.005

Table 8.18 Air Quality Impact on Boyne Estuary SPA

Distance to Road (m)	NO_X Conc. (µg/m³) Opening Year (2022)			NO_X Conc. (µg/m³) Design Year (2037)			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do Nothing	Do Something	Impact - Increase in Concentrations	Do Nothing	Do Something	Impact - Increase in Concentrations	2022	2037
2	38.37	40.64	2.27	39.87	42.11	2.23	0.115	0.108
12	33.61	35.38	1.77	34.80	36.55	1.75	0.092	0.086
22	29.70	31.07	1.36	30.62	31.96	1.34	0.072	0.068
32	26.80	27.86	1.06	27.52	28.56	1.04	0.057	0.054
42	24.59	25.42	0.83	25.15	25.97	0.82	0.045	0.043
52	22.87	23.52	0.65	23.31	23.95	0.64	0.035	0.034
62	21.50	22.02	0.52	21.85	22.36	0.51	0.029	0.027
72	20.43	20.83	0.41	20.70	21.10	0.40	0.022	0.021
82	19.57	19.89	0.32	19.79	20.10	0.31	0.018	0.017
92	18.91	19.15	0.25	19.07	19.32	0.24	0.014	0.013
102	18.39	18.58	0.19	18.52	18.71	0.19	0.011	0.01
112	18.00	18.16	0.15	18.11	18.26	0.15	0.008	0.008
122	17.73	17.85	0.12	17.81	17.93	0.12	0.006	0.006
132	17.54	17.64	0.10	17.61	17.71	0.10	0.006	0.005
142	17.40	17.48	0.08	17.46	17.54	0.08	0.005	0.004
152	17.28	17.35	0.08	17.33	17.40	0.07	0.004	0.004
162	17.18	17.25	0.07	17.23	17.30	0.07	0.004	0.003
172	16.98	17.04	0.06	17.01	17.07	0.06	0.003	0.003
182	16.90	16.95	0.05	16.93	16.97	0.05	0.003	0.003
192	16.71	16.74	0.03	16.73	16.76	0.03	0.002	0.002
200	16.55	16.56	0.01	16.56	16.56	0.01	0	0

Table 8.19 Air Quality Impact on River Boyne and River Blackwater SAC

8.6 Ameliorative, Remedial or Reductive Measures

8.6.1 Construction Stage

8.6.1.1 Air Quality

The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. The main contractor will be responsible for the coordination, implementation and ongoing monitoring of the dust management plan. The key aspects of controlling dust are listed below. Full details of the dust management plan can be found in Appendix 8.3.

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

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

8.6.1.2 Climate

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

Nevertheless, some site-specific mitigation measures can be implemented during the construction phase of the proposed development to ensure emissions are reduced further. In particular the prevention of on-site or delivery vehicles from leaving engines idling, even over short periods. Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site.

8.6.2 Operational Stage

No additional mitigation measures are required as the operational phase of the proposed development as it is predicted to have an imperceptible impact on ambient air quality and climate.

8.7 **Residual Impact of the Proposed Development**

8.7.1 Construction Stage

8.7.1.1 Air Quality

When the dust minimisation measures detailed in the mitigation section of this Chapter (Section 8.6 and Appendix 8.3) are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

8.7.1.2 Climate

Impacts to climate during the construction phase are considered imperceptible and therefore residual impacts are not predicted.

8.7.2 Operational Stage

The results of the air dispersion modelling study indicate that the impact of the proposed development on air quality and climate is predicted to be imperceptible with respect to the operational phase.

There is the potential for odour impacts to occur during the operational phase of the proposed development as a result of the nearby WWTP. However, it is the overall responsibility of Irish Water, the operators of the WWTP to ensure that odour impacts are not occurring outside the boundary of their site.

8.8 **Monitoring**

8.8.1 Construction Stage

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

8.8.2 Operational Stage

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

8.9 **Difficulties Encountered**

There were no difficulties encountered while carrying out this assessment.

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Appendix 8.1 - Ambient Air Quality Standards

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU (& previously the EC & EEC). The initial interest in ambient air pollution legislation in the EU dates from the early 1980s and was in response to the most serious pollutant problems at that time which was the issue of acid rain. As a result of this sulphur dioxide, and later nitrogen dioxide, were both the focus of EU legislation. Linked to the acid rain problem was urban smog associated with fuel burning for space heating purposes. Also apparent at this time were the problems caused by leaded petrol and EU legislation was introduced to deal with this problem in the early 1980s.

In recent years the EU has focused on defining a basis strategy across the EU in relation to ambient air quality. In 1996, a Framework Directive, Council Directive 96/62/EC, on ambient air quality assessment and management was enacted. The aims of the Directive are fourfold. Firstly, the Directive's aim is to establish objectives for ambient air quality designed to avoid harmful effects to health. Secondly, the Directive aims to assess ambient air quality on the basis of common methods and criteria throughout the EU. Additionally, it is aimed to make information on air quality available to the public via alert thresholds and fourthly, it aims to maintain air quality where it is good and improve it in other cases.

As part of these measures to improve air quality, the European Commission has adopted proposals for daughter legislation under Directive 96/62/EC. The first of these directives to be enacted, Council Directive 1999/30/EC, has been passed into Irish Law as S.I. No 271 of 2002 (Air Quality Standards Regulations 2002), and has set limit values which came into operation on 17th June 2002. The Air Quality Standards Regulations 2002 detail margins of tolerance, which are trigger levels for certain types of action in the period leading to the attainment date. The margin of tolerance varies from 60% for lead, to 30% for 24-hour limit value for PM_{10}, 40% for the hourly and annual limit value for NO_2 and 26% for hourly SO_2 limit values. The margin of tolerance commenced from June 2002, and started to reduce from 1 January 2003 and every 12 months thereafter by equal annual percentages to reach 0% by the attainment date. A second daughter directive, EU Council Directive 2000/69/EC, has published limit values for both carbon monoxide and benzene in ambient air. This has also been passed into Irish Law under the Air Quality Standards Regulations 2002.

The most recent EU Council Directive on ambient air quality was published on the 11/06/08 which has been transposed into Irish Law as S.I. 180 of 2011. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive and its subsequent daughter directives. Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$. The margins of tolerance specific to each pollutant were also slightly adjusted from previous directives. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. In addition, new ambient standards for $PM_{2.5}$ are included in Directive 2008/50/EC. The approach for $PM_{2.5}$ was to establish a target value of 25 $\mu g/m^3$, as an annual average (to be attained everywhere by 2010) and a limit value of 25 $\mu g/m^3$, as an annual average (to be attained everywhere by 2015), coupled with a target to reduce human exposure generally to $PM_{2.5}$ between 2010 and 2020. This exposure reduction target will range from 0% (for

$PM_{2.5}$ concentrations of less than 8.5 µg/m^3 to 20% of the average exposure indicator (AEI) for concentrations of between 18 - 22 µg/m^3). Where the AEI is currently greater than 22 µg/m^3 all appropriate measures should be employed to reduce this level to 18 µg/m^3 by 2020. The AEI is based on measurements taken in urban background locations averaged over a three year period from 2008 - 2010 and again from 2018-2020. Additionally, an exposure concentration obligation of 20 µg/m^3 was set to be complied with by 2015 again based on the AEI.

Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions. The Alert Threshold is defined in Council Directive 96/62/EC as “a level beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken as laid down in Directive 96/62/EC”. These steps include undertaking to ensure that the necessary steps are taken to inform the public (e.g. by means of radio, television and the press).

The Margin of Tolerance is defined in Council Directive 96/62/EC as a concentration which is higher than the limit value when legislation comes into force. It decreases to meet the limit value by the attainment date. The Upper Assessment Threshold is defined in Council Directive 96/62/EC as a concentration above which high quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.

An annual average limit for both NO_X (NO and NO_2) is applicable for the protection of vegetation in highly rural areas away from major sources of NO_X such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex VI of EU Directive 1999/30/EC identifies that monitoring to demonstrate compliance with the NO_X limit for the protection of vegetation should be carried out distances greater than:

- 5 km from the nearest motorway or dual carriageway
- 5 km from the nearest major industrial installation
- 20 km from a major urban conurbation

As a guideline, a monitoring station should be indicative of approximately 1000 km^2 of surrounding area.

Under the terms of EU Framework Directive on Ambient Air Quality (96/62/EC), geographical areas within member states have been classified in terms of zones. The zones have been defined in order to meet the criteria for air quality monitoring, assessment and management as described in the Framework Directive and Daughter Directives. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The Zones were defined based on among other things, population and existing ambient air quality.

EU Council Directive 96/62/EC on ambient air quality and assessment has been adopted into Irish Legislation (S.I. No. 33 of 1999). The act has designated the Environmental Protection Agency (EPA) as the competent authority responsible for the implementation of the Directive and for assessing ambient air quality in the State. Other commonly referenced ambient air quality standards include the World Health Organisation. The WHO guidelines differ from air quality standards in that they are primarily set to protect public health from the effects of air pollution. Air quality standards, however, are air quality guidelines recommended by governments, for which additional factors, such as socio-economic factors, may be considered.

Air Dispersion Modelling

The inputs to the DMRB model consist of information on road layouts, receptor locations, annual average daily traffic movements, annual average traffic speeds and background concentrations(15). Using this input data the model predicts ambient ground level concentrations at the worst-case sensitive receptor using generic meteorological data.

The DMRB has recently undergone an extensive validation exercise(15) as part of the UK's Review and Assessment Process to designate areas as Air Quality Management Areas (AQMAs). The validation exercise was carried out at 12 monitoring sites within the UK DEFRAs national air quality monitoring network. The validation exercise was carried out for NO_X, NO_2 and PM_{10}, and included urban background and kerbside/roadside locations, "open" and "confined" settings and a variety of geographical locations(15).

In relation to NO_2, the model generally over-predicts concentrations, with a greater degree of over-prediction at "open" site locations. The performance of the model with respect to NO_2 mirrors that of NO_X showing that the over-prediction is due to NO_X calculations rather than the NO_X:NO_2 conversion. Within most urban situations, the model overestimates annual mean NO_2 concentrations by between 0 to 40% at confined locations and by 20% to 60% at open locations. The performance is considered comparable with that of sophisticated dispersion models when applied to situations where specific local validation corrections have not been carried out.

The model also tends to over-predict $PM_{10.}$ Within most urban situations, the model will over-estimate annual mean PM_{10} concentrations by between 20% to 40%. The performance is comparable to more sophisticated models, which, if not validated locally, can be expected to predict concentrations within the range of $\pm$50%.

Thus, the validation exercise has confirmed that the model is a useful screening tool for the Second Stage Review and Assessment, for which a conservative approach is applicable(15).

Appendix 8.2 - Transport Infrastructure Ireland Significance Criteria

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

Table A1: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Absolute Concentration in Relation to Objective/Limit Value	**Change in Concentration Note 1**		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40 μg/m³ of NO_2 or PM_{10}) (≥25 μg/m³ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36 - <40 μg/m³ of NO_2 or PM_{10}) (22.5 - <25 μg/m³ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30 - <36 μg/m³ of NO_2 or PM_{10}) (18.75 - <22.5 μg/m³ of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30 μg/m³ of NO_2 or PM_{10}) (<18.75 μg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥40 μg/m³ 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/m³ of NO_2 or PM_{10}) (22.5 - <25 μg/m³ of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (30 - <36 μg/m³ of NO_2 or PM_{10}) (18.75 - <22.5 μg/m³ of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<30 μg/m³ of NO_2 or PM_{10}) (<18.75 μg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

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

Table A2: Air Quality Impact Significance Criteria For Annual Mean NO_2 and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration Note 1		
	Small	**Medium**	**Large**
	Increase with Scheme		
Above Objective/Limit Value With Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
	Decrease with Scheme		
Above Objective/Limit Value With Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Note 1 Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible

Table A3: Air Quality Impact Significance Criteria For Changes to Number of Days with PM_{10} Concentration Greater than 50 µg/m^3 at a Receptor

Appendix 8.3 - Dust Minimisation Plan

The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK[35 - 38] and the USA[39].

Site Management

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design and effective control strategies.

At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance (see Figure 8.1 for the windrose for Dublin Airport). As the prevailing wind is predominantly westerly to south-westerly, locating construction compounds and storage piles downwind of sensitive receptors will minimise the potential for dust nuisance to occur at sensitive receptors.

Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2mm/day, dust generation is generally suppressed[36,38]. The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7m above ground) to release loose material from storage piles and other exposed materials[40]. Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods were care will be needed to ensure that dust nuisance does not occur. The following measures shall be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions:

- The Principal Contractor or equivalent must monitor the contractors' performance to ensure that the proposed mitigation measures are implemented and that dust impacts and nuisance are minimised;
- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions;
- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details;
- It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out;

- It is the responsibility of the contractor at all times to demonstrate full compliance with the dust control conditions herein;
- At all times, the procedures put in place will be strictly monitored and assessed.

The dust minimisation measures shall be reviewed at regular intervals during the works to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed and satisfactory procedures implemented to rectify the problem. Specific dust control measures to be employed are described below.

Site Roads / Haulage Routes

Movement of construction trucks along site roads (particularly unpaved roads) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80%[(38)].

- A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles using unpaved site roads;
- Access gates to the site shall be located at least 10m from sensitive receptors where possible;
- Bowsers or suitable watering equipment will be available during periods of dry weather throughout the construction period. Research has found that watering can reduce dust emissions by 50%(39). Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use;
- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.

Land Clearing / Earth Moving

Land clearing / earth-moving works during periods of high winds and dry weather conditions can be a significant source of dust.

- During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust;
- During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided.

Storage Piles

The location and moisture content of storage piles are important factors which determine their potential for dust emissions.

- Overburden material will be protected from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles should be located downwind of sensitive receptors;
- Regular watering will take place to ensure the moisture content is high enough to increase the stability of the soil and thus suppress dust. The regular watering of stockpiles has been found to have an 80% control efficiency(38);
- Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.

Site Traffic on Public Roads

Spillage and blow-off of debris, aggregates and fine material onto public roads should be reduced to a minimum by employing the following measures:

- Vehicles delivering or collecting material with potential for dust emissions shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- At the main site traffic exits, a wheel wash facility shall be installed if feasible. All trucks leaving the site must pass through the wheel wash. In addition, public roads outside the site shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary.

Summary of Dust Mitigation Measures

The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory performance of the contractor. The key features with respect to control of dust will be:

- The specification of a site policy on dust and the identification of the site management responsibilities for dust issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust minimisation plan can be regularly monitored and assessed; and
- The specification of effective measures to deal with any complaints received.