9 CLIMATE (AIR QUALITY AND CLIMATE CHANGE)

9.1 Introduction

This chapter assesses the likely air quality and climate impacts, if any, associated with the Woodbrook residential development, Co. Dublin.

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9.2 Background Information

9.2.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table 9.1 and Appendix 9.1).

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 9.1). 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 9.1).

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 9.1: Air Quality Standards Regulations.

9.2.1.1 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 9.1 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.

9.2.1.2 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002(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 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.

9.2.1.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$.

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD)(8), 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(9,10).

The data available from the EPA in 2019 indicated that Ireland complied with the emissions ceilings for SO_2 and NH_3 but failed to comply with the ceiling for NO_X and NMVOCs[11]. Directive (EU) 2016/2284 "*On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC*" was published in December 2016. The Directive will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020 emission targets are 25.5 kt for SO_2 (65% on 2005 levels), 66.9 kt for NO_X (49% reduction on 2005 levels), 56.9 kt for NMVOCs (25% reduction on 2005 levels), 112 kt for NH_3 (1% reduction on 2005 levels) and 15.6 kt for $PM_{2.5}$ (18% reduction on 2005 levels). In relation to 2030, Ireland's emission targets are 10.9 kt (85% below 2005 levels) for SO_2, 40.7 kt (69% reduction) for NOx, 51.6 kt (32% reduction) for NMVOCs, 107.5 kt (5% reduction) for NH_3 and 11.2 kt (41% reduction) for $PM_{2.5}$.

9.3 Assessment Methodology

9.3.1 Local Air Quality Assessment

The air quality assessment has been carried out following procedures described in the publications by the EPA[12-15] and using the methodology outlined in the guidance documents published by the UK DEFRA[16-18]. The assessment of air quality was carried out using a phased approach as recommended by the UK DEFRA[19]. 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[20,21] 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[20,21]. 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[20,21]. 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[21]. 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.
- 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[19] (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet[22] (Version 6.1, October 2017), and following guidance issued by the TII[23], UK Highways Agency[19], UK DEFRA[16-18] and the EPA[12-15].

The TII guidance[30] 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.
- Sensitive receptors exist within 50m of a complex road layout (e.g. grade separated junctions, hills etc).

The UK DMRB guidance[19], 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*[23] 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 9.2 Table 1 to Table 3. 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 $\mu g/m^3$). 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.

9.3.2 Regional Air Quality and Climate Impact Assessment

The impact of the proposed development at a national / international level has been determined using the procedures given by Transport Infrastructure Ireland[23] and the methodology provided in Annex 2 in the UK Design Manual for Roads and Bridges[19]. 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. he inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds.

9.3.3 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*"[23].

The TII guidelines recommend the use of DEFRAs NO_x to NO_2 calculator[22] 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.

9.3.4 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[23]. 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[24] and Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities[25] 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.
- A significant change in AADT flows (>5%) will occur.

There are no ecological sites within 200m of any of the impacted road links and therefore the ecological assessment is not required.

9.4 Receiving Environment

9.4.1 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)[26]. 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 25 km north 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 9.1). For data collated during five representative years (2013 - 2017), the predominant wind direction is westerly to south-westerly with predominately moderate wind speeds.

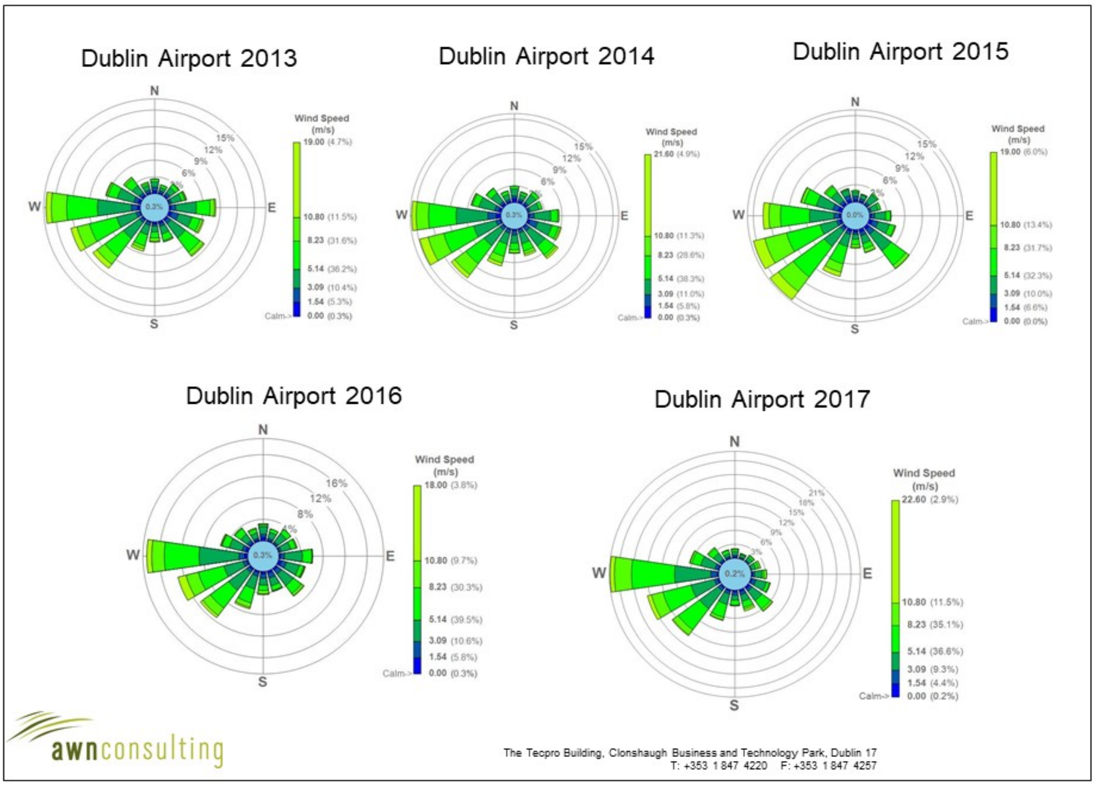

Figure 9.1: Dublin Airport Windrose 2013 – 2017.

9.4.2 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(19). 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(18), 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(18) 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(27) 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.

9.4.3 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*"(20). 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(20). 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 A(21). 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.).

With regard to NO_2, continuous monitoring data from the EPA(20) at the Zone A locations of Winetavern Street, Rathmines, Blanchardstown, Dún Laoghaire and Swords show that levels of NO_2 are below both the annual and 1-hour limit values (see Table 9.2), with average long-term concentrations ranging from 13 - 37 µg/m^3 for the period 2013 - 2017. There was one exceedance (in Blanchardstown) of the maximum 1-hour limit of 200 µg/m^3 in 2017 (18 exceedances are allowed per year). The most representative monitoring station is Dún Laoghaire, which is located 8.3 km north of the site has an average annual mean concentration of 16.4 µg/m^3 over the five-year period. Based on these results and keeping regard for the greater distance from the city centre to the site, a conservative estimate of the current background NO_2 concentration in the region of the proposed development is 18 µg/m^3.

Station	**Averaging Period** Notes 1, 2	**Year**				
		2013	**2014**	**2015**	**2016**	**2017**
Winetavern Street	Annual Mean NO_2 (µg/m^3)	31	31	31	37	27
	Max 1-hr NO_2 (µg/m^3)	158	188	182	194	196
Rathmines	Annual Mean NO_2 (µg/m^3)	19	17	18	20	27
	Max 1-hr NO_2 (µg/m^3)	107	112	106	102	116
Blanchardstown	Annual Mean NO_2 (µg/m^3)	29	31	25	30	26
	Max 1-hr NO_2 (µg/m^3)	154	215	178	160	331
Dún Laoghaire	Annual Mean NO_2 (µg/m^3)	16	15	16	19	17
	Max 1-hr NO_2 (µg/m^3)	123	105	103	142	153
Swords	Annual Mean NO_2 (µg/m^3)	15	14	13	16	14
	Max 1-hr NO_2 (µg/m^3)	211	325	170	206	107

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 9.2: Trends In Zone A Air Quality - Nitrogen Dioxide (NO_2).

Continuous PM_{10} monitoring carried out at the locations of Winetavern Street, Rathmines, Phoenix Park and Dún Laoghaire showed 2013 - 2017 annual mean concentrations ranging from 9 – 17 µg/m^3 (Table 9.3), with at most 8 exceedances (in Rathmines) of the 24-hour limit value of 50 µg/m^3 (35 exceedances are permitted per year)(20). The most representative location is Dún Laoghaire which had an average annual mean concentration of 14.2 µg/m^3 over the five year period. Based on the EPA data (Table 9.3) a conservative estimate of the current background PM_{10} concentration in the region of the proposed development is 15 µg/m^3.

Station	Averaging Period Notes 1, 2	Year				
		2013	2014	2015	2016	2017
Winetavern Street	Annual Mean PM_{10} (µg/m^3)	14	14	14	14	13
	24-hr Mean > 50 µg/m^3 (days)	3	1	4	2	3
Rathmines	Annual Mean PM_{10} (µg/m^3)	17	14	15	15	13
	24-hr Mean > 50 µg/m^3 (days)	8	3	5	3	5
Phoenix Park	Annual Mean PM_{10} (µg/m^3)	14	12	12	11	9
	24-hr Mean > 50 µg/m^3 (days)	3	0	2	0	1
Dún Laoghaire	Annual Mean PM_{10} (µg/m^3)	17	14	13	13	12
	24-hr Mean > 50 µg/m^3 (days)	5	2	3	0	2

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 9.3: Trends In Trends In Zone A Air Quality - PM_{10}

Continuous $PM_{2.5}$ monitoring carried out at the Zone A location of Rathmines showed $PM_{2.5}/PM_{10}$ ratios ranging from 0.63 – 0.68 over the period 2013 - 2017. Based on this information, a conservative ratio of 0.7 was used to generate a background $PM_{2.5}$ concentration in the region of the proposed development of 10.5 µg/m^3.

In terms of benzene, the annual mean concentration in the Zone A monitoring location of Rathmines ranged from 0.92 – 1.0 µg/m^3 for the period 2013 – 2017 An upper average annual mean concentration of 0.95 µg/m^3 was observed for this period. This is well below the limit value of 5 µg/m^3. Based on this EPA data a conservative estimate of the background benzene concentration in the vicinity of the proposed development is 1.0 µg/m^3.

With regard to CO, annual averages at the Zone A, locations of Winetavern Street and Coleraine Street over the 2013 – 2017 period are low, peaking at 5% of the limit value (10 mg/m^3). Based on this EPA data, a conservative estimate of the background CO concentration in the region of the development is 0.5 mg/m^3.

Background concentrations for the opening and design years have been calculated, these have used the predicted current background concentrations and the year on year reduction factors provided by Transport Infrastructure Ireland in the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* and the UK Department for Environment, Food and Rural Affairs LAQM.TG(16)(17).

9.5 Characteristics of the Proposed Development

The site is generally bounded by the Old Dublin Road (R119) and St. James (Crinken) Church to the west, Shanganagh Public Park and Shanganagh Cemetery to the north, Woodbrook Golf Course to the east and Corke Lodge and woodlands and Woodbrook Golf Clubhouse and car park to the south. The replacement golf hole lands are generally bounded by the existing train line to the west, Shanganagh Public Park to the north and Woodbrook Golf Course to the east and south. The proposed development is within the townlands of Cork Little and Shanganagh, Shankill, Co. Dublin.

In summary, the proposed Strategic Housing Development broadly comprises: -

- 685no. residential units (207no. houses, 48no. duplex and 430no. apartments) in buildings ranging from 2 to 8-storeys.
- 1no. childcare facilities (c. 429 sq. m gross floor area).
- Provision of Woodbrook Distributor Road / Woodbrook Avenue from the Old Dublin Road (R119) to the future Woodbrook DART Station, including the provision of a temporary surface car park (164no. parking spaces including set down areas and ancillary bicycle parking and storage) adjacent the future Woodbrook DART Station in northeast of site.
- Provision of a series of linear parks and green links (Coastal Park and Corridor Park), including 2no. pedestrian / cycle links to Shanganagh Public Park and provision of interim landscaping of future public plaza to serve future Local Centre to allow full north / south connection, supplemented by smaller pocket parks.
- Provision of SuDS infrastructure and connection to existing surface water culvert on Old Dublin Road (R119).
- Provision of waste water infrastructure (pumping station including 24 hour emergency storage and rising foul main through Shanganagh Public Park to tie-in to existing services at St. Anne's Park Residential Estate).
- 2no. replacement golf holes on eastern side of railway line.
- All associated and ancillary site development and infrastructural works, hard and soft landscaping and boundary treatment works.

A full project description is provided in Chapter 3: Description of Proposed Development.

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.

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

9.6 Potential Impact of the Proposed Development

9.6.1 Proposed Development

9.6.1.1 Construction Stage

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[(23)] (Table 9.4). While construction dust tends to be deposited within 200m of a construction site, the majority of the deposition occurs within the first 50m. There are a small number of sensitive receptors, predominantly residential properties and recreational areas in close proximity to the site. 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 9.3) are adhered to, the air quality impacts during the construction phase will not be significant. These measures are summarised in Section 9.7.

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 9.4: Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place[(23)]

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.

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.

9.6.1.2 Operational Stage

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 Atkins 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(16,17). Firstly, background concentrations(20) have been included in the modelling study. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern(20). Appropriate background levels were selected based on the available monitoring data provided by the EPA(20) (see Section 9.4.3). The modelling scenarios include for the cumulative impact of other developments in the vicinity of the proposed development, where such information is available, primarily traffic data associated with the proposed Shanganagh Castle development to the direct north of the proposed Woodbrook site has been included in the modelling.

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 which satisfied the assessment criteria detailed in Section 9.3.1 is shown in Table 9.5, with the percentage of HGV's shown in parenthesis below the AADT. Five sensitive residential receptors (R1 – R5) 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 9.2.

Road Name	Base Year	Do-Nothing			Do-Something			Average Speed (kph)
	2018	2020	2025	2035	2020	2025	2035	
	AADT (% HGV)	AADT (% HGV)	AADT (% HGV)	AADT (% HGV)	AADT (% HGV)	AADT (% HGV)	AADT (% HGV)	
Link A – R119 Between Wilford Roundabout and Cherrington Rd / Quinns Rd Roundabout	10,282 (0.9%)	10,562 (0.9%)	11,294 (1%)	12,317 (1.1%)	11,510 (0.9%)	12,099 (0.9%)	15,598 (0.9%)	56
Link B – R119 Between Cherrington Rd / Quinns Rd Roundabout and Corbawns lane / Dublin Rd Roundabout	13,290 (0.8%)	13,651 (0.8%)	14,596 (0.8%)	15,916 (0.9%)	14,418 (0.8%)	15,248 (0.8%)	18,786 (0.8%)	35
Link C - R837 Between Corbawns lane / Dublin Rd Roundabout and N11 / M11 Roundabout	11,580 (1%)	11,821 (1%)	12,641 (1.1%)	13,789 (1.2%)	12,153 (1%)	12,923 (1.1%)	15,075 (1.1%)	49
Link D – R761 Between Old Connaught Junction and Wilford Roundabout	12,285 (3.9%)	12,626 (3.9%)	13,522 (4.1%)	14,807 (4.6%)	13,470 (3.9%)	14,239 (4.2%)	17,902 (4.2%)	50
Link E – M11 Between M11 Junction 5 and M50 Junction 17	76,708 (3.9%)	78,841 (4%)	84,440 (4.2%)	92,462 (4.7%)	79,297 (4.1%)	92,462 (4.3%)	94,025 (4.2%)	100

Table 9.5: Traffic Data used in Modelling Assessment.

Figure 9.2: Approximate Location of Sensitive Receptors used in Modelling Assessment.

Modelling Assessment

Transport Infrastructure Ireland *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes*(23) 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.

<u>NO_2</u>

The results of the assessment of the impact of the proposed Phase 1 development on NO_2 in the opening year 2020 are shown Table 9.6 for the Highways Agency IAN 170/12 and Table 9.7 using the UK Department for Environment, Food and Rural Affairs technique respectively. The annual average concentration is within the limit value at all worst-case receptors using both techniques. Levels of NO_2 are 56% of the annual limit value in 2020 using the more conservative IAN technique, while concentrations are 53% of the annual limit value in 2020 using the UK Department for Environment, Food and Rural Affairs technique. The hourly limit value for NO_2 is 200 µg/m^3 and is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded using either technique (Table 9.8).

The impact of the proposed development on annual mean NO_2 levels can be assessed relative to "Do Nothing (DN)" levels in 2020. Relative to baseline levels, some imperceptible increases in pollutant levels are predicted as a result of Phase 1 of the proposed development. With regard to impacts at individual receptors, the greatest impact on NO_2 concentrations will be an increase of 0.7% of the annual limit value at Receptor 3 (R3). Thus, using the assessment criteria outlined in Appendix 9.2 Tables 1 – 2, 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 Phase 1 development is long-term and imperceptible at all of the receptors assessed.

PM_{10}

The results of the modelled impact of the proposed Phase 1 development for PM_{10} in the opening year 2020 are shown in Table 9.9. Predicted annual average concentrations at the worst-case receptor in the region of the development are at most 40% of the limit value in 2020. It is predicted that the worst case receptors will not experience any exceedances of the 50 $\mu g/m^3$ 24-hour mean value with or without the proposed development in place, 35 exceedances are permitted per year.

Relative to baseline levels, some imperceptible increases in PM_{10} levels at the worst-case receptors are predicted as a result of the proposed Phase 1 development. The greatest impact on PM_{10} concentrations in the region of the proposed development will be an increase of 0.15% of the annual limit value at Receptor 3. Thus, the magnitude of the changes in air quality are negligible at all receptors based on the criteria outlined in Appendix 9.2, Tables 1 – 3. Therefore, the overall impact of PM_{10} concentrations as a result of the proposed Phase 1 development is long-term and imperceptible.

$PM_{2.5}$

The results of the modelled impact of the proposed Phase 1 development for $PM_{2.5}$ are shown in Table 9.10. Predicted annual average concentrations in the region of the proposed development are 45% of the limit value in 2020 at all worst-case receptors.

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 0.17% of the limit value. Therefore, using the assessment criteria outlined in Appendix 9.2, Tables 1 – 2, 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 Phase 1 development is long-term and imperceptible.

CO and Benzene

The results of the modelled impact of CO and benzene are shown in Table 9.11 and Table 9.12 respectively. Predicted pollutant concentrations with the proposed Phase 1 development in place are below the ambient standards at all locations. Levels of CO are 28% of the limit value in 2020 with levels of benzene reaching 22% of the limit value.

Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the proposed Phase 1 development. The greatest impact on CO and benzene concentrations will be an increase of 0.19% of the CO limit and 0.09% of the Benzene limit value at Receptor 3. Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Appendix 9.2 and applying these criteria to CO and benzene, the impact of the proposed Phase 1 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 Phase 1 of 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 9.2, Table 1 – 3, the impact of the Phase 1 of the development in terms of PM_{10}, $PM_{2.5}$, CO, NO_2 and benzene is negligible, long-term, localised negative and imperceptible.

Regional Air Quality Impact

The regional impact of the proposed Phase 1 development on emissions of NO_X and VOCs has been assessed using the procedures of Transport Infrastructure Ireland[(23)] and the UK Department for Environment, Food and Rural Affairs[(17)]. The results (see Table 9.13) show that the likely impact of the proposed Phase 1 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 2020, the predicted impact of the changes in AADT is to increase NO_x levels by 0.0009% of the NO_x emissions ceiling and increase VOC levels by 0.00025% of the VOC emissions ceiling to be complied with in 2020.

Therefore, the likely overall magnitude of the changes on air quality in the operational stage of Phase 1 is imperceptible, long-term and not significant.

Climate

The impact of the proposed Phase 1 development on emissions of CO_2 impacting climate were also assessed using the Design Manual for Roads and Bridges screening model (see Table 9.13). The results show that the impact of the proposed Phase 1 development in the opening year 2020 will be to increase CO_2 emissions by 0.00076% of Ireland's 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[(29)].

Therefore, the likely overall magnitude of the changes on climate in the operational stage of Phase 1 is imperceptible, long-term and not significant.

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.

9.6.1.3 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).

9.6.2 Cumulative – Woodbrook

9.6.2.1 Construction Stage

Air Quality

As with the Phase 1 development, the primary sources of air quality impacts during the construction phase of the other phases of the Woodbrook development will be nuisance dust impacts. The dust minimisation measures outlined for the Phase 1 development should be implemented throughout the construction phase of the full development to avoid any nuisance dust impacts occurring. Once these minimisation measures are in place the impact to air quality is considered short-term and imperceptible.

Climate

Construction machinery and vehicles have the potential to impact climate through the release of GHG emissions. However, the impact to climate is considered imperceptible due to the low volumes of machinery and vehicles required.

Human Health

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 short-term and imperceptible with respect to human health.

9.6.2.2 Operational Stage

Local Air Quality

Air dispersion modelling of operational phase traffic impacts was undertaken for the design years of 2025 and 2035 which assumes the cumulative impact of the full phase of the Woodbrook development as well as the proposed school and train station park and ride facility and Shanganagh Castle development. The traffic data used in the modelling assessment is detailed in Table 9.5.

<u>NO_2</u>

The results of the assessment of the impact of the proposed cumulative development on NO_2 in the design years of 2025 and 2035 are shown Table 9.6 for the Highways Agency IAN 170/12 and Table 9.7 using the UK Department for Environment, Food and Rural Affairs technique respectively. The annual average concentration is within the limit value at all worst-case receptors using both techniques. Levels of NO_2 are 56% of the annual limit value in 2025, while concentrations are 53% of the annual limit value in 2035 using the more conservative IAN technique. The hourly limit value for NO_2 is 200 $\mu g/m^3$ and is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded using either technique (Table 9.8).

The impact of the proposed cumulative development on annual mean NO_2 levels can be assessed relative to "Do Nothing (DN)" levels in 2025 and 2035. Relative to baseline levels, some small increases in pollutant levels are predicted as a result of the proposed cumulative development. With regard to impacts at individual receptors, the greatest impact on NO_2 concentrations will be an increase of 2.2% of the annual limit value at Receptor 3 (R3). Thus, using the assessment criteria outlined in Appendix 9.2 Tables 1 – 2, 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 cumulative development is long-term and imperceptible at all of the receptors assessed.

<u>PM_{10}</u>

The results of the modelled impact of the proposed cumulative development for PM_{10} in the design years 2025 and 2035 are shown in Table 9.9. Predicted annual average concentrations at the worst-case receptor in the region of the development are at most 40.7% of the limit value in 2025 and 2035. It is predicted that the worst case receptors will not experience any exceedances of the 50 $\mu g/m^3$ 24-hour mean value with or without the proposed development in place, 35 exceedances are permitted per year.

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 0.5% of the annual limit value at Receptor 3.

Thus, the magnitude of the changes in air quality are negligible at all receptors based on the criteria outlined in Appendix 9.2, Tables 1 – 3. Therefore, the overall impact of PM_{10} concentrations as a result of the proposed cumulative development is long-term and imperceptible.

$PM_{2.5}$

The results of the modelled impact of the proposed cumulative development for $PM_{2.5}$ are shown in Table 9.10. Predicted annual average concentrations in the region of the proposed development are 45.5% of the limit value in 2025 and 45.6% in 2035 at all worst-case receptors.

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 0.5% of the limit value. Therefore, using the assessment criteria outlined in Appendix 9.2, Tables 1 – 2, 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 cumulative development is long-term and imperceptible.

CO and Benzene

The results of the modelled impact of CO and benzene are shown in Table 9.11 and Table 9.12 respectively. Predicted pollutant concentrations with the proposed cumulative development in place are below the ambient standards at all locations. Levels of CO are 28.2% of the limit value in 2025 with levels of benzene reaching 22.3% of the limit value. Similarly low levels are predicted for 2035 with levels of CO 28.4% of the limit value and levels of benzene reaching 22.4% 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 cumulative development. The greatest impact on CO and benzene concentrations will be an increase of 0.6% of the CO limit value and 0.3% of the benzene limit value at Receptor 3. Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Appendix 9.2 and applying these criteria to CO and benzene, the impact of the proposed cumulative 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 cumulative impact of the proposed development will not exceed the ambient air quality standards either with or without the proposed cumulative development in place. Using the assessment criteria outlined in Appendix 9.2, Table 1 – 3, the impact of the cumulative development in terms of PM_{10}, $PM_{2.5}$, CO, NO_2 and benzene is negligible, long-term, localised, negative and imperceptible.

Regional Air Quality Impact

The regional impact of the proposed cumulative development on emissions of NO_X and VOCs has been assessed using the procedures of Transport Infrastructure Ireland[23] and the UK Department for Environment, Food and Rural Affairs[17]. The results (see Table 9.13) show that the likely impact of the proposed cumulative 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 design year of 2025, the predicted impact of the changes in AADT is to increase NO_x levels by 0.0015% of the NO_x emissions ceiling and increase VOC levels by 0.00026% of the VOC emissions ceiling to be complied with in 2030. Similarly low impacts are predicted for the design year of 2035 with changes in AADT predicted to increase NO_x levels by 0.0007% of the NO_x emissions ceiling and increase VOC levels by 0.00048% of the VOC emissions ceiling to be complied with in 2030.

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

Climate

The impact of the proposed cumulative development on emissions of CO_2 impacting climate were also assessed using the Design Manual for Roads and Bridges screening model (see Table 9.13). The results show that the impact of the proposed cumulative development in the design year 2025 will be to increase CO_2 emissions by 0.00072% of Ireland's EU 2020 Target. Emissions of CO_2 are predicted to increase by 0.0013% in 2035. Thus, the impact of the proposed cumulative development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2020 Target(29).

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

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.

9.6.2.3 Do-Nothing Impact

The Do-Nothing impact for the cumulative development is the same as that for the Phase 1 development as outlined in Section 9.6.1.3.

Receptor	Impact Opening Year 2020					Impact Design Year 2025					Impact Design Year 2035				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	19.8	20.0	0.19	Imperceptible	Negligible Increase	19.4	19.6	0.20	Imperceptible	Negligible Increase	19.2	19.4	0.22	Imperceptible	Negligible Increase
2	22.5	22.5	0.07	Imperceptible	Negligible Increase	21.9	22.2	0.31	Imperceptible	Negligible Increase	21.5	21.4	-0.17	Imperceptible	Negligible Decrease
3	19.9	20.2	0.27	Imperceptible	Negligible Increase	19.5	19.7	0.25	Imperceptible	Negligible Increase	19.1	20.0	0.88	Small	Small Increase
4	19.9	20.0	0.17	Imperceptible	Negligible Increase	19.4	19.5	0.12	Imperceptible	Negligible Increase	18.9	19.1	0.20	Imperceptible	Negligible Increase
5	20.2	20.3	0.09	Imperceptible	Negligible Increase	19.7	19.8	0.08	Imperceptible	Negligible Increase	19.4	19.7	0.36	Imperceptible	Negligible Increase

Table 9.6: Annual Mean NO_2 Concentrations (µg/m^3) (using IAN 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Impact Opening Year 2020					Impact Design Year 2025					Impact Design Year 2035				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	18.6	18.7	0.18	Imperceptible	Negligible Increase	16.3	16.4	0.17	Imperceptible	Negligible Increase	15.9	16.1	0.18	Imperceptible	Negligible Increase
2	21.2	21.3	0.07	Imperceptible	Negligible Increase	18.9	19.2	0.27	Imperceptible	Negligible Increase	18.5	18.3	-0.15	Imperceptible	Negligible Decrease
3	18.7	18.9	0.25	Imperceptible	Negligible Increase	16.4	16.6	0.21	Imperceptible	Negligible Increase	15.9	16.7	0.73	Small	Small Increase
4	18.6	18.8	0.16	Imperceptible	Negligible Increase	16.3	16.4	0.10	Imperceptible	Negligible Increase	15.8	15.9	0.17	Imperceptible	Negligible Increase
5	18.9	19.0	0.08	Imperceptible	Negligible Increase	16.6	16.7	0.07	Imperceptible	Negligible Increase	16.2	16.5	0.30	Imperceptible	Negligible Increase

Table 9.7: Annual Mean NO_2 Concentrations (µg/m^3) (using Defra's Technical Guidance)

Receptor	IAN 170/12 V3 Long Term NO2 Trend Projections Technique						Defra's Technical Guidance Technique					
	Opening Year 2020		Design Year 2025		Design Year 2035		Opening Year 2020		Design Year 2025		Design Year 2035	
	DN	DS	DN	DS	DN	DS	DN	DS	DN	DS	DN	DS
1	69.4	70.1	67.9	68.6	67.1	67.8	65	65.6	56.9	57.5	55.7	56.4
2	78.6	78.8	76.6	77.7	75.4	74.7	74.3	74.5	66.1	67	64.6	64.1
3	69.8	70.7	68.1	69	66.9	70	65.4	66.3	57.3	58.1	55.8	58.3
4	69.6	70.2	67.9	68.4	66.2	66.9	65.2	65.8	57.1	57.5	55.2	55.8
5	70.6	70.9	69	69.3	67.8	69.1	66.2	66.5	58.2	58.4	56.7	57.8

Table 9.8: 1 Hour 99.8th%ile NO_2 Concentrations (µg/m^3)

Receptor	Impact Opening Year 2020					Impact Design Year 2025					Impact Design Year 2035				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	15.3	15.4	0.04	Imperceptible	Negligible Increase	15.4	15.4	0.03	Imperceptible	Negligible Increase	15.4	15.5	0.05	Imperceptible	Negligible Increase
2	16.1	16.1	0.01	Imperceptible	Negligible Increase	16.2	16.3	0.06	Imperceptible	Negligible Increase	16.3	16.3	0.00	Imperceptible	Negligible Decrease
3	15.4	15.5	0.06	Imperceptible	Negligible Increase	15.5	15.5	0.05	Imperceptible	Negligible Increase	15.6	15.7	0.19	Imperceptible	Negligible Increase
4	15.6	15.6	0.05	Imperceptible	Negligible Increase	15.7	15.7	0.03	Imperceptible	Negligible Increase	15.7	15.8	0.06	Imperceptible	Negligible Increase
5	15.5	15.5	0.02	Imperceptible	Negligible Increase	15.6	15.6	0.02	Imperceptible	Negligible Increase	15.7	15.8	0.08	Imperceptible	Negligible Increase

Table 9.9: Annual Mean PM_{10} Concentrations (µg/m^3)

Receptor	Impact Opening Year 2020					Impact Design Year 2025					Impact Design Year 2035				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	10.7	10.7	0.03	Imperceptible	Negligible Increase	10.8	10.8	0.02	Imperceptible	Negligible Increase	10.8	10.8	0.04	Imperceptible	Negligible Increase
2	11.3	11.3	0.00	Imperceptible	Negligible Increase	11.3	11.4	0.04	Imperceptible	Negligible Increase	11.4	11.4	0.00	Imperceptible	Negligible Decrease
3	10.8	10.8	0.04	Imperceptible	Negligible Increase	10.8	10.9	0.04	Imperceptible	Negligible Increase	10.9	11.0	0.13	Imperceptible	Negligible Increase
4	10.9	10.9	0.03	Imperceptible	Negligible Increase	11.0	11.0	0.02	Imperceptible	Negligible Increase	11.0	11.0	0.04	Imperceptible	Negligible Increase
5	10.9	10.9	0.01	Imperceptible	Negligible Increase	10.9	10.9	0.01	Imperceptible	Negligible Increase	11.0	11.0	0.06	Imperceptible	Negligible Increase

Table 9.10: Annual Mean $PM_{2.5}$ Concentrations (µg/m^3)

Receptor	Impact Opening Year 2020					Impact Design Year 2025					Impact Design Year 2035				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	2.67	2.68	0.011	Imperceptible	Negligible Increase	2.68	2.69	0.009	Imperceptible	Negligible Increase	2.7	2.7	0.017	Imperceptible	Negligible Increase
2	2.69	2.69	0.001	Imperceptible	Negligible Increase	2.70	2.70	0.007	Imperceptible	Negligible Increase	2.7	2.7	0.001	Imperceptible	Negligible Increase
3	2.71	2.73	0.019	Imperceptible	Negligible Increase	2.72	2.74	0.016	Imperceptible	Negligible Increase	2.7	2.8	0.057	Imperceptible	Negligible Increase
4	2.79	2.80	0.016	Imperceptible	Negligible Increase	2.81	2.82	0.011	Imperceptible	Negligible Increase	2.8	2.8	0.022	Imperceptible	Negligible Increase
5	2.75	2.75	0.007	Imperceptible	Negligible Increase	2.76	2.77	0.006	Imperceptible	Negligible Increase	2.8	2.8	0.026	Imperceptible	Negligible Increase

Table 9.11: Maximum 8-hour CO Concentrations (mg/m^3)

Receptor	Impact Opening Year 2020					Impact Design Year 2025					Impact Design Year 2035				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	1.04	1.04	0.003	Imperceptible	Negligible Increase	1.04	1.04	0.002	Imperceptible	Negligible Increase	1.04	1.05	0.009	Imperceptible	Negligible Increase
2	1.10	1.10	0.000	Imperceptible	Negligible Increase	1.11	1.12	0.010	Imperceptible	Negligible Increase	1.12	1.12	0.002	Imperceptible	Negligible Increase
3	1.05	1.05	0.004	Imperceptible	Negligible Increase	1.05	1.06	0.004	Imperceptible	Negligible Increase	1.06	1.07	0.015	Imperceptible	Negligible Increase
4	1.07	1.07	0.004	Imperceptible	Negligible Increase	1.07	1.07	0.003	Imperceptible	Negligible Increase	1.08	1.09	0.014	Imperceptible	Negligible Increase
5	1.06	1.06	0.002	Imperceptible	Negligible Increase	1.06	1.06	0.001	Imperceptible	Negligible Increase	1.07	1.07	0.006	Imperceptible	Negligible Increase

Table 9.12: Annual Mean Benzene Concentrations (μg/m^3)

Year	Scenario	VOC (kg/annum)	NOX (kg/annum)	CO2 (tonnes/annum)
2020	Do Nothing	5,699	29,391	15,037
	Do Something	5,841	30,014	15,324
2025	Do Nothing	6,131	31,746	16,286
	Do Something	6,265	32,371	16,557
2035	Do Nothing	6,857	35,863	18,129
	Do Something	7,107	36,144	18,623
Increment in 2020		141.9 kg	623.1 kg	287.1 Tonnes
Increment in 2025		133.5 kg	624.3 kg	271.6 Tonnes
Increment in 2035		249.6 kg	280.5 kg	494.2 Tonnes
Emission Ceiling (kilo Tonnes) 2020		**56.9**	**66.9**	**37,943**
Emission Ceiling (kilo Tonnes) 2030		**51.6**	**40.7**	**37,943**
Impact in 2020 (%)		0.00025 %	0.0009 %	0.00076 %
Impact in 2025 (%)		0.00026 %	0.0015 %	0.00072 %
Impact in 2035 (%)		0.00048 %	0.0007 %	0.0013 %

Table 9.13: Regional Air Quality and Climate Impact Assessment

9.7 Ameliorative, Remedial or Reductive Measures

9.7.1 Proposed Development

9.7.1.1 Construction Stage

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 9.3.

- 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.

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.

9.7.1.2 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.

9.7.2 Cumulative – Woodbrook

9.7.2.1 Construction Stage

The dust minimisation measures outlined in Appendix 9.3 should be implemented for the duration of the construction phase for both the Phase 1 development and the full Woodbrook development.

9.7.2.2 Operational Stage

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

9.8 Residual Impact of the Proposed Development

9.8.1 Proposed Development

9.8.1.1 Construction Stage

Air Quality

When the dust minimisation measures detailed in the mitigation section of this Chapter (Section 9.7) are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

Climate

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

9.8.1.2 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.

9.8.1.3 Worst Case Impact

As part of the air dispersion modelling, worst-case traffic data was used in the assessment. In addition, conservative background concentrations were used in order to ensure a robust assessment. Thus, the predicted results of the operational stage assessment are worst-case and will not cause a significant impact on either air quality or climate.

9.8.1.4 Cumulative – Woodbrook

The residual impact of the cumulative Woodbrook development is the same as that detailed above in Section 9.8.1 for the proposed Phase 1 development for both the construction and operational stages.

9.9 Monitoring

9.9.1 Proposed Development

9.9.1.1 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.

9.9.1.2 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.

9.9.2 Cumulative – Woodbrook

9.9.2.1 Construction Stage

Dust deposition monitoring as detailed in Section 9.9.1.1 should also be implemented during the full Woodbrook development to avoid dust nuisance impacts at nearby sensitive receptors.

9.9.2.2 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.

9.10 Reinstatement

This section is not applicable to air quality and climate.

9.11 Difficulties Encountered

There were no difficulties encountered while carrying out this assessment.