9.0 AIR QUALITY & CLIMATE

9.1 INTRODUCTION

This section of the EIAR chapter has been prepared by Byrne Environmental Consulting Ltd to identify and assess the potential air quality and climatic impacts with the proposed development of lands at Clay Farm, Dublin 18, during both the Construction and Operational Phases of the development. This chapter was prepared by Ian Byrne MSc. MIOA. Dip Environmental & Planning Law, who has over 20 years' experience as an environmental consultant specialising in Acoustics and Air Quality Monitoring, Impact Assessment and Management.

The Clay Farm Phase 2 development of c.20.5 hectares relates to the construction of 927 no. residential units in a mix of houses and apartments, a 607m^2 crèche, 2 No. retail units each with a ground floor area of 85m^2 together with associated open space, car parking and a bridged link road between the Phase 2 and Phase 1 development currently under construction. A total of 1,478 no. car parking spaces including 730 no. spaces for the houses, 732 no. spaces for the apartment blocks and 14 no. spaces for the creche and 2 no. spaces for the commercial units at the neighbourhood centre are proposed. 1,128 no. cycle parking spaces are provided for.

The residential component of the development consists of 365 no. houses and 562 no. apartments, to be provided as follows:

- 9 no. 3 bed two storey terraced houses with a GFA of 125.5 sq.m (Type B1);
- 33 no. 3 bed two storey terraced houses with a GFA of 113.8 sq.m (Type B2);
- 2 no. 3 bed two storey terraced houses with a GFA of 119.4 sq.m (Type B3);
- 201 no. 4 bed three storey terraced houses with a GFA of 169.5 sq.m (Type C1);
- 76 no. 3 bed two storey terraced houses with a GFA of 112 sq.m (Type C2);
- 3 no. 4 bed three storey terraced houses with a GFA of 139 sq.m (Type C3);
- 34 no. 4 bed three storey terraced houses with a GFA of 171.8 sq.m (Type D1);
- 7 no. 3 bed two storey terraced houses with a GFA of 121.9 sq.m (Type D2);
- 16 no. apartment blocks (W01-07 & E01-09) ranging from three to six no. storeys in height, over undercroft / basement car parking, and which contain a total of 113 no. 1 bed apartments with a GFA of 51 sq.m and 383 no. 2 bed apartments with a GFA of 88 sq.m. The apartment blocks also contain 48 no. 3 bed duplex / own door apartments units ranging in size from 110 sq.m to 114 sq.m GFA.
- 18 no. 3 bed duplex / own door apartment units are located at the neighbourhood centre ranging in size from 110 sq.m to 115 sq.m in a three to four storey building (which also contains the childcare facility and retail units at ground floor level).

Bin and cycle storage areas are proposed within the apartment blocks and single and double bin stores are proposed for the houses. 3 no. electricity sub-stations are proposed for the site. The associated site and infrastructural works include foul and surface water drainage, attenuation tanks, open space including playgrounds, a MUGA (multi-use games area) and exercise units, cycle spaces, landscaping, boundary walls and fences, internal roads, cyclepaths and footpaths. The application site includes the possible linear earthworks (DU026-087), a Recorded Monument, located along the northern site boundary.

This document includes a comprehensive description of the existing air quality and climate at and in the vicinity of the subject site, a description of how the construction and operational phases of the development may impact existing air quality and finally; the mitigation measures that shall be implemented to control and minimise the impact that the development may have on local ambient air quality and reduce the impact on the local micro climate.

9.2 STUDY METHODOLOGY

The general assessment methodology of the potential impact of the proposed development on air quality and climate has been devised in accordance with:

- Draft Guidelines on the information to be contained in environmental impact assessment reports, EPA, August 2017
- Guidelines on Information to be Contained in an Environmental Impact Statement (EPA 2002).
- Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA 2003).
- Environmental Impact Assessment (EIA), Guidance for Consent Authorities Regarding Sub-Threshold Development (DoEHLG 2003).
- Development Management Guidelines (DoEHLG, 2007).
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoECLG, March 2013).

9.2.1 Air Quality Assessment Methodology

Baseline Environment

The existing ambient air quality in the vicinity of the site has been characterised with information obtained from a number of sources as follows:

- Environmental Protection Agency's Annual Air Quality in Ireland Report 2015
- Site specific air quality monitoring surveys at site boundaries

The ambient air quality data collected and reviewed for the purpose of this study focused on the principal substances (dust, vehicle exhaust emissions and boiler emissions) which may be released from the site during the construction and operation phases and which may exert an influence on local air quality.

Impact Assessment Methodology

Legislation and Guidance

Air quality standards and guidelines are available from a number of sources. The guidelines and standards referenced in this report include those from Ireland and the European Union.

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 (Ref Table 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 National Air Quality Standards Regulations 2011 (S.I No. 180 of 2011), which incorporate European Commission Directive 2008/50/EC which has set limit values for the pollutants SO_2, NO_2, PM_{10}, benzene and CO Council Directive 2008/50/EC combines the previous Air Quality Framework Directive (96/62/EC) and its subsequent daughter directives (including 1999/30/EC and 2000/69/EC). Provisions are also made for the inclusion of new ambient limit values relating to $PM_{2.5}$.

The European 2008/50/EC Clean Air For Europe (CAFÉ) Directive is the current air quality directive for Europe which supersedes the European Directives 1999/30/EC and 2000/69/EC.

In order to assess a wider range of air pollutants in the development area it is necessary to review current air quality monitoring data from published sources such as the most recent EPA's 2015 Annual report entitled Air Quality in Ireland. This EPA report provides detailed monitoring data collected from a number of monitoring locations throughout Ireland on an annual basis to assess national compliance with National Air Quality Regulations. Given the location of the site in Ballyogan, South County Dublin it is characterised as a Zone A area as defined by the EPA.

EU legislation on air quality requires that Member States divide their territory into zones for the assessment and management of air quality. The zones in place in Ireland in 2016 are as follows:

Zone A is the Dublin conurbation,
Zone B is the Cork conurbation
Zone C comprising 23 large towns in Ireland with a population >15,000.
Zone D is the remaining area of Ireland.
The zones changed on 1 January 2013 to reflect the results of the 2011 census.

The air quality in each zone is assessed and classified with respect to upper and lower assessment thresholds based on measurements over the previous five years. Upper and lower assessment thresholds are prescribed in the legislation for each pollutant. The number of monitoring locations required is dependent on population size and whether ambient air quality concentrations exceed the upper assessment threshold, are between the upper and lower assessment thresholds, or are below the lower assessment threshold. A summary of the EPA's Annual report entitled Air Quality in Ireland 2015 is detailed below in Table 9.2.

Table 9.1: **Air Quality Standards Regulations 2011 (based on EU Council Directive 2008/50/EC)**

POLLUTANT	REGULATION	LIMIT CRITERIA	TOLERANCE	LIMIT VALUE
NITROGEN DIOXIDE	2008/50/EC	Hourly limit for the protection of human health – not to be exceeded more than 18 times/year	40% until 2003 reducing linearly to 0% by 2010	200 µg/m^3
		Annual limit for the protection of human health	40% until 2003 reducing linearly to 0% by 2010	40 µg/m^3
		Annual limit for the protection of vegetation	None	400 µg/m^3 NO & NO_2
LEAD	2008/50/EC	Annual limit for the protection of human health	100%	0.5 µg/m^3
SULPHUR DIOXIDE	2008/50/EC	Hourly limit for protection of human health – not to be exceeded more than 24 times/year	150 µg/m^3	350 µg/m^3
		Daily limit for protection of human health – not to be exceeded more than 3 times/year	NONE	125 µg/m^3
		Annual and Winter limit for the protection of ecosystems	NONE	20 µg/m^3
PARTICULATE MATTER PM10	2008/50/EC	24-hour limit for protection of human health – not to be exceeded more than 35 times/year	50%	50 µg/m^3
			20%	

		Annual limit for the protection of human health		40 µg/m^3
PARTICULATE MATTER PM2.5 STAGE 1	2008/50/EC	Annual limit for the protection of human health	20% from June 2008. Decreasing linearly to 0% by 2015	25 µg/m^3
PARTICULATE MATTER PM2.5 STAGE 2	2008/50/EC	Annual limit for the protection of human health	NONE	20 µg/m^3
BENZENE	2008/50/EC	Annual limit for the protection of human health	20% until 2006. Decreasing linearly to 0% by 2010	5 µg/m^3
CARBON MONOXIDE	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	60%	10 mg/m^3
DUST DEPOSITION	German TA Luft Air Quality Standard [Note 1]	30 Day Average	NONE	350 mg/m^2/day

Note 1 Dust levels in urban atmospheres can be influenced by industrial activities and transport sources. There are currently no national or European Union air quality standards with which these levels of dust deposition can be compared. However, a figure of 350 mg/m^2-day (as measured using Bergerhoff type dust deposit gauges as per German Standard Method for determination of dust deposition rate, VDI 2129) is commonly applied to ensure that no nuisance effects will result from industrial or construction activities.

Table 9.2: EPA 2014 Assessment Zone Classification

Pollutant	EPA 2015 Assessment Classification
NO_2	
Zone A & B	Above lower assessment threshold
Zone C & D	Below lower assessment threshold
SO_2	
Zone A & B	Below lower assessment threshold
Zone C & D	Below lower assessment threshold
CO	
Zone A & B	Below lower assessment threshold
Zone C & D	Below lower assessment threshold
Ozone	
Zone A & B	Below long term objective
Zone C & D	Above long term objective
PM_{10}	
Zone A & B & C	Above lower assessment threshold
Zone D	Below lower assessment threshold
$PM_{2.5}$	
Zone A & B	Below lower assessment threshold
Zone C & D	Above lower assessment threshold
Benzene	
Zone A & B	Below lower assessment threshold
Zone C & D	Below lower assessment threshold
Heavy Metals (As, Ni, Cd, Pb)	
Zone A & B	Below lower assessment threshold
Zone C & D	Below lower assessment threshold
Poly Aromatic Hydrocarbons (PAH)	
Zone A & C & D	Above lower assessment threshold
Zone B	Above upper assessment threshold

Construction Impact Assessment Criteria

The National Roads Authority 'Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes' (Revision 1, 2011) states that "it is very difficult to accurately quantify dust emissions arising from construction activities" and that "it is thus not possible to easily predict changes to dust soiling rates or PM_{10} concentrations." The guidance advises the use of a semi-quantitative approach to determine the likelihood of a significant impact which should be combined with an assessment of the proposed mitigation measures.

The construction assessment criteria, reproduced from the NRA guidance, are set out in Table 9.3 below.

Table 9.3 Assessment criteria for the impact of duct emissions from construction activities with standard mitigation in place (NRA, 2011)

Source		**Potential distance for significant effects (distance from source)**		
Scale	**Description**	**Soiling**	**PM_{10} [a]**	**Vegetation effects**
Major	Large construction sites, with high use of haul routes	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul routes	50m	15m	15m
Minor	Minor construction sites, with limited use of haul routes	25m	10m	10m

The impact of construction related dust emissions is assessed by estimating the area over which there is a risk of significant impacts as per the NRA guidance. The significance of impact is assessed in terms of the significance criteria outline in the EPA advice Notes on Current Practice in the Preparation of Environmental Impact Statement (EPA, 2003).

In relation to construction related traffic, air quality significance criteria are assessed on the basis of compliance with the appropriate standards air limit values. The Air Quality Standards Regulations 2011 replace the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and S.I. No. 33 of 1999.

Operational Impact Assessment Criteria

Once operational the proposed Clay Farm Phase 2 development may impact on air quality as a result of the requirements of new buildings to be heated and with the increased traffic movements associated with the development.

Air quality significance criteria are assessed on the basis of compliance with the national air qualitylimit values. The Air Quality Standards Regulations 2011 replace the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and S.I. No. 33 of 1999.

9.2.2 Climate Assessment Methodology

Climate has implications for many aspects of the environment from soils to biodiversity and land use practices. The proposed development may impact on both the macro-climate and micro-climate. The macro-climate is the climate of a large geographic area such as Ireland. The micro-climate refers to the climate in the immediate area.

With respect to microclimate, green areas are considered to be sensitive to development. Development of any green area is generally associated with a reduction in the abundance of vegetation including trees and a reduction in the amount of open, undeveloped space. The removal of vegetation or the development of man-made structures in these areas can intensify the temperature gradient.

To assess the impacts of converting vegetative surfaces to hard-standing with residential buildings and its significance, the amount of vegetative surfaces associated with the proposed development that will be converted to residential buildings and hard-standing has been considered.

The impact of the proposed scheme upon the macro-climate is assessed through the consideration of the change in CO_2 emissions that will occur due to the changes in traffic flow that occur in response to the proposed scheme.

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997 (FCCC 1997, 1999). For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, Ireland agreed to limit the net anthropogenic growth of the six GHGs under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012 (ERM 1998). 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 (COP20) to the agreement was convened in Lima, Peru in December 2014. COP20 was viewed as an important step towards the new 2015 agreement on climate change which was signed in Paris in late 2015. 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, on the 23/24th of October 2014, agreed the “2030 Climate and Energy Policy Framework” (EU 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in 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.

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 (SO2), Nitrogen Oxides (NOX), Volatile Organic Compounds (VOCs) and Ammonia (NH3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO2 (67% below 2001 levels), 65 kt for NOX (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH3 (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 PM2.5. In relation to Ireland, 2020 emission targets are 25 kt for SO2 (65% below 2005 levels), 65 kt for NOX (49% reduction), 43 kt for VOCs (25% reduction), 108 kt for NH3 (1% reduction) and 10 kt for PM2.5 (18% reduction). COM (2013) 917 Final is the “Proposal for a Council Decision for the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone”.

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005 (DEHLG 2004, 2007). The most recent data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO2, VOCs and NH3 but failed to comply with the ceiling for NOX (EEA 2011). COM (2013) 920 Final is the “Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC”. The proposal will apply the 2010 NECD limits until 2020 and establish new national

emission reduction commitments which will be applicable from 2020 and 2030 for SO2, NOX, NMVOC, NH3, PM2.5 and CH4. In relation to Ireland, 2020-29 emission targets are for SO2 (65% below 2005 levels), for NOX (49% reduction), for VOCs (25% reduction), for NH3 (1% reduction) and for PM2.5 (18% reduction). In relation to 2030, Ireland's emission targets are for SO2 (83% below 2005 levels), for NOX (75% reduction), for VOCs (32% reduction), for NH3 (7% reduction), for PM2.5 (35% reduction) and for CH4 (7% reduction).

Guidance issued by the European Commission in 2013 entitled Guidance On Integrating Climate Change and Biodiversity into Strategic Environmental Assessment has been applied to this assessment in order to determine the potential impacts the proposed developments may have an climate change and biodiversity

9.3 EXISTING RECEIVING ENVIRONMENT

9.3.1 Description of the baseline environment/ Context

The site is located off the Ballyogan Road and is set back to the south of the existing Clay Farm Phase 1 development currently under construction. The Ballyogan Stream runs between the Phase 1 and Phase 2 sites. Stepaside Park and Cruagh residential estates are located at the western and southwestern site boundaries respectively. The ESB Carrickmines Electrical Transformer Station is to the north east of the site. The former Ballyogan landfill site is located to the east of the site. This site has been closed as an active landfill for c.10 years. Stepaside golf course borders the southern site boundary.

The development area is located within a zone which includes a significant sources of transportation related air emissions principally from the Ballyogan Road, the M50 Motorway and local road infrastructure. It is noted that there are no major sources of industrial air emissions within 5km of the site.

9.3.2 Description of Existing Climate

The nearest representative synoptic meteorological station to the subject site at Carrickmines is at Dublin Airport which is located approximately 20km north of the site and as such, long-term measurements of wind speed/direction and air temperature for this location are representative of prevailing conditions experienced at the subject site. Recent meteorological data sets for Dublin Airport were obtained from Met Éireann for the purposes of this assessment study.

Rainfall

Precipitation data from the Dublin Airport meteorological station for the period 2011-2016 indicates a mean annual total of about 762 mm. This is within the expected range for most of the eastern half of the Ireland which has between 750 mm and 1000 mm of rainfall in the year.

Temperature

The annual mean temperature at Dublin Airport (2011-2016) is 9.5ºC with a mean maximum of 15.3ºC and a mean minimum of 4.0ºC. Given the relative close proximity of this meteorological station to the proposed development site, similar conditions would be observed. Table 9.4 sets out meteorological data for Dublin Airport from 2011-2016.

Table 9.4 Meteorological Data for Dublin Airport 2011-2016

Year	Period	Rainfall (mm)	Maximum mean Temperature (^{0}C)	Minimum mean Temperature (^{0}C)	Mean Temperature (^{0}C)
2011	Annual Mean	672	16.7	3.1	9.4
2012	Annual Mean	850	15.3	5.4	9.3

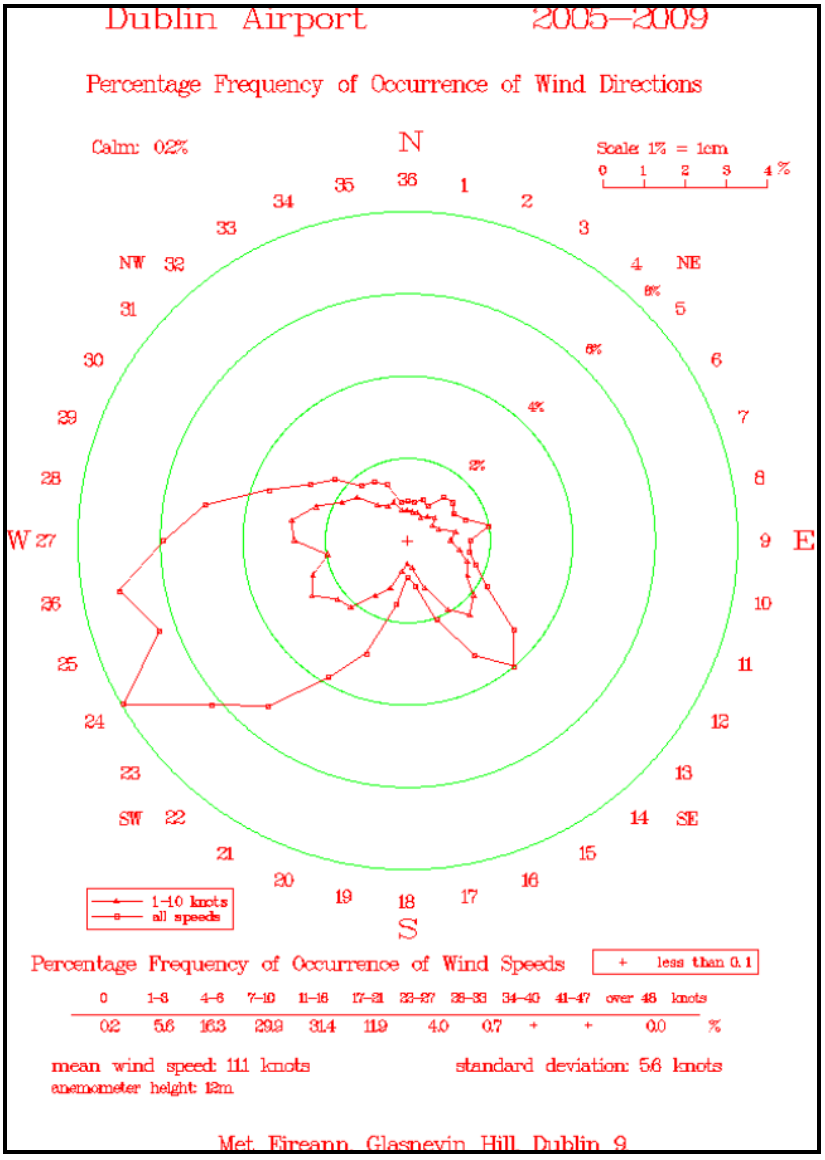
Year	Period	Rainfall (mm)	Maximum mean Temperature (^{0}C)	Minimum mean Temperature (^{0}C)	Mean Temperature (^{0}C)
2013	Annual Mean	764	14.0	3.6	9.9
2014	Annual Mean	870	15.8	5.4	10.6
2015	Annual Mean	766	14.0	4.0	9.0
2016	Annual Mean	725	15.7	4.4	10.1
Mean		762	15.3	4.0	9.5

Note 1: Data supplied by Met Eireann

Wind

Wind is of key importance for both the generation and dispersal of air pollutants. The windrose for Dublin Airport during five representative years (2005-2009) as presented below in Figure 9.1 indicates that the prevailing wind direction, in the Dublin area, is from the West and Southwest and blows Northeast across the proposed development. The mean annual wind speed in the Dublin area is approximately 5.7 m/s.

Figure 9.1 Windrose for Dublin Airport 2005-2009



9.3.3 Description of existing air quality

The existing ambient air quality at and in the vicinity of the site is typical of an out of city urban location and as such, domestic and commercial heating sources and road traffic are identified as the dominant contributors of hydrocarbon, combustion gases and particulate emissions to ambient air quality.

Trends in 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 "Air Quality in Ireland 2015 – Key Indicators of Ambient Air Quality" details the range and scope of monitoring undertaken throughout Ireland.

EU legislation on air quality requires that Member States divide their territory into zones for the assessment and management of air quality. Four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2013).
Zone A is the Dublin conurbation, Zone B is the Cork conurbation with Zone C comprising 23 large towns in Ireland with a population >15,000. Zone D is the remaining area of Ireland. In terms of air quality monitoring, the proposed development is categorised as Zone A.

The most recent EPA publication includes a number of monitoring locations in Dublin City which would be broadly comparable to the expected air quality at the subject site. The various air quality monitoring stations within the Dublin area provides a comprehensive range of air quality monitoring data sets which have been selected as part of this assessment to describe the existing ambient air quality at the subject site.

Nitrogen Dioxide

The Air Quality Standards Regulations 2011 specify a limit value of 40 µg/m^3, for the protection of human health, over a calendar year. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term NO_2 monitoring was carried out at eight Zone A locations in 2015. The NO_2 average in 2013 for these sites ranged from 13-31 µg/m^3. Therefore, long term averages were below the annual average limit of 40 µg/m^3. There was one exceedance of the 1-hour limit value of 200 µg/m^3.

Sulphur Dioxide

The Air Quality Standards Regulations 2011 specify a daily limit value of 125 µg/m3 for the protection of human health. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term SO_2 monitoring was carried out at four Zone A locations in 2015. The daily maximum SO_2 hourly averages in 2015 for these sites ranged from 6-17 µg/m^3. Therefore, long term averages were significantly below the daily limit of 125 µg/m^3. The annual means measured at these five sites ranged from 0.3 – 3.0 µg/m^3 and there was no exceedance of the hourly limit of 350 µg/m^3.

The annual mean SO_2 concentrations in Ireland have being slightly declining since 2003. This trend is reflective in the shift in fuel choice across Ireland in both residential heating and the energy production sector.

Carbon Monoxide

The Air Quality Standards Regulations 2011 specify an 8-hour limit value (on a rolling basis) for the protection of human health of 10,000 µg/m^3. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term CO monitoring was carried out at two Zone A locations in 2015. The rolling 8-hour CO concentrations ranged from 92-106 mg/m^3 in 2015. Therefore, long term averages were significantly below the 8-hour limit value (on a rolling basis) of 10 µg/m^3.

Particulate Matter PM_{10}

The Air Quality Standards Regulations 2011 specify a PM_{10} limit value of 40 µg/m^3 over a calendar year. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term PM_{10} monitoring was carried out at nine Zone A locations in 2015. The PM_{10} average in 2015 for these sites ranged from 12-17 µg/m^3. Therefore, long term averages were below the annual average limit of 40 µg/m^3. The daily limit of 40 µg/m^3 was not exceeded, more than 35 times per year, at any of the 9 monitoring stations.

Particulate Matter $PM_{2.5}$

The Air Quality Standards Regulations 2011 specify a $PM_{2.5}$ target value of 25 µg/m^3 over a calendar year to be met by 1 January 2010. From 1 January 2015 this target value shall become a limit value.

Long term $PM_{2.5}$ monitoring was carried out at four Zone A locations in 2015. The $PM_{2.5}$ average in 2015 for these sites ranged from 8-10 µg/m^3. Therefore, long term averages were below the target value 25 µg/m^3.

Benzene

The Air Quality Standards Regulations 2011 specify a benzene limit value of 5 µg/m^3 over a calendar year. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term benzene monitoring was carried out at one Zone A location in 2015. The benzene average in 2015 for this site was 0.92 µg/m^3. Therefore, long term averages were below the limit value 5 µg/m^3.

Table 9.5 below presents a summary of the 2015 Air Quality data obtained from the Dublin Zone A which may be considered to be broadly similar to that of the Carrickmines site in which the subject development site is located. Indeed, it is expected that the air quality at the subject site will be of a higher quality as it is further removed from the monitoring locations within the Dublin City Area.

Table 9.5 Summary of the 2015 Air Quality data obtained from the Dublin Zone A

Pollutant	Regulation	Limit type	Limit value	EPA monitoring data 2015
Nitrogen dioxide	2008/50/EC	Annual limit for protection of human health	40 µg/m^3	13-31 µg/m^3
Sulphur dioxide	2008/50/EC	Daily limit for protection of human health (not to be exceeded more than 3 times per year)	125 µg/m^3	6-17 µg/m^3
Carbon monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	10,000 µg/m^3	82 - 106 mg/m^3
Particulate matter (as PM_{10})	2008/50/EC	Annual limit for protection of human health	40 µg/m^3	12-17 µg/m^3
Particulate matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	20 µg/m^3	8-10 µg/m^3
Benzene	2008/50/EC	Annual limit for protection of human health	5 µg/m^3	0.92 µg/m^3

Baseline Air Quality Monitoring

A site specific short-term monitoring study was carried out in 2016 for Nitrogen oxides, Sulphur dioxide and BTEX (Benzene, Toluene, Ethylbenzene and Xylene). All pollutants were measured at two locations (AQM1, AQM2) using passive diffusion tubes over a two week period. Figure 9.2 identifies the monitoring locations.

These locations were chosen in order to obtain short-term sample concentrations for the identified parameters from the principal sources of pollution i.e. vehicle exhaust emissions and boiler emissions.

The survey was indicative only and results obtained cannot be used to demonstrate compliance with short-term or annual limit values detailed in Table 9.1 above. The survey does, however, aid in identifying the influence of sources in the vicinity of the proposed development site. The results from the monitoring surveys are presented in Table 9.6.

The concentrations of NO_x, NO_2, SO_2 and Benzene measured during the short term measurement survey were significantly below their respective annual limit values and comparable with levels reported by the EPA.

Table 9.6 Results of passive diffusion tube monitoring at Clay Farm Phase 2 development site

Pollutant	Sampling period	Concentration AQM1	Concentration AQM2	Assessment value
Nitrogen dioxide	28.01 17 – 28.02.17	<6 µg/m^3	<6 µg/m^3	40 µg/m^3 (as annual average)
Sulphur dioxide	28.01 17 – 28.02.17	<4 µg/m^3	<4 µg/m^3	125 µg/m^3 (as annual average)
Benzene	28.01 17 – 28.02.17	<2 µg/m^3	<2 µg/m^3	10 mg/m^3 (as annual average)
Ethylbenzene	28.01 17 – 28.02.17	<3 µg/m^3	<3 µg/m^3	N/A
Toulene	28.01 17 – 28.02.17	<10 µg/m^3	<10 µg/m^3	N/A
m/p-Xylene	28.01 17 – 28.02.17	<3 µg/m^3	<3 µg/m^3	N/A
o-Xylene	28.01 17 – 28.02.17	<3 µg/m^3	<3 µg/m^3	N/A
Dust	28.01 17 – 28.02.17	<49 mg/m^2-day	<49 mg/m^2-day	350 mg/m^2-day

Note 1: Annual limit
Note 2 < value indicates below Laboratory limit of detection

Figure 9.2 : Baseline air quality monitoring locations AQM1 & AQM2

9.3.4 Significance

Based on published air quality data for the Zone A Dublin city area in the vicinity of the subject site together with site specific monitoring data, it may be concluded that the existing baseline air quality at the subject site may be characterised as being good with no exceedances of the Air Quality Regulations 2011 limit values of individual pollutants.

The quality of existing air quality at the subject site must be maintained and improved where possible as a result of the proposed development to ensure that local human health and the ecological environment is not adversely affected.

9.3.5 Sensitivity

The subject site shall be developed by ground clearance and site preparation works and the subsequent construction of residential units, a creche, roads, open spaces and landscaped areas.

9.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

When considering a development of this nature, the potential impact on air quality and climate must be considered for each distinct stage: the short (1-7 years) and medium term (7-10) impact of the construction phase and the longer term impact of the operational phase. The Phase 2 construction phase will be undertaken over a maximum 10 year period. It is important that there are no unacceptable decreases in ambient air quality levels predicted during the construction phases and during the operational phase. Details of the indicative phased delivery of the proposed development are set out in Chapter 2 of this EIAR.

9.5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT

9.5.1 Predicted Impact

Various elements of both the construction and operational phases of the proposed development have the potential to impact on the local receiving environment, on adjacent residential properties and on human health. The likely potential impacts for both construction and operation of the proposed scheme prior to mitigation are described in this section of the EIAR. The mitigation measures are described in Section 9.7.

Construction Impacts

Air quality

The development of the site will be conducted in the following phased stages:

Enabling works - Site set up and Site clearance
Construction works including site infrastructure, house building and landscaping

Construction impacts with both of these phased stages are considered below.

Enabling works - Site Set Up and Clearance

Works activities associated with the 'Site set up' will be undertaken prior to construction works commencing in each sub-phase. The setting up of the site shall involve the construction of site security hoarding and site compounds, site offices, materials and waste storage areas and staff welfare facilities. These temporary activities will have a minimal potential to generate fugitive dust emissions or combustion gas emissions.

Site clearance and ground excavation works will be undertaken in separate phases and these activities have the potential to generate fugitive windblown dust emissions rising from the operation of mechanical plant such as dozers, excavators and tipper trucks and the movement of these vehicles on exposed surfaces at the site. With regard to the phased development approach, only one phase at a time shall be developed with the remaining phased areas remaining generally undisturbed until such a time as they are developed. Infrastructural works will be required to facilitate site services but it is not predicted that there would be bulk excavations of stripped soils until such a time as the development of subsequent phases are commenced.

With regard to the volume of waste material generated during site clearance, there will be a requirement for HGV trucks to remove the material from the site. These trucks shall be loaded with material on-site by mechanical excavators and loading shovels which will generate fugitive dust emissions as a result of the transfer of the excavated materials comprised principally of soils and stones from stockpile to truck.

The movements of construction vehicles on the site shall also generate windblown dust emissions. Where dusty waste material is loaded onto exposed open trucks, fine dusts may be released as the truck travels along public roads.

It is estimated that there will be a maximum of 4 (No.) x 20 tonne tipper truck movements per hour or an average of 32 movements per day associated with site clearance woks for each development phase. This relatively small volume of truck movements will have a negligible impact on local ambient air quality.

The impact on local air quality during Site Set Up and Clearance will be temporary in nature and will result in an imperceptible impact on local air quality and sensitive receptors.

Building and Site Infrastructure Construction Works

The development relates to the construction of residential units in a mix of houses and apartments, a crèche, 2 retail units and surface and undercroft car parking. The proposal includes for internal roads and streets along with appropriate hard and soft landscaping treatments and the construction of outdoor amenity, sport and exercise areas.

During the construction phase there will be extensive site works, involving construction machinery, construction activities on site which have the potential to generate fugitive windblown dust emissions.

Construction equipment including generators and compressors will also give rise to some exhaust emissions. However, due to the size and nature of construction activities, exhaust emissions during construction will have a negligible impact on local air quality.

Construction traffic to and from the site shall result in a short term increase in the volume of diesel fuelled HGV's along the local road network which will generate additional hydrocarbon and particulate emissions from the vehicle exhausts.

However, the activities detailed above will result in an imperceptible impact on local air quality and sensitive receptors.

Climate

During the construction phase, existing vegetated areas throughout the development site will be removed due to site clearance works and associated movement of construction traffic thus impacting the micro-climate. Whilst this will impact the evapotranspiration rates of vegetation, there will be no impact upon the moisture evaporation from the exposed soil. Therefore, there will be no significant impacts on microclimate.

CO_2 will be released into the atmosphere as a result of the movement of construction vehicles and use of plant. However emissions associated with such activities will not be significant.

Operational Phase

Air quality

The operational phase of the proposed development will result in a slight impact on local air quality primarily as a result of the requirements of new buildings to be heated and with the increased traffic movements associated with the development.

Traffic movements associated with the development have been evaluated and assessed as part of the Traffic Impact Assessment for the development which will include parking for 1325 (No.) vehicles which will enter a exit the site via road junctions. The split in am and pm peak traffic movements will not result in an adverse impact on local air quality at any of the junctions and it is predicted that the impact of car engine exhaust emissions will have a negligible impact on local ambient air quality. Given the location of the LUAS Cherrywood Green line located on the Ballyogan Road opposite the Clay Farm development, it is expected that a significant proportion of the commuting residents will avail of this and the local Dublin Bus services. The availability of public transport will significantly reduce the number of vehicles exiting and entering the Clay Farm Phase 2 site during am and pm peak times.

The design and construction of all buildings in accordance with National Building Regulations shall ensure that modern building materials are used and that they are designed to be thermally efficient resulting in a reduction in the volume of fossil fuel required to heat the buildings. It is predicted that fossil fuel combustion gas emissions

including Carbon Dioxide, Sulphur Dioxide, Nitrogen Oxides, Carbon Monoxide and hydrocarbon particulate emissions will be slight and will not have an adverse significant impact on the existing ambient air quality in the vicinity of the proposed development site.

The design and development of the proposed development at Clay Farm shall be conducted in a manner which considers a number of sustainable heating and energy proposals. The proposed residential development has considered the following energy saving strategies:

Energy Efficiency - All proposals for development shall seek to meet the highest standards of sustainable design and construction with regard to the optimum use of sustainable building design criteria such as passive solar principles and also green building materials. In order to reduce energy consumption, the following key design considerations have been considered in the design process and will be incorporated into the construction of the residential units, where feasible:

- Passive solar design including the orientation, location and sizing of windows
- The use of green building materials: low embodied energy & recycled materials
- The use of natural ventilation or mechanical ventilation with heat recovery
- Energy efficient window units and frames with triple glazing for thermal and acoustic insulation
- Building envelope air tightness
- Installation of roof mounted Photvoltaic Solar Panels

Climate

The site area of the Phase 2 lands is c. 20.5 hectares. Approximately 6.2 ha of open space and landscaped areas are proposed. The overall development includes the construction of buildings and roadways will have the effect of marginally raising local air temperatures, especially in summer. However, approximately 6.2 ha of open space will be retained as green areas as part of the proposed development. Therefore, the proposed development will not have an adverse impact on micro-climate at the nearest residential properties or on the local receiving environment in the vicinity of the site boundaries.

The extensive landscaping schemes including the “green corridor” which extends through the site of the Phase 2 development will include native trees, grasses and shrubs which will also contribute albeit in a minor way to the adsorption of Carbon Dioxide from the atmosphere and the release of Oxygen to the atmosphere.

The proposed development includes structures which will have a minor impact on the local micro-climate by means of wind sheer effects. There will however be no unacceptable impact within the overall site as detailed in the Wind Micro Climate study conducted as part of the EIAR, Chapter 11, for the development.

Greenhouse gases occur naturally in the atmosphere (e.g. carbon dioxide, water vapour, methane, nitrous oxide and ozone) and in the correct balance, are responsible for keeping the lower part of the atmosphere warmer than it would otherwise be. These gases permit incoming solar radiation to pass through the Earth’s atmosphere, but prevent most of the outgoing infrared radiation from escaping from the surface and lower atmosphere into the upper levels. However, human activities are now contributing to an upward trend in the levels of these gases, along with other pollutants with the net result of an increase in temperature near the surface.

Motor vehicles are a major source of atmospheric emissions thought to contribute to climate change, however, vehicle exhaust emissions generated from site related vehicles will have a negligible impact on the macro-climate given modern technological developments in cleaner and more efficient vehicle engines.

Electric car charging points shall be installed within the development site to promote the use of electric vehicles.

9.6 POTENTIAL CUMULATIVE IMPACTS

In accordance with *Schedule 6, Part 2(c) of the Planning and Development Regulations 2001*, this section has considered the cumulative impact of the proposed development in conjunction with future development in the vicinity of the subject site. This section relates to the cumulative impact on the subject site itself and on surrounding sites.

The European Commissions report of May 1999 'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions' defines cumulative impact as follows:

"Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project".

The cumulative air quality impact of the existing Clay Farm Phase 1 development and the proposed Clay Farm Phase 2 development is assessed with regard to having established the baseline air quality and then predicting the impact that the proposed development will have on the baseline air quality. Together the combined impact can be assessed to determine if there is sufficient "atmospheric budget" to facilitate the proposed development.

The Phase 1 development which is currently under construction provides for the same range of environmental management and control measures and sustainable initiatives as are proposed for Phase 2. Thus it is predicted that the cumulative impact of the construction and operational phases of both developments will not have an adverse impact on the receiving environment.

It is considered that there will be short to medium term slight negative cumulative impacts associated with the construction phase of the Phase 2 development on ambient air quality and climate. This assumption is based on the results of environmental noise and air quality surveys conducted by the Applicant during 2017 at the closest receptors to the Phase 1 site. The results of the surveys demonstrate the effectiveness of the implemented Phase 1 construction phase environmental monitoring and management plan. The Phase 2 development will similarly have a construction phase environmental monitoring and management plan to ensure the receiving environment including off site residential receptors and the on-site Ballyogan stream and habitat will not be adversely impacted by the construction or the operational phases.

9.7 DO NOTHING IMPACT

The subject site is currently comprised of farmland, which in recent years has been left unmanaged. If the subject site remains undeveloped it shall become overgrown and shall have no impact on the existing ambient air quality or local micro-climate.

Based on the projected increase in traffic up to the reference year of 2032, the increase in traffic related emissions, based on projected Traffic Impact Assessment figures without the subject development would be insignificant. This increase above the existing situation would be minor and would not result in a perceptible change in the existing local air quality environment.

9.7 AVOIDANCE, REMEDIAL AND MITIGATION MEASURES

9.8.1 Construction Phase

In order to ensure that adverse air quality impacts are minimised during the construction phase and that the potential for soiling of property and amenity and local public roads is minimised, the following mitigation measures shall be implemented during the course of all construction activities:

AQ CONST 1: Air Quality Mitigation Measure

- Avoid unnecessary vehicle movements and manoeuvring, and limit speeds on site so as to minimise the generation of airborne dust.
- Use of rubble chutes and receptor skips during construction activities.
- During dry periods, dust emissions from heavily trafficked locations (on and off site) will be controlled by spraying surfaces with water and wetting agents.
- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only.
- Re-suspension in the air of spillages material from trucks entering or leaving the site will be prevented by limiting the speed of vehicles within the site to 10kmh and by use of a mechanical road sweeper.
- The overloading of tipper trucks exiting the site shall not be permitted.
- Aggregates will be transported to and from the site in covered trucks.
- Where the likelihood of windblown fugitive dust emissions is high and during dry weather conditions, dusty site surfaces will be sprayed by a mobile tanker bowser.
- Wetting agents shall be utilised to provide a more effective surface wetting procedure.
- Exhaust emissions from vehicles operating within the construction site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor by ensuring that emissions from vehicles are minimised by routine servicing of vehicles and plant, rather than just following breakdowns; the positioning of exhausts at a height to ensure adequate local dispersal of emissions, the avoidance of engines running unnecessarily and the use of low emission fuels.
- All plant not in operation shall be turned off and idling engines shall not be permitted for excessive periods.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- Material stockpiles containing fine or dusty elements shall be covered with tarpaulins.
- Where drilling or pavement cutting, grinding or similar types of stone finishing operations are taking place, measures to control dust emissions will be used to prevent unnecessary dust emissions by the erection of wind breaks or barriers. All concrete cutting equipment shall be fitted with a water dampening system.
- A programme of air quality monitoring shall be implemented at the site boundaries for the duration of construction phase activities to ensure that the air quality standards relating to dust deposition and PM_{10} are not exceeded. Where levels exceed specified air quality limit values, dust generating activities shall immediately cease and alternative working methods shall be implemented.
- A complaints log shall be maintained by the construction site manager and in the event of a complaint relating to dust nuisance, an investigation shall be initiated.

9.8.2 Operational Phase

The Operational Phase of Clay Farm Phase 2 site will not generate air emissions that would have an adverse impact on local ambient air quality or local human health and as such there are no mitigation measures specified for the Operational Phase.

9.9 PREDICTED IMPACTS OF THE PROPOSED DEVELOPMENT

Various elements associated with the construction phase of the proposed development have the potential to impact local ambient air quality, however the potential construction phase impacts shall be mitigated as detailed in Section 9.7.1 above to ensure there is a minimal impact on ambient air quality for the duration of all construction phase works. It is predicted that the operational phase of the development will not generate air emissions that would have an adverse impact on local ambient air quality or local human health.

9.10 MONITORING

This section describes the dust monitoring methodologies that shall be implemented at the site during the construction phases to ensure that dust generated by site activities does not cause nuisance or cause detrimental health effects to residential areas and sensitive receptors located in the vicinity of the site boundaries.

Dust Deposition Monitoring Methodology

Dust deposition levels will be monitored on a regular basis in order to assess the impact that site construction site activities may have on the local ambient air quality and to demonstrate that the environmental control measures in place at the site are effective in minimising the impact of construction site activities on the local receiving environment including the Stepaside Park and Cruagh residential estates, the Ballyogan Stream habitat and Stepaside Golfcourse. Dust deposition measurements shall be conducted to determine the potential for dust nuisance or complaint to arise from local residents' adjacent site works areas. The following procedure shall be implemented at the site on commencement of site activities:

The dust deposition rate will be measured by positioning Bergerhoff Dust Deposit Gauges at strategic locations near the boundaries of the site for a period of 30 +-2 days. Monitoring shall be conducted on a quarterly basis during periods when the highest levels of dust are expected to be generated ie, during site preparation works and soil stripping activities. The proposed monitoring locations (D1 – D5) are presented below in Figure 9.3.

The selection of sampling point locations will be completed after consideration of the requirements of *Method VDI 2119* with respect to the location of the samplers relative to obstructions, height above ground and sample collection and analysis procedures. The optimum locations will be determined by a suitably qualified air quality expert to ensure that the dust gauge locations are positioned in order to best determine potential dust deposition in the vicinity of the site boundaries and existing on-site buildings.

After each (30 +-2 days) exposure period, the gauges will be removed from the sampling location, sealed and the dust deposits in each gauge will be determined gravimetrically by an accredited laboratory and expressed as a dust deposition rate in mg/m^2-day in accordance with the relevant standards.
Technical monitoring reports detailing all measurement results, methodologies and assessment of results shall be subsequently prepared and maintained by the Site Manager.

A dust deposition limit value of 350 mg/m^2-day (measured as per German Standard Method VDI 2119 – Measurement of Particulate Precipitations – Determination of Dust Precipitation with Collecting Pots Made of Glass (Bergerhoff Method) or Plastic. is commonly specified by Local Authorities and by the EPA to ensure that no nuisance effects will result from specified activities and it is to this Best Practice standard method that this programme of dust monitoring and control has been prepared.

The *German Federal Government Technical Instructions on Air Quality Control - TA Luft* specifies an emission value for the protection against significant nuisances or significant disadvantages due to dustfall. This limit value is 350 mg/m^2-day and it is to this limit value that all measured dust deposition levels shall be assessed. This limit value is commonly specified by Local Authorities at construction sites.

Figure 9.3: **Construction Phase dust monitoring locations D1 – D5**

9.11 REINSTATEMENT

Reinstatement issues are not relevant to this Section of the EIAR.

9.12 INTERACTIONS

The traffic data used in the assessment of air quality impact was obtained from the traffic consultant for the proposed development.

The principal interactions between Air & Climate impacts and Human Health / Human Beings have been addressed in Section 9.7 of this report which describes in detail the mitigation measures that shall be

implemented to ensure that human health, residential amenity and existing habitats are not adversely impacted by any aspect of the construction or operational phases of the development.

Similarly, the mitigation measures have also been designed to minimise the potential impact that the construction and operational phases of the development may have on the receiving environment which includes, flora, fauna, soil and water.

The concept of control and attenuation at source of potential emission sources that may impact the receiving environment is the principal that has been adapted in the design, construction and operational phases of the development.

9.13 DIFFICULTIES ENCOUNTERED IN COMPILING INFORMATION

There were no difficulties encountered in compiling this section of the EIAR.

9.14 REFERENCES & SOURCES

Air Quality Regulations 2011, SI 180 of 2011
Department of Environment, Heritage and Local Government 2003 Environmental Impact Assessment (EIA), Guidance for Consent Authorities Regarding Sub-Threshold Development
Department of Environment, Heritage and Local Government 2007 Development Management Guidelines
Department of Environment, Community and Local Government March 2013 Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment
Environmental Protection Agency, 2002. Guidelines on the Information to be Contained in Environmental Impact Statements
Environmental Protection Agency, 2003. Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements)
Environmental Protection Agency, 2013. Air Quality in Ireland 2013 – Key Indicators of Ambient Air Quality
European Standard EN12341 Ambient air. Standard gravimetric measurement method for the determination of the PM_{10} or $PM_{2,5}$ mass concentration of suspended particulate matter
European Union Directive (2008/50/EC).
German Federal Government Technical Instructions on Air Quality Control - TA Luft 2002
German Standard Method for determination of dust deposition rate, VDI 2129.)
Greater London Authority – The Control of dust emissions from construction and demolition – Best Practice Guidelines, Nov 2006.
National Roads Authority 2011. Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes Revision 1