9 AIR QUALITY & CLIMATE

9.1 INTRODUCTION

The following section presents an assessment on the impacts of the proposed development at Abbvie, Ballytivnan, Co. Sligo, in terms of Air Quality and Climate on the local environment as defined in the guidelines referred to in Section 2.1.

9.1.1 AIR QUALITY

The modelling of air emissions from the site was carried out to assess the concentrations of Nitrogen Dioxide (NO_2) and Sulphur Dioxide (SO_2) and the consequent impact on human health. The air dispersion modelling input data consisted of information on the physical environment, design details for all emission points on-site and five full years of meteorological data. Using this input data, the model predicted ambient concentrations at various receptors for each hour of the meteorological years. This study adopted a worst-case approach which will lead to an over-estimation of the actual levels that will arise, in keeping with good EIA practice.

To obtain all the meteorological information required for use in the model, data collected during 2012 - 2016 from Shannon Airport has been incorporated into the modelling. The air dispersion modelling input data consisted of information on the physical environment, design details for all emission points on-site and a five full years of meteorological data. Using this input data the model predicted ambient ground level concentrations beyond the site boundary for each hour of the modelled meteorological year. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration was then added to the background concentration to give the worst-case predicted environmental concentration (PEC). The PEC was then compared with ambient air quality standards to assess the significance of the releases from the site. This study adopted a worst-case approach which will lead to an over-estimation of the actual levels that will arise, in keeping with good EIA practice. The worst-case assumptions are outlined below:

- All emission points were assumed to be in operation for every hour of the year; and
- Maximum predicted concentrations were reported in this study, even if no residential receptors are near the location of this maximum.

Emissions from the site have been modelled using the AERMOD dispersion model (Version 16216r) which has been developed by the U.S Environmental Protection Agency (USEPA) and the American Meteorological Society (AMS). The model is recommended as an appropriate model for assessing the impact of air emissions from industrial facilities in the EPA Guidance document "*Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (2010)*"[1].

The model is a "new-generation" steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement of the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources. Details of the model are given in Appendix 9.1 . Fundamentally, the model has made significant advances in simulating the dispersion process in the boundary layer. This will lead to a more accurate reflection of real world processes and thus considerably enhance the reliability and accuracy of the model particularly under those scenarios which give rise to the highest ambient concentrations. Due to the proximity to surrounding buildings, the PRIME Building Downwash Program (BPIP Prime) has been incorporated into the model to determine the influence (wake effects) of these buildings on dispersion in each direction considered.

The AERMOD model incorporated the following features:

[1] EPA (2010) Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)

- Two receptor grids were created at which concentrations would be modelled. Receptors were mapped with sufficient resolution to ensure all localised "hot-spots" were identified without adding unduly to processing time. The receptor grids were based on Cartesian grids with the site at the centre. An outer grid measuring 8 x 8 km, with the site at the centre and concentrations calculated at 400 m intervals and an inner grid measuring 2 x 2 km, with the site at the centre and concentrations calculated at 50 m intervals were included in the model. Boundary receptor locations were also placed along the boundary of the site, at 50 m intervals giving a total of 2,236 calculation points for the model.

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

- Hourly-sequenced meteorological information has been used in the model. Meteorological data over a five year period (Shannon Airport, 2012 – 2016, Figure 9.1) was used in the models. AERMOD incorporates a meteorological pre-processor AERMET. The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and albedo and to a distance of 1km for surface roughness in line with USEPA recommendations (see Appendix 9.2).

- Detailed terrain has been mapped into the model using SRTM (Shuttle Radar Topography Mission) data with 30m resolution. The site is located in rolling terrain. For AERMOD, all terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP.

Due to the proximity of the neighbouring Abbvie site and the potential for cumulative impacts on ambient air quality as a result of NO_2 emissions, a cumulative assessment with the proposed development and the neighbouring Abbvie site has been undertaken. There are three sources on the neighbouring Abbvie site with relevant NO_2 and SO_2 emissions: boilers A1-1 and A1-2 and thermal oxidiser A2-1c. Emission details for these three sources have been based on actual monitoring data from the site from 2016 and 2017 and licenced emission details. Details on the neighbouring Abbvie site were included in the model and emission concentrations were calculated in the same way as with the proposed development, described above.

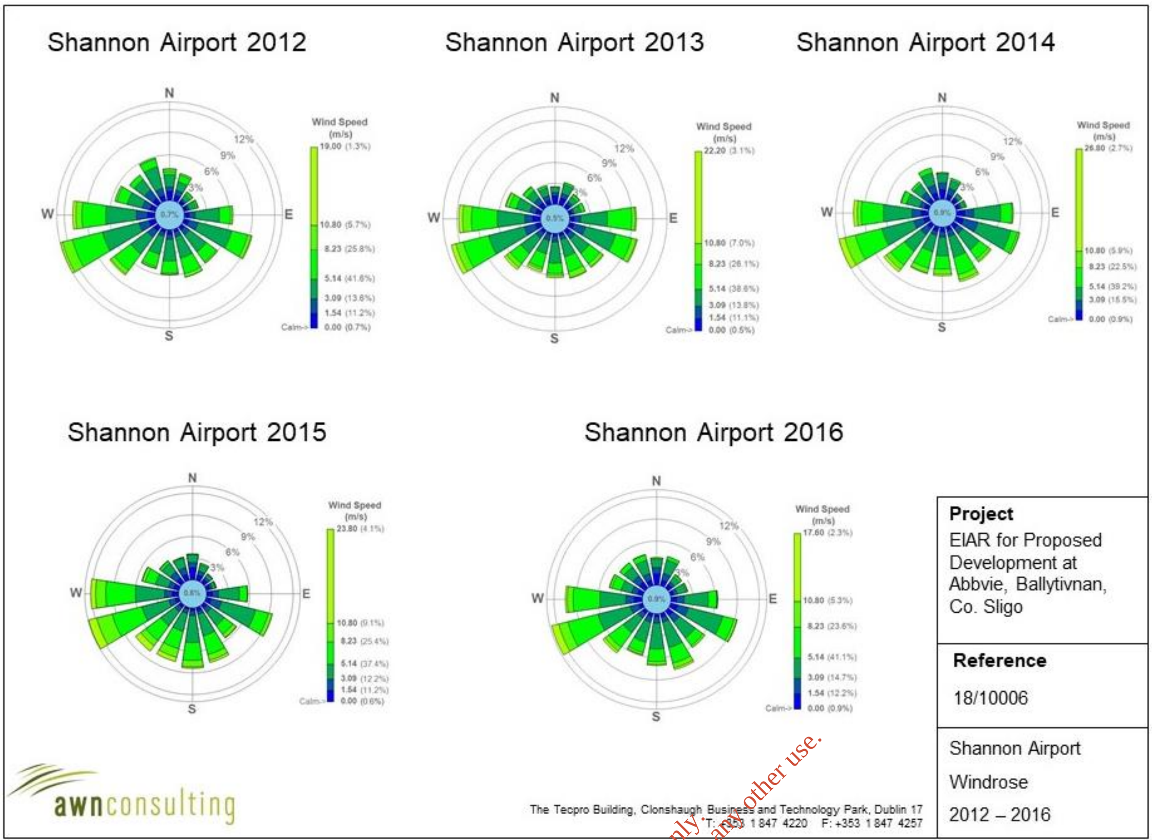

Figure 9.1 Shannon Airport Windrose 2012 – 2016

9.1.2 CRITERIA FOR RATING OF IMPACTS

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC. The ambient air quality standards applicable for NO_2 are outlined in this Directive (see Table 9.1). These standards have been used in the current assessment to determine the potential impact of NO_2 emissions from the proposed facility on air quality.

Table 9.1 EU Air Quality Standards[2]

Pollutant	Regulation Note 1	Limit Type	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 μg/m^3
		Annual limit for protection of human health	40 μg/m^3
		Critical load for protection of vegetation	30 μg/m^3
Sulphur Dioxide (SO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 μg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 μg/m^3
		Critical limit for the protection of ecosystems	20 μg/m^3

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

9.1.3 CLIMATE

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997[3,4]. 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[5]. 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 (COP23) took place in Bonn, Germany from the 6th to the 17th of November 2017 and focussed on advancing the implementation of the Paris Agreement. The Paris Agreement was established at COP21 in Paris 2015 and is an important milestone in terms of international climate change agreements. The "Paris Agreement", agreed by over 200 nations, 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, on the 23rd/24th of October 2014, agreed the "2030 Climate and Energy Policy Framework"[6]. 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

[2] based on European Commission Directive 2008/50/EC (transposed as S.I. 180 of 2011)
[3] FCCC (1997) Kyoto Protocol To The United Nations Framework Convention On Climate Change
[4] FCCC (1999) Ireland – Report on the in-depth review of the second national communication of Ireland
[5] ERM (1998) Limitation and Reduction of CO2 and Other Greenhouse Gas Emissions in Ireland
[6] EU (2014) EU 2030 Climate and Energy Framework

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

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005[7]. Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X[8]. 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, 2020-29 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (85% below 2005 levels), for NO_X (69% reduction), for VOCs (32% reduction), for NH_3 (5% reduction) and for $PM_{2.5}$ (41% reduction).

In relation to the EU 20-20-20 targets for CO_2, Ireland has a target of a 20% reduction in non-Emission Trading Scheme (non-ETS) greenhouse gas emissions by 2020 relative to the 2005 levels. The EPA confirmed that the 2015 levels are on target but that projections from 2016 – 2020 indicate that the target is unlikely to be met.

9.2 THE PROPOSED DEVELOPMENT

The proposed development will have two new boiler stacks which will have a height of 17.4 m above ground level. The two boilers will operate in a standby/duty mode, with only one boiler in operation at any one time. However, for the purposes of this modelling assessment, both boilers have been modelled as running simultaneously as a conservative approach and to allow for any potential future need to increase capacity.

There are also a number of existing LPHW boilers (3 no.) and proposed LPHW boilers (4 no.) which emit via a common flue. Separately these emission points are all less than 1 MW, however, as advised under the Medium Combustion Plant Directive, when these emission points are aggregated they are greater than 1 MW and as such have been included in the modelling assessment. These sources have been modelled as one single emission point for the existing 3 no. LPHW boilers and one single emission point for the proposed 4 no. LPHW boilers. For the purposes of this assessment it has been assumed that all 7 the LPHW boilers are operating continuously, whereas in reality these operate in a standby/duty mode with only 5 in operation at any one time.

The manufacturer could not provide maximum emissions values for SO_2, however the manufacturer confirmed that the SO_2 emissions would be negligible. Therefore, the SO_2 concentrations for the boilers have been modelled at the MCP Directive limit value of 35 µg/m^3 for gaseous fuels other than natural gas (all boilers will run on LPG) as this would be the worst case emissions scenario. NO_2 concentrations have been based on maximum emissions as specified by the manufacturer.

[7] DEHLG (2004) National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010 Transport Infrastructure Ireland (2011)
[8] EEA (2012) NEC Directive Status Reports 2011

A cumulative assessment with the neighbouring AbbVie site has also been undertaken. The relevant source parameters for the neighbouring AbbVie site (emission points A1-1, A1-2 and A2-1c) are based on actual monitoring data over the past two years. The source information for the modelled emission points can be seen in Table 9.2.

Table 9.2 Summary of Source Information

Stack Reference	Location (Irish Grid Coordinates)		Height Above Ground Level (m)	Exit Diameter (m)	Temp (K)Note 1	Max Volume Flow (Nm^3/hr) Note 2	Exit Velocity (m/sec actual)	NO_2		SO_2	
								NO_2 Concentration (mg/Nm^3)	Mass Emission (g/s)Note 3	SO_2 Concentration (mg/Nm^3)	Mass Emission (g/s)Note 3
New Boiler 1	E169867	N337606	17.4	0.355	403.2	837	4.07	200	0.048	35	0.008
New Boiler 2	E169868	N337605	17.4	0.355	403.2	837	4.07	200	0.048	35	0.008
New LPHW Boilers Combined Flue	E169861	N337604	12.5	0.25	366.2	1,187	9.30	40	0.013	35	0.012
Existing LPHW Boilers Combined Flue	E169775	N337488	12.5	0.25	366.2	1,542	12.08	40	0.017	35	0.015
A1_1	E170604	N337494	26	0.75	358	1,137	0.94	166	0.052	70	0.022
A1_2	E170604	N337494	26	0.75	366	1,518	1.28	148	0.062	70	0.030
A2-1c	E170674	N337478	15	0.3	413	1,477	8.77	200	0.082	70	0.029

Note 1 Kelvin (K) SI Unit for Temperature

Note 2 (Nm^3/hr) Cubic Metres per Hour measured under normal temperature and pressure conditions

Note 3 (g/s) Grams per Second

9.3 THE RECEIVING ENVIRONMENT

9.3.1 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 Annual Monitoring Report 2016", details the range and scope of monitoring undertaken throughout Ireland.

As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined in Ireland for air quality management and assessment purposes[9]. 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, Ballytivnan is categorised as Zone C due to its proximity to Sligo town[9].

NO_2

Long-term NO_2 monitoring was carried out at three Zone C locations for the period 2012 - 2016, Kilkenny, Portlaoise and Mullingar[9]. The NO_2 concentrations measured in Kilkenny and Portlaoise in 2016 were 7 µg/m^3 and 11 µg/m^3 respectively. The NO_2 annual average for this five year period suggests an upper average limit of no more than 13 µg/m^3 (Table 9.3). Long term average concentrations are significantly below the annual average limit of 40 µg/m^3. Based on the above information, a conservative estimate of the current background NO_2 concentration in the region of the proposed development is 13 µg/m^3.

The Ozone Limiting Method (OLM) was used to model NO_2 concentrations. The OLM is a regulatory option in AERMOD which calculates ambient NO_2 concentrations by applying a background ozone concentration and an in-stack NO_2/NOx ratio to predicted NOx concentrations. An in-stack NO_2/NOx ratio of 0.1 and a background ozone concentration of 60 µg/m^3 were used for modelling.

In relation to the annual average background, the ambient background concentration was added directly to the process concentration with the short-term peaks assumed to have an ambient background concentration of twice the annual mean background concentration.

Table 9.3 Annual Mean NO_2 Concentrations in Zone C Locations (µg/m^3)

Year	Station		
	Kilkenny	Portlaoise	Mullingar
2012	4	-	7
2013	4	-	6
2014	5	16	4
2015	5	10	-
2016	7	11	-
Average	**5.0**	**12.3**	**5.7**

SO_2

Continuous SO_2 monitoring was carried out at a number of Zone C locations over the period 2012 – 2016, Mullingar, Ennis and Portlaoise. Concentrations ranged from 1 – 5 µg/m^3, with no exceedances of the daily limit value of 125 µg/m^3 for the protection of human health. Long term annual average results suggest an upper limit of 3.4 µg/m^3 as a background concentration. Based on this EPA data a conservative estimate of the annual mean background SO_2 concentration in the region of the proposed development is 4 µg/m^3.

[9] *Air Quality Annual Monitoring Report 2016*, EPA, 2017

SO_2 concentrations for the representative rural Zone C monitoring station at Ennis in 2017 were 14.63 µg/m^3 for the 99.2nd%ile of 24-hour means. The 1-hour limit value for SO_2 (measured as a 99.7th%ile) was 31.65 µg/m^3, which is significantly below the 350 µg/m^3 limit value.

Table 9.4 Annual Mean SO_2 Concentrations in Zone C Locations (µg/m^3)

Year	Station		
	Ennis	Portlaoise	Mullingar
2012	3	-	3
2013	3	-	3
2014	4	5	2
2015	3	1	-
2016	4	1	-
Average	**3.4**	**2.3**	**2.7**

In relation to the annual averages, the ambient background concentration was added directly to the process concentration. However, in relation to the short-term peak concentration, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA and EPA[1] advises that for SO_2 an estimate of the maximum combined pollutant concentration can be obtained as shown below:

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

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

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

SO_2 - The 99.2nd%ile of total 24-hour mean SO_2 is equal to the maximum of either C or D below:

c) 99.2nd%ile of 24-hour mean background SO_2 + (2 x annual mean process concentration SO_2)

d) 99.2nd%ile 24-hour mean process contribution SO_2 + (2 x annual mean background concentration SO_2)

9.4 PREDICTED IMPACTS

9.4.1 Do Nothing Scenario

The Do Nothing scenario includes retention of the current site and associated processes without the proposed development. 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).

9.4.2 Construction Phase

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. While construction dust tends to be deposited within 200 m of a construction site, the majority of the deposition occurs within the first 50 m. Construction of an earthen berm to the south of the proposed development less than 10m from the houses which boarder the southern site boundary could result in a dust related impacts.

However, additional mitigation measures will be implemented to avoid any impact to these nearby sensitive receptors and once in place, emissions of dust should be imperceptible. When the dust minimisation measures detailed in the mitigation section of this chapter and Appendix 9.3 are implemented, fugitive emissions of dust from the site will be short-term and insignificant and pose no nuisance at nearby receptors.

The additional traffic generated due to the construction of the proposed development may also lead to the release of air pollutants. The UK DMRB guidance[10], on which the TII guidance[11] 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;
- HDV 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.

None of the road links impacted by the construction of the proposed development meet the criteria to be defined as 'affected'. Therefore, this assessment is not necessary as there is unlikely to be an air quality impact at nearby sensitive receptors as a result of traffic emissions.

Climate

There is the potential for a number of greenhouse gas emissions to the atmosphere during the construction phase of the development. Construction vehicles, generators etc., may give rise to CO_2 and NO_2 emissions impacting climate. Due to the size and nature of the construction activities, CO_2 and NO_2 emissions during construction will have a short-term and imperceptible impact on climate and will not be significant.

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 short-term and imperceptible with respect to human health.

9.4.3 OPERATIONAL PHASE

There is the potential for a number of emissions to the atmosphere during the operational phase of the development. In particular, boiler related air emissions may generate quantities of air pollutants such as NO_2. Additional traffic generated due to the opening of the proposed development may also lead to the release of air pollutants. However, the increase in traffic associated with the proposed development during the operational phase is not of the required magnitude to cause any significant impacts at nearby sensitive receptors according to TII and UK guidance outlined in Section 0.

Air Quality Impact From Process Emissions

NO_2

The NO_2 modelling results from the proposed boiler emissions at the worst-case off-site receptor i.e. the highest NO_2 concentrations measured off-site (including the site boundary), are detailed in Table

[10] UK Highways Agency (2007) Design Manual for Roads and Bridges Vol 11 Chapter 3, HA 207/07 (Document & Calculation Spreadsheet)

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

9.5. The results indicate that the ambient ground level concentrations are significantly below the relevant air quality standards for NO_2. For the worst-case year, emissions from the site lead to an ambient NO_2 concentration (including background) which is 24% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 38% of the annual limit value at the worst-case off-site receptor for the worst-case years modelled (2014 and 2015). The geographical variations in the 1-hour mean (99.8th%ile) and annual mean NO_2 ground level concentrations are illustrated as concentration contours in Figure 9.2 and Figure 9.3.

The locations of the maximum concentrations for NO_2 are close to the boundary of the site with concentrations decreasing with distance from the facility.

Table 9.5 NO_2 Dispersion Model Results – Proposed Development

Pollutant / Meteorological Year	Background (µg/m³)	Averaging Period	Process Contribution (µg/m³)	Predicted Emission Concentration (µg/m³)	Standard (µg/m³) Note 1
NO_2 / 2012	13	Annual Mean	2.09	15.09	40
	26	99.8th%ile of 1-hr means	21.11	47.11	200
NO_2 / 2013	13	Annual Mean	2.20	15.20	40
	26	99.8th%ile of 1-hr means	22.35	48.35	200
NO_2 / 2014	13	Annual Mean	2.31	15.31	40
	26	99.8th%ile of 1-hr means	21.16	47.16	200
NO_2 / 2015	13	Annual Mean	2.10	15.10	40
	26	99.8th%ile of 1-hr means	22.39	48.39	200
NO_2 / 2016	13	Annual Mean	2.18	15.18	40
	26	99.8th%ile of 1-hr means	20.77	46.77	200

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC and S.I. 180 of 2011)

SO_2

The SO_2 modelling results are detailed in Table 9.6. The results indicate that the ambient ground level concentrations are below the 1-hour and 24-hour ambient air quality standards. Emissions from the facility lead to an ambient SO_2 concentration (including background) that is 21% of the maximum ambient 1-hour limit value (measured as a 99.7th%ile) and 23% of the 24-hour limit value (measured as a 99.2nd%ile) at the worst-case location off-site for the worst case years modelled (2013 and 2014).

The geographical variation in the 1-hour mean (99.7th%ile) and 24-hour mean (99.2nd%ile) SO_2 ground level concentrations are illustrated as concentration contours in Figures 9.4 and 9.5.

Table 9.6 SO_2 Dispersion Model Results – Proposed Development

Pollutant/ Meteorological year	Background ($\mu g/m^3$)	Averaging Period	Process Contribution SO_2 ($\mu g/m^3$)	Predicted Environmental Concentration (PEC) SO_2 ($\mu g/Nm^3$)	Standard ($\mu g/Nm^3$) Note 1
SO_2 / 2012	14.63	24 Hour 99.2nd%ile	18.2	26.2	125
	31.65	1-Hour 99.7th%ile	59.0	67.0	350
SO_2 / 2013	14.63	24 Hour 99.2nd%ile	20.8	28.8	125
	31.65	1-Hour 99.7th%ile	57.1	65.1	350
SO_2 / 2014	14.63	24 Hour 99.2nd%ile	19.1	27.1	125
	31.65	1-Hour 99.7th%ile	67.0	75.0	350
SO_2 / 2015	14.63	24 Hour 99.2nd%ile	17.5	25.5	125
	31.65	1-Hour 99.7th%ile	56.2	64.2	350
SO_2 / 2016	14.63	24 Hour 99.2nd%ile	19.8	27.8	125
	31.65	1-Hour 99.7th%ile	63.2	71.2	350

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC and S.I. 180 of 2011)

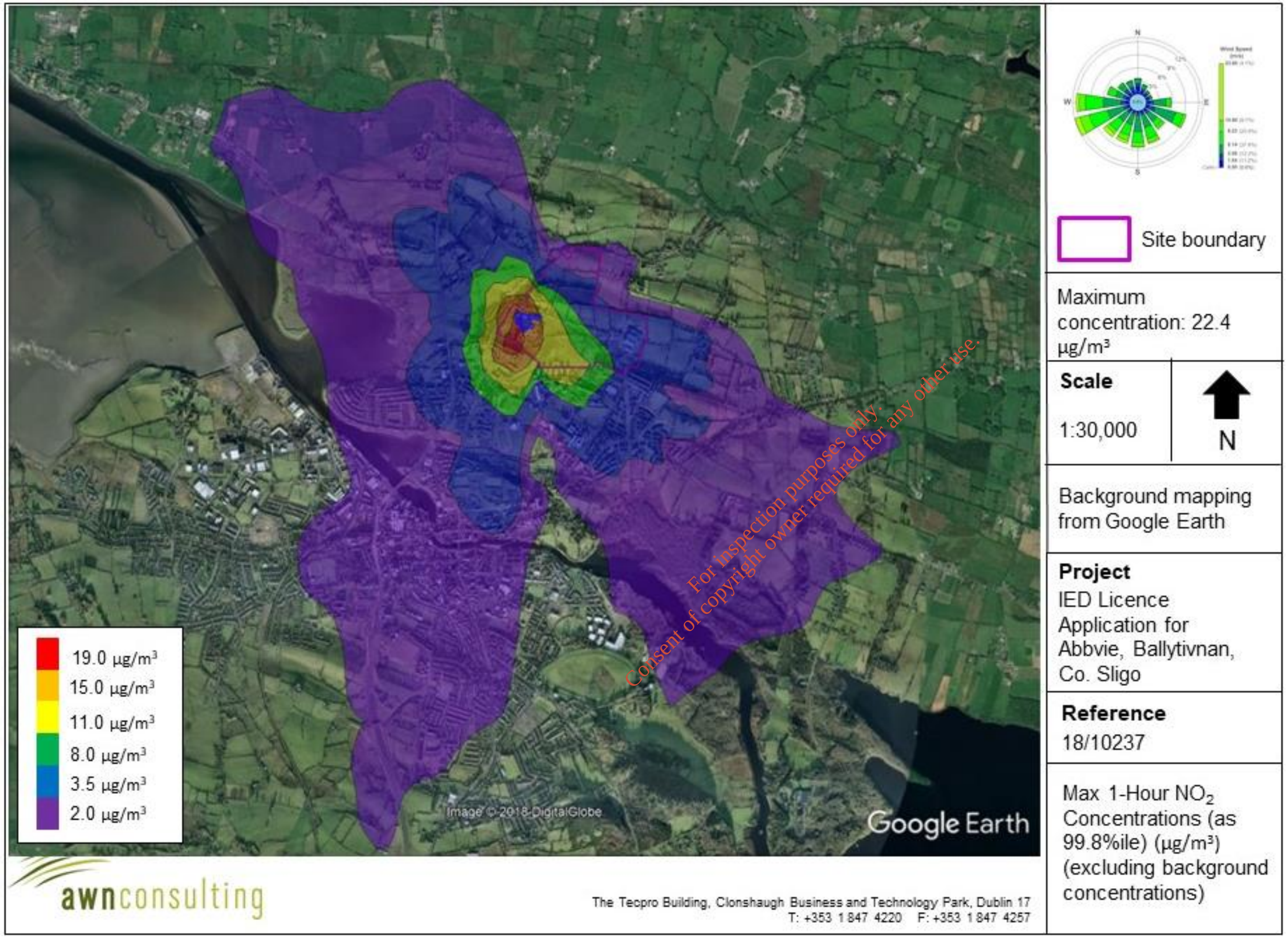

Figure 9.2 Maximum 1-Hour NO_2 Concentrations (as a 99.8th%ile) (µg/m^3)

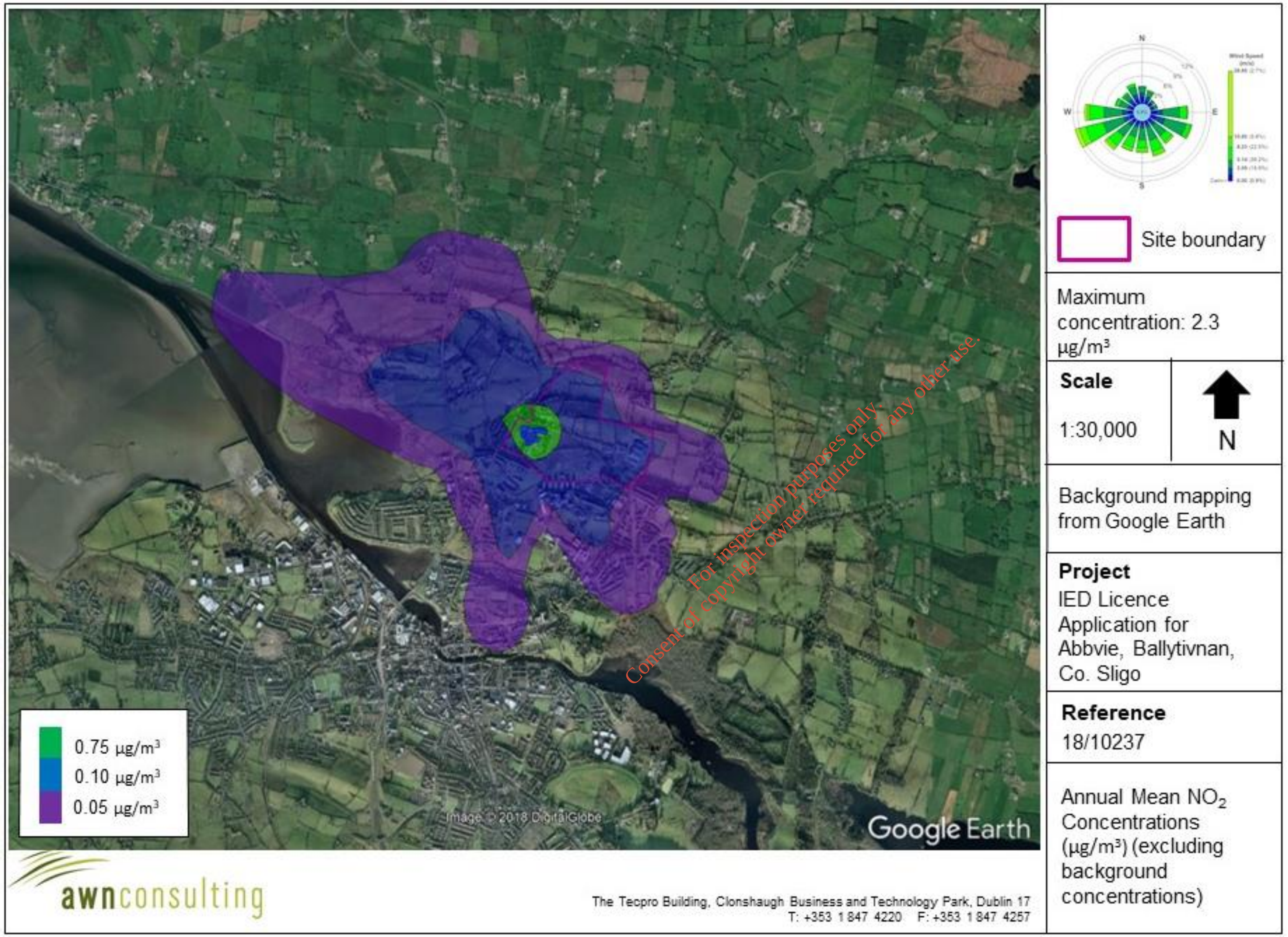

Figure 9.3 Annual Mean NO_2 Concentrations (µg/m³)

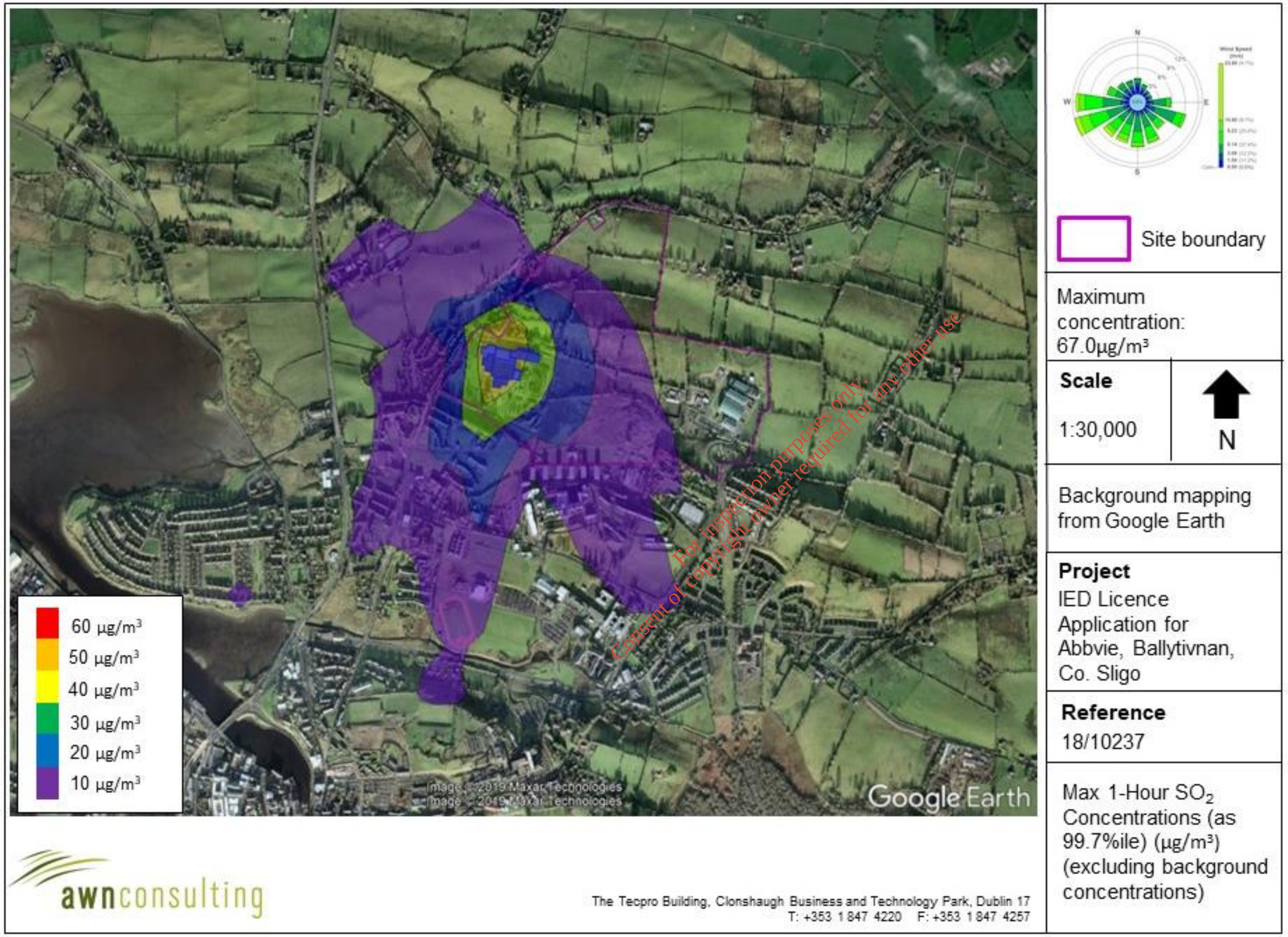

Figure 9.4 Maximum 1-Hour SO_2 Concentrations (as 99.7th percentile) (µg/m³)

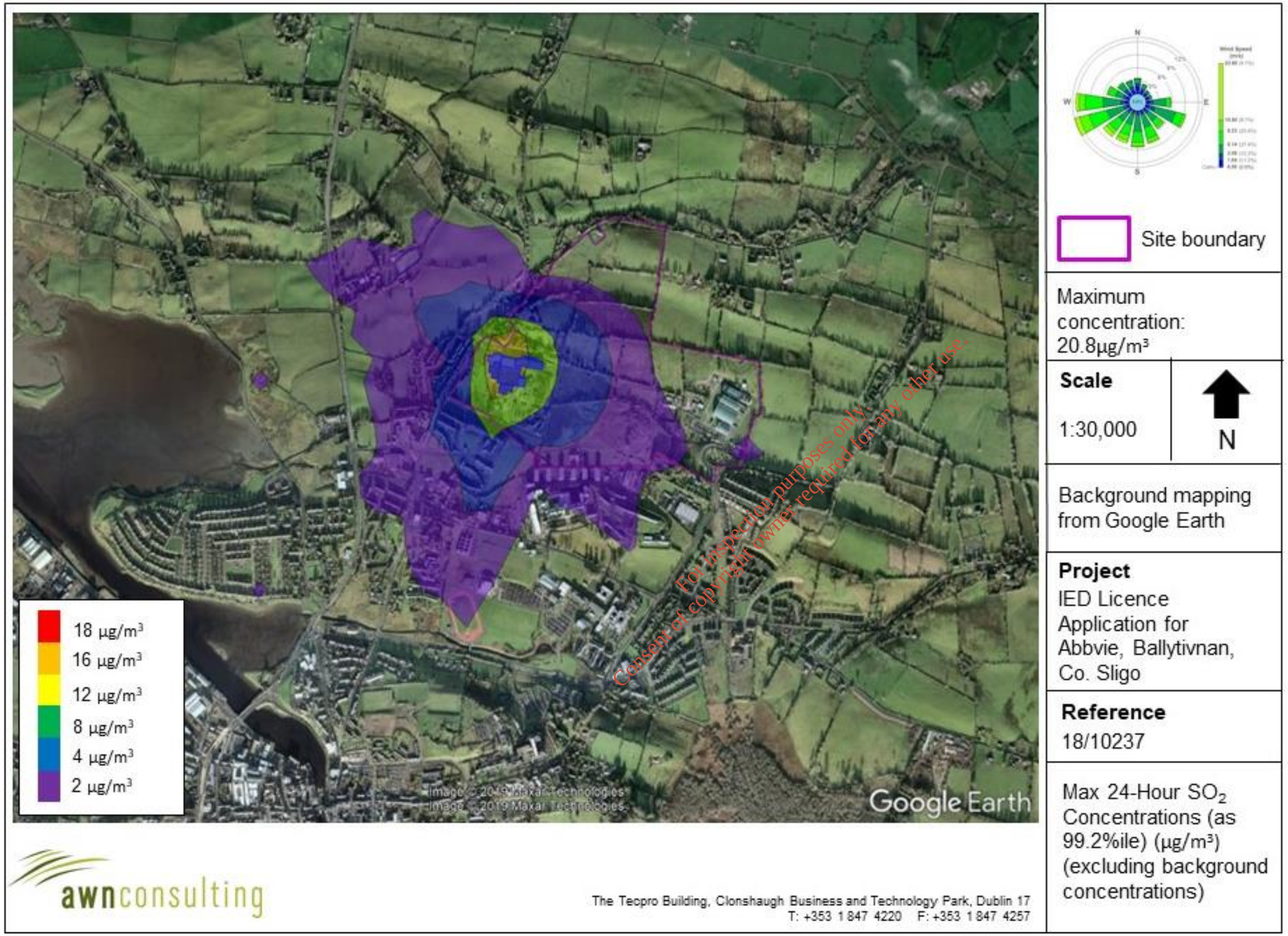

Figure 9.5 Maximum 24-Hour SO_2 Concentrations (as 99.2nd percentile) (µg/m³)

Cumulative Assessment

NO_2

The cumulative impact of process emissions of NO_2 from the proposed development and the neighbouring Abbvie facility are detailed in Table 9.7 below. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for NO_2. For the worst-case year, emissions from the site lead to an ambient NO_2 concentration (including background) which is 25% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 39% of the annual limit value at the worst-case off-site receptor for the worst-case years modelled (2014 and 2016).

Table 9.7 NO_2 Dispersion Model Results – Cumulative Assessment

Pollutant / Meteorological Year	Background ($\mu g/m^3$)	Averaging Period	Process Contribution ($\mu g/m^3$)	Predicted Emission Concentration ($\mu g/m^3$)	Standard ($\mu g/m^3$) Note 1
NO_2 / 2012	13	Annual Mean	2.18	15.18	40
	26	99.8th%ile of 1-hr means	22.23	48.23	200
NO_2 / 2013	13	Annual Mean	2.33	15.33	40
	26	99.8th%ile of 1-hr means	24.07	50.07	200
NO_2 / 2014	13	Annual Mean	2.43	15.43	40
	26	99.8th%ile of 1-hr means	23.48	49.48	200
NO_2 / 2015	13	Annual Mean	2.20	15.20	40
	26	99.8th%ile of 1-hr means	22.39	48.39	200
NO_2 / 2016	13	Annual Mean	2.27	15.27	40
	26	99.8th%ile of 1-hr means	24.08	50.08	200

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC and S.I. 180 of 2011)

SO_2

The SO_2 modelling results for the cumulative assessment are detailed in Table 9.8. The results indicate that the ambient ground level concentrations are below the 1-hour and 24-hour ambient air quality standards. Emissions from both facilities lead to an ambient SO_2 concentration (including background) that is 25% of the maximum ambient 1-hour limit value (measured as a 99.7th%ile) and 23% of the 24-hour limit value (measured as a 99.2nd%ile) at the worst-case location off-site for the worst case years modelled (2013 and 2014).

Table 9.8 SO_2 Dispersion Model Results – Cumulative Assessment

Pollutant/ Meteorological year	Background (µg/m^3)	Averaging Period	Process Contribution SO_2 (µg/m^3)	Predicted Environmental Concentration (PEC) SO_2 (µg/Nm^3)	Standard (µg/Nm^3) Note 1
SO_2 / 2012	14.63	24 Hour 99.2nd%ile	19.1	26.3	125
	31.65	1-Hour 99.7th%ile	75.1	82.3	350
SO_2 / 2013	14.63	24 Hour 99.2nd%ile	21.1	28.9	125
	31.65	1-Hour 99.7th%ile	76.9	84.7	350
SO_2 / 2014	14.63	24 Hour 99.2nd%ile	20.0	28.5	125
	31.65	1-Hour 99.7th%ile	80.5	89.0	350
SO_2 / 2015	14.63	24 Hour 99.2nd%ile	18.0	25.3	125
	31.65	1-Hour 99.7th%ile	62.1	69.4	350
SO_2 / 2016	14.63	24 Hour 99.2nd%ile	20.3	28.3	125
	31.65	1-Hour 99.7th%ile	77.4	85.4	350

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC and S.I. 180 of 2011)

Summary of the Modelling Assessment

The modelling assessment has found that ambient NO_2 and SO_2 concentrations as a result of the Proposed Development and the Cumulative Assessment are in compliance with the relevant ambient air quality limit values at all locations at or beyond the site boundary. The impacts to air quality from operation of the proposed development are therefore deemed long-term, negative and not significant.

Climatic Impact

It is not predicted that the operational phase of the development will have an impact on climate. Impacts to climate could occur indirectly through the energy requirements of the building. However, the CO_2 emissions from electricity to operate the facility will not be significant in relation to Ireland's national annual CO_2 emissions. The electricity will be supplied from the national grid. Electricity to operate the facility will be purchased from the available energy suppliers including power stations and renewable generation sources such as wind power. The Electricity Supplier for the site currently holds a Commission for Energy Regulation (CER) certified fuel mix disclosure, guaranteeing every megawatt-hour (MWh) that they supply in the market is generated from renewable sources. Therefore, the impact to climate as a result of the indirect generation of greenhouse gases due to the electricity requirements of the site is deemed long-term, imperceptible and not significant.

Human Health

Air dispersion modelling 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 dispersion modelling results, emissions from the site are compliant with all National and EU ambient air quality limit values and, therefore, will not result in a significant impact on human health. Conservative assumptions were made when determining the input data for the air modelling assessment and the approach used in the study leads to an over-estimation of the actual levels that will arise. In relation to the spatial extent of air quality impacts from the site, ambient concentrations will decrease significantly with distance from the site boundary.

9.5 MITIGATION MEASURES

9.5.1 CONSTRUCTION PHASE

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.

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.

However, 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.

9.5.2 OPERATIONAL PHASE

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

9.6 RESIDUAL IMPACTS

Once the mitigation measures outlined in Section 1.5 are implemented, there will be no residual impacts of significance on air quality or climate from the construction or operational phases of the proposed development.