8.0 AIR QUALITY & CLIMATE

8.1 INTRODUCTION

This chapter evaluates the impacts which the Proposed Development may have on Air Quality & Climate during the construction, operational and decommissioning stages as defined in the Environmental Protection Agency (EPA) documents Draft Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2017) and Draft Advice Notes for Preparing Environmental Impact Statements (EPA, 2015), as well as in line with Article 94 and Schedule 6 of the Planning and Development Regulations 2001 (as amended) and Article 5 and Annex IV of the EIA Directive (2011/92/EU, as amended).

An assessment of the likely dust related impacts as a result of construction activities and decommissioning activities was undertaken and used to inform a series of mitigation measures presented in this chapter. Air dispersion modelling of operational stage emissions from the diesel-powered emergency backup generators was carried out using the United States Environmental Protection Agency's regulated model AERMOD as recommended by the EPA (EPA, 2020a). The modelling of air emissions from the site was carried out to assess concentrations of nitrogen dioxide (NO_2) at a variety of locations beyond the site boundary. The modelling was undertaken to assess the impact to ambient air quality from scheduled testing of the data centre standby generators and the energy centre engines when fuelled by diesel oil, and the infrequent emergency operation of the data centre standby generators.

The back-up diesel generators will have emissions of NO_2, CO, SO_2 and particulate matter (PM_{10}/$PM_{2.5}$). Odour is not considered relevant for the Proposed Development. Modelling for NO_2 was undertaken in detail. In relation to CO, SO_2, PM_{10} and $PM_{2.5}$ no detailed modelling was undertaken. Emissions of these pollutants are significantly lower than the NO_X emissions from the generators relative to their ambient air quality standards and thus ensuring compliance with the NO_2 ambient limit value will ensure compliance for all other pollutants. For example, the emission of CO from the generators is at least eight times lower than NO_X whilst the CO ambient air quality standard is 10,000 $\mu g/m^3$ compared to the 1-hour NO_2 standard of 200 $\mu g/m^3$. Similarly, levels of PM_{10}/$PM_{2.5}$ emitted from the generators will be 90 times lower whilst the ambient air quality standards are comparable. Emissions of SO_2 are approximately 55 times lower than emissions of NO_X.

As discussed in Chapter 2, the Proposed Development will have 84 no. back-up generators for the data centre and 18 no. lean-burn natural gas engines for the energy centre. A review of licensed facilities in the surrounding area has been conducted and none have been identified with the potential for cumulative impact with the Proposed Development. Consideration of all developments identified in Chapter 3 Appendix 3.1 was also undertaken and no potential for cumulative impact with the Proposed Development was identified as the planned developments have no or negligible potential for NO_2 emissions.

8.2 METHODOLOGY

8.2.1 Criteria for Rating of Impacts

8.2.1.1 Ambient Air Quality Standards

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

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which give effect to European Commission Directive 2008/50/EC which has set limit values for the pollutants NO_2, PM_{10}, and $PM_{2.5}$ relevant to this assessment. 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) and also includes ambient limit values relating to $PM_{2.5}$.

Table 8.1 *Air Quality Standards Regulations 2011 (based on EU Council Directive 2008/50/EC)*

Pollutant	Regulation (Note 1)	Limit Type	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m3 NO2
		Annual limit for protection of human health	40 µg/m3 NO2
Particulate Matter (as PM10)	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m3 PM10
		Annual limit for protection of human health	40 µg/m3 PM10
PM2.5	2008/50/EC	Annual limit for protection of human health	25 µg/m3 PM2.5

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

8.2.1.2 Dust Deposition Guidelines

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

With regard to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction and decommissioning phases of a development in Ireland.

With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust) (German VDI, 2002) sets a maximum permissible emission level for dust deposition of 350 mg/(m^2*day) averaged over a one-year period at any receptors outside the site boundary. The TA-Luft standard has been applied for the purpose of this assessment based on recommendations from the EPA in Ireland in the document titled *'Environmental Management Guidelines - Environmental Management in the Extractive Industry (Non-Scheduled Minerals)'* (EPA, 2006). The document recommends that the Bergerhoff limit of 350 mg/(m^2*day) be applied to the site boundary of quarries. This limit value shall be implemented with regard to dust impacts from construction of the Proposed Development.

8.2.1.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% below 2005 levels), 65 kt for NO_X (49% reduction), 43 kt for VOCs (25% reduction), 108 kt for NH_3 (1% reduction) and 10 kt for $PM_{2.5}$ (18% reduction).

European Commission Directive 2001/81/EC National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National EPA Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005 (DEHLG, 2004; 2007). The data available from the EU in 2020 (EPA, 2020b) indicated that Ireland complied with the emissions ceilings for SO_2 in recent years but failed to comply with the ceilings for NMVOCs, NH_3 and NO_X. 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 applies 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, emission targets applicable from 2020 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). In relation to 2030, Ireland's emission targets are 10.9 kt (85% below 2005 levels) for SO_2, 40.7 kt (69% reduction) for NO_X, 51.6 kt (32% reduction) for NMVOCs, 107.5 kt (5% reduction) for NH_3 and 11.2 kt (41% reduction) for $PM_{2.5}$.

8.2.1.4 Climate Agreements

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an 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 Greenhouse Gas (GHG) emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG 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 in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions.

In order to meet the commitments under the Paris Agreement, the EU enacted *Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013* (the Regulation). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. Ireland's obligation under the Regulation is a 30% reduction in non-ETS greenhouse gas emissions by 2030 relative to its 2005 levels.

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

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

The *Climate Action Plan* (CAP) (Government of Ireland, 2019), published in June 2019, outlines the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The CAP also details the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The CAP has set a built environment sector reduction target of 40 - 45% relative to 2030 pre-NDP (National Development Plan) projections.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 in December 2019 (Government of Ireland, 2020a). The General Scheme was prepared for the purposes of giving statutory effect to the core objectives stated within the CAP. The Climate Action and Low Carbon Development (Amendment) Bill 2021 (the Bill) was published in March 2021.

The purpose of the 2021 Climate Bill is to provide for the approval of plans '*for the purpose of pursuing the transition to a climate resilient and climate neutral economy by the end of the year 2050'*. The 2021 Climate Bill will also '*provide for carbon budgets and a decarbonisation target range for certain sectors of the economy'*. The 2021 Climate Bill removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister shall request each local authority to make a 'local authority climate action plan' lasting five years and to specify the mitigation measures and the adaptation measures to be adopted by the local authority. The Bill has set a target of a 51% reduction in the total amount of greenhouse gases over the course of the first two carbon periods ending 31 December 2030 relative to 2018 annual emissions. The 2021 Climate Bill defines the carbon budget as 'the total amount of greenhouse gas emissions that are permitted during the budget period'.

Individual county councils in Ireland have also published their own Climate Change Strategies which outline the specific climate objectives for that local authority and associated actions to achieve the objectives. Clare County Council's Climate Change Adaptation Strategy 2019 -2024 was published by Clare County Council in 2019 and includes the following two goals and associated objectives which relate to the Built Environment and Development:

- Theme 2 Infrastructure and Built Environment – Objective 2: "To promote County Clare as a Low Carbon County and support the development of low carbon and green technology businesses and industries throughout the County.";
- Theme 3 Land-use and Development – Objective 2: "To integrate climate action consideration into land-use planning policy and influence positive behaviour."; and
- Theme 5 Natural Resources and Cultural Infrastructure – Objective 4: "To promote and facilitate the provision of high quality, secure, efficient and reliable renewable energy sources along with appropriate energy storage facilities in order to assist in the creation of a low carbon County Clare."

8.2.2 Construction Phase

8.2.2.1 Air Quality

The current assessment focused firstly on identifying the existing baseline levels of NO_2, PM_{10} and $PM_{2.5}$ in the region of the Proposed Development by an assessment of EPA monitoring data. Thereafter, the impact of the construction phase on air quality was determined by a qualitative assessment of the nature and scale of dust generating construction activities associated with the Proposed Development.

8.2.2.2 Climate

The impact of the construction phase of the Proposed Development on climate was determined by a qualitative assessment of the nature and scale of greenhouse gas generating construction activities associated with the Proposed Development.

8.2.3 Operational Phase

8.2.3.1 Air Quality

Air dispersion modelling was carried out by AWN Consulting Ltd. using the United States Environmental Protection Agency's regulated model AERMOD (Version 19191). AERMOD 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)"* (2020a).

The modelling of air emissions from the site was carried out to assess the concentrations of nitrogen dioxide (NO_2) beyond the site boundary and the consequent impact on human health.

The assessment was undertaken in order to quantify the impact of the Proposed Development and the existing baseline level of pollutants on ambient air quality concentrations.

To obtain all the meteorological information required for use in the model, data collected during 2016 – 2020 from the Met Éireann meteorological station at 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 five full years of meteorological data. Using this input data, the model predicted ambient concentrations beyond the site boundary for each hour of the meteorological year. This study adopted a conservative approach which will lead to an over-estimation of the actual levels that will arise.

AERMOD 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 8.1. 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.

A receptor grid and discrete receptors were identified 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 a Cartesian grid with the site at the centre. The outer grid measured 20 x 20 km with the site at the centre and with concentrations calculated at 1000 m intervals. A middle grid measured 10 x 10 km with the site at the centre and with concentrations calculated at 500 m intervals. The inner grid measured 5 x 5 km with the site at the centre and with concentrations calculated at 125 m intervals. Boundary receptor locations were also placed along the boundary of the site, at 100 m intervals, giving a total of 2,800 calculation points for the model. The impact of the data centre back-up diesel generators and the energy centre gas/diesel engine was also measured at nearby residential receptors which were added to the model as discrete receptors.

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

Hourly-sequenced meteorological information has been used in the model covering the years 2016 – 2020 from the Met Éireann meteorological station at Shannon Airport as shown in Figure 8.1 (www.met.ie). AERMOD incorporates a meteorological pre-processor AERMET which allows AERMOD to account for changes in the plume behaviour with height using information on the surface characteristics of the site. AERMET calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, temperature scale, convective boundary layer (CBL) height, stable boundary layer (SBL) height, and surface heat flux (see Appendix 8.2).

Terrain has been mapped out in the model as using SRTM (Shuttle Radar Topography Mission) data with 30m resolution. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP.

8.2.3.2 Process Emissions

The Proposed Development (Data Centre and Energy Centre) will have six data centres with a total of 84 no. back-up generators with associated stacks which will be built to a height of 8 m above ground level. The energy centre will have 18 no. lean-burn natural gas engines, with the associated stacks built to a height of 25 m above ground level. All modelling scenarios assumed all six data halls and all 18 energy centre engines are operational simultaneously. In reality the Proposed Development will become operational in phases over a period of 4 – 5 years, with two data centre halls and six energy centre engines in operation for each phase.

The natural gas engines may also be powered by diesel fuel oil as back-up to the normal gas supply. It is not expected that this operation mode would cause any significant impacts on ambient air quality considering the infrequent and unpredictable usage of this back-up fuel; the worst availability performance for disruption to natural gas supply is 22 hours in 5 years (Gas Networks Ireland, 2017). This potential level of disruption is also applicable to the data centre back-up generators, as the data centres are supplied by the energy centre. A worst-case assumption of 24 hours emergency operation powered by diesel fuel oil has been modelled.

In order for the data centre generators to be kept in good condition, ready to be started at full load during an emergency power failure, it is necessary to carry out a scheduled maintenance programme, which includes periodic testing. The diesel mode for the energy centre engines will also be tested. All testing is assumed to only occur between 8am and 5pm, Monday to Friday. The maintenance plan for the proposed development comprises the following two tests:

- Test 1: testing once per month of all 84 no. data centre back-up generators at up to 100% load for a maximum of one hour each, two generators at a time, sequentially;
- Test 2: testing once per month of all 18 no. energy centre engines powered by fuel oil at up to 100% load for a maximum of one hour each, one engine at a time, sequentially.

USEPA Guidance suggests that for emergency operations, an average hourly emission rate should be used rather than the maximum hourly rate (USEPA, 2011). For modelling purposes only, a worst case/conservative figure of 100 hours in total per year of operation has been applied to the Proposed Development. However, in reality, and based on recent experience over the past number of years, generators are rarely used other than during testing and maintenance described above. As a result, the maximum hourly emission rates from all the back-up generators were reduced by a factor of (100/8760) to give an average hourly emission rate (in line with USEPA protocol) and the generators were modelled over a period of one full year.

A second methodology for modelling back-up generators has been published by the UK Environment Agency. The consultation document is entitled "Diesel Generator Short-Term NO_2 Impact Assessment" (UK EA, 2016). The methodology is based on considering the statistical likelihood of an exceedance of the NO_2 hourly limit value (18 exceedances are allowable per year before the air standard is deemed to have been exceeded). The assessment assumes a hypergeometric distribution to assess the likelihood of exceedance hours coinciding with the operational hours of the back- up generators. The cumulative hypergeometric distribution of 19 and more hours per year is computed and the probability of an exceedance determined. The guidance suggests that the 95th percentile confidence level should be used to indicate if an exceedance is likely. More recent guidance (UK EA, 2019) has recommended this probability should be multiplied by a factor of 2.5 and therefore, the 98th percentile confidence level should be used to indicate if an exceedance is likely. The guidance suggests that the assessment should be conducted at the nearest residential receptor or at locations where people are likely to be exposed and that there should be no running time restrictions on these generators when providing power on site during an emergency.

Both the methodology advised in the USEPA guidance as well as the approach described in the UK EA guidance have been applied in this study to ensure a robust assessment of predicted air quality impacts from the back-up generators. The methodology for converting NO_X to NO_2 was based on the ozone limiting method (OLM) approach based on an initial NO_2/NO_X ratio of 0.1 and a background ozone level of 55 µg/m^3 based on a review of EPA data for similar Zone C locations.

The modelling was undertaken to assess the impact to ambient air quality from the following operations scenario:

- **Proposed Development (Worst-Case) Scenario:** This comprises the emission points associated with the Proposed Development (Data Centre and Energy Centre). This scenario involves the emergency operation of 84 no. data centre diesel generators, continuous operation of 18 no. energy centre natural gas engines and emergency operation of the natural gas engines on backup diesel fuel oil. The scenario also includes testing for all 84 data centre generators and all 18 energy centre engines. Application of selective catalytic reduction (SCR) has been assumed to reduce energy centre emissions for gas operation by 63% and by 87% for diesel operation to meet emission limits. Selective catalytic reduction is an abatement technique where ammonia or urea is injected into the gas stream to convert nitrogen oxides to nitrogen and water. The process emissions used for the Proposed Development Scenario are outlined in Table 8.2.
- **Proposed Development (Likely Average Operation) Scenario:** This comprises the emission points associated with the Proposed Development (Data Centre and Energy Centre). This scenario involved the emergency operation of 84 no. data centre diesel generators, continuous operation of 18 no. energy centre natural gas engines and emergency operation of the natural gas engines on backup diesel fuel oil. The scenario also included testing for all 84 data centre generators and all 18 energy centre engines. Application of SCR has been assumed to reduce energy centre emissions by 95% for both gas and diesel operation to meet emission limits. The process emissions used for the Proposed Development Scenario are outlined in Table 8.3.

Table 8.2 Summary of Process Emission Information for Data Centre and Energy Centre –Proposed Development (Worst-Case) Scenario

Stack Reference	Grid Reference (ITM, m)	Stack Height Above Ground Level (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temp (K)	Volume Flow (Nm^3/hr at 15% Ref. O2)	Exit Velocity (m/sec actual)	NOx	
								Concentration (mg/Nm^3 at 15% Ref. O2)	Mass Emission (g/s)
Data Centre Emergency Operation for Back-up Diesel Generators (100% load)	505597, 5857039 – 504857, 5857040	8 m	0.6 m	0.28	755.15	24,900	39.7	2,362	0.14 Note 1
Data Centre Test 1 for Back-up Diesel Generators (100% load)	505597, 5857039 – 504857, 5857040	8 m	0.6 m	0.28	755.15	24,900	39.7	2,362	6.06 Note 2
Energy Centre Continuous Operation for Natural Gas Engines (100% load)	505027, 5857343 – 505081, 5857341	25 m	0.9 m	0.64	649.15	31,212	22.1	95	0.82
Energy Centre Test 2 for Back-up Diesel Powered Engines (100% load)	505027, 5857343 – 505081, 5857341	25 m	0.9 m	0.64	628.15	38,160	28.9	190	2.01 Note 2
Energy Centre Emergency Operation on Back-up Diesel Fuel Oil (100% load)	505027, 5857343 – 505081, 5857341	25 m	0.9 m	0.64	628.15	38,160	28.9	190	0.0055 Note 3

Note 1 Reduced emission rates based on USEPA protocol (assuming 100 hours / annum) used to model emissions during emergency operation of generators (100% load)

Note 2 Emission rates used to model emissions during testing at 100% load assumed to occur once per month, per generator

Note 3 Emergency operation of natural gas engines on backup diesel fuel oil assumed for 24 hours / annum as a worst-case.

Table 8.3 Summary of Process Emission Information for Data Centre and Energy Centre –Proposed Development (Likely Average Operation) Scenario

Stack Reference	Grid Reference (ITM, m)	Stack Height Above Ground Level (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temp (K)	Volume Flow (Nm^3/hr at 15% Ref. O2)	Exit Velocity (m/sec actual)	NO_x	
								Concentration (mg/Nm^3 at 15% Ref. O2)	Mass Emission (g/s)
Data Centre Emergency Operation for Back-up Diesel Generators (100% load)	505597, 5857039 – 504857, 5857040	8 m	0.6 m	0.28	755.15	24,900	39.7	2,362	0.14 Note 1
Data Centre Test 1 for Back-up Diesel Generators (100% load)	505597, 5857039 – 504857, 5857040	8 m	0.6 m	0.28	755.15	24,900	39.7	2,362	6.06 Note 2
Energy Centre Continuous Operation for Natural Gas Engines (100% load)	505027, 5857343 – 505081, 5857341	25 m	0.9 m	0.64	649.15	31,212	22.1	13	0.11
Energy Centre Test 2 for Back-up Diesel Powered Engines (100% load)	505027, 5857343 – 505081, 5857341	25 m	0.9 m	0.64	628.15	38,160	28.9	73	0.77 Note 2
Energy Centre Emergency Operation on Back-up Diesel Fuel Oil (100% load)	505027, 5857343 – 505081, 5857341	25 m	0.9 m	0.64	628.15	38,160	28.9	190	0.0021 Note 3

Note 1 Reduced emission rates based on USEPA protocol (assuming 100 hours / annum) used to model emissions during emergency operation of generators (100% load)

Note 2 Emission rates used to model emissions during testing at 100% load assumed to occur once per month, per generator

Note 3 Emergency operation of natural gas engines on backup diesel fuel oil assumed for 24 hours / annum as a worst-case.

8.2.3.3 Climate & Transboundary Pollution

The back-up diesel generators modelled for the purpose of this assessment will only be used in the event of a power failure at the site. In reality and based on recent experience over the past number of years, generators are rarely used other than during testing and maintenance described in the previous section. During normal operations at the facility, the electricity will be supplied from the national grid so there will be no direct emissions of CO_2 or transboundary pollutants from the site.

The impact of the operational phase of the Proposed Development on climate was determined by an assessment of the indirect CO_2 emissions associated with the electricity supplied from the national grid. The details and results of the assessment are provided in section 8.7.2.2.

8.3 RECEIVING ENVIRONMENT

8.3.1 Baseline Air Quality

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality *'Air Quality in Ireland 2019'* (EPA 2020c) 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 as outlined within the EPA document titled *'Air Quality Monitoring Report 2018'* (EPA 2020c). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000 is defined as Zone D. In terms of air monitoring, the Proposed Development is within Zone C, as defined in Scheule 19 of the Air Quality Standards Regulations 2011. As the Proposed Development is considered a Zone C environment, the baseline air quality for NO_2, PM_{10} and $PM_{2.5}$ is reviewed for all Zone C monitoring locations in the following sections.

8.3.1.1 NO_2

With regard to NO_2, continuous monitoring data from the EPA (2020c; 2021) from all Zone C locations of Dundalk, Kilkenny and Portlaoise in 2019 show that levels of NO_2 are below both the annual and 1-hour limit values (see Table 8.3). Average long-term concentrations at the three sites range from 5 – 14 µg/m^3 for the period 2015 – 2019; suggesting an upper average over the five-year period of no more than 14 µg/m^3. There were no exceedances of the maximum 1-hour limit of 200 µg/m^3 in any year (18 exceedances are allowed per year). Based on these results an estimate of the background NO_2 concentration in the region of the development is 14 µg/m^3. It is expected that this background concentration will remain at this level or decrease slightly over the operational lifetime of the project.

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 8.3 *Trends In Zone C Air Quality - Nitrogen Dioxide (µg/m³)*

Station	Averaging Period	Year				
		2015	2016	2017	2018	2019
Kilkenny	Annual Mean NO_2 (µg/m³)	5	7	5	6	5
	Max 1-hr NO_2 (µg/m³)	70	51	58	71	59
Portlaoise	Annual Mean NO_2 (µg/m³)	10	11	11	11	11
	Max 1-hr NO_2 (µg/m³)	84	86	80	119	77
Dundalk	Annual Mean NO_2 (µg/m³)	-	-	-	14	12
	Max 1-hr NO_2 (µg/m³)	-	-	-	91	144

8.3.1.2 PM_{10}

Continuous PM_{10} monitoring carried out at three Zone C locations in 2019 showed annual mean concentrations ranging from 13 to 18 µg/m³, with at most 12 exceedances (in Ennis) of the 24 hour limit value of 50 µg/m³ (35 exceedances are permitted per year) (EPA, 2020c). Long-term data for the period 2015 – 2019 for Ennis and Portlaoise shows that concentrations range from 10 – 18 µg/m³, suggesting an upper average concentration over the five-year period of no more than 17 µg/m³. Based on this EPA data, an estimate of the background PM_{10} concentration in the region of the development is 17 µg/m³. It is expected that this background concentration will remain at this level or decrease slightly over the operational lifetime of the project.

8.3.1.3 $PM_{2.5}$

Continuous $PM_{2.5}$ monitoring carried out at two Zone C locations at Ennis and Bray in 2019 showed annual mean concentrations ranging from 7 to 14 µg/m³. Long-term data for the period 2015 – 2019 for Bray and Ennis shows that concentrations range from 5 – 14 µg/m³. The $PM_{2.5}/PM_{10}$ ratio in Ennis ranged from 0.63 – 0.78 over the five year period. Based on this information, a conservative ratio of 0.8 was used to generate a background $PM_{2.5}$ concentration in the region of the Proposed Development of 13.6 µg/m³. It is expected that this background concentration will remain at this level or decrease slightly over the operational lifetime of the project.

8.3.1.4 Climate Baseline

Anthropogenic emissions of greenhouse gases in Ireland included in the EU 2020 strategy are outlined in the most recent review by the EPA which details provisional emissions up to 2019 (EPA, 2020d). The data published in 2020 states that Ireland will exceed its 2019 annual limit set under the EU's Effort Sharing Decision (ESD), 406/2009/EC by an estimated 6.98 Mt. For 2019, total national greenhouse gas emissions are estimated to be 59.90 million tonnes carbon dioxide equivalent (Mt CO2eq) with 45.71 MtCO2eq of emissions associated with the ESD sectors for which compliance with the EU targets must be met. Agriculture is the largest contributor in 2019 at 35.3% of the total, with the transport sector accounting for 20.3% of emissions of CO_2.

GHG emissions for 2019 are estimated to be 4.5% lower than those recorded in 2018. Emission reductions have been recorded in 6 of the last 10 years. However, compliance with the annual EU targets has not been met for four years in a row. Emissions from 2016 – 2019 exceeded the annual EU targets by 0.29 MtCO2eq, 2.94 MtCO2eq, 5.57 MtCO2eq and 6.98 MtCO2eq respectively. Agriculture is consistently the largest contributor to emissions with emissions from the transport and energy sectors being the second and third largest contributors respectively in recent years.

The EPA 2020 GHG Emissions Projections Report for 2019 – 2040 (EPA, 2020e) notes that there is a long-term projected decrease in greenhouse gas emissions as a result of inclusion of new climate mitigation policies and measures that formed part of the National Development Plan (NDP) which was published in 2018. Implementation of these are classed as a *"With Additional Measures scenario"* for future scenarios. A change from generating electricity using coal and peat to wind power and diesel vehicle engines to electric vehicle engines are envisaged under this scenario. While emissions are projected to decrease in these areas, emissions from agriculture are projected to grow steadily due to an increase in animal numbers. However, over the period 2013 – 2020 Ireland is projected to cumulatively exceed its compliance obligations with the EU's Effort Sharing Decision (Decision No. 406/2009/EC) 2020 targets by approximately 10 Mt CO2eq under the *"With Existing Measures"* scenario and 9 Mt CO2eq under the *"With Additional Measures"* scenario (EPA, 2020e).

8.4 CHARACTERISTICS OF THE DEVELOPMENT

The proposed development is described in further detail in Chapter 2 (Description of the Proposed Development). The details of the construction and operation of the development in terms of air quality and climate are discussed below.

8.4.1 Construction Phase

The Proposed Development will comprise construction of a six data storage facilities, a gas powered energy centre and associated ancillary development. The key civil engineering works which will have a potential impact on air quality and climate during construction are summarised below:

(i) During construction, an amount of soil will be generated as part of the site preparation works and during excavation for construction of roads, car parking areas, foundations, installation of drainage services and ancillary infrastructure;

(ii) Following completion of the building shell, commissioning of the mechanical and electrical equipment is undertaken;

(iii) Infilling and landscaping will be undertaken. Spoil generated during site preparation will be re-used where possible;

(iv) Temporary storage of construction materials; and

(v) Construction traffic accessing the site will emit air pollutants and greenhouse gases during transport.

As outlined in Section 8.6, a dust minimisation plan will be formulated for the construction phase of the Proposed Development to ensure no dust nuisance occurs at nearby sensitive receptors.

8.4.2 Operational Phase

The key works which will have a potential impact on air quality and climate during operation of the Proposed Development are summarised below:

(i) The scheduled testing for maintenance of the back-up diesel generators in the data storage facility will release air pollutant emissions (primarily NO_X emissions);

(ii) The infrequent emergency operation of the natural gas engines on backup diesel fuel oil in the event of disruption to the natural gas supply.

(iii) The infrequent emergency operation of the back-up diesel generators for the data storage facility in the event of a power outage would release air pollutant emissions (primarily NO_X emissions). A review of operational data from similar operational data storage facilities in Ireland indicates that that standby generators are rarely used other than during the scheduled maintenance and testing.

(iv) Road traffic accessing the site will emit air pollutants and greenhouse gases. However, the operational phase of the Proposed Development is not expected to contribute a significant volume of additional traffic on the local road network (see Chapter 12 (Traffic & Transportation)). Therefore, no local air quality assessment of the traffic impact is required for this development; and

(v) The indirect impact of emissions from electricity to operate the data storage facilities will have an impact on climate and regional air quality. However, it is predicted that these will not be significant in relation to Ireland's national emission ceiling limits for CO_2, NO_X, SO_2 and NMVOCs.

8.4.3 Decommissioning Phase

The Proposed Development may be decommissioned at some stage in the future. At that time a dust minimisation plan will be formulated for the decommissioning phase of the Proposed Development to ensure no dust nuisance occurs at nearby sensitive receptors.

8.5 POTENTIAL IMPACTS OF THE DEVELOPMENT

8.5.1 Construction Phase

8.5.1.1 Air Quality & Climate

The greatest potential impact on air quality during the construction phase of the Proposed Development is from construction dust emissions as a result of excavation works, infilling and landscaping activities and storage of soil in stockpiles. This leads to the potential for nuisance dust. While construction dust tends to be deposited within 350 m of a construction site, the majority of the deposition occurs within the first 50 m (IAQM, 2014). The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction. Sensitive receptors include residential properties within 350m of the site boundary on the R352 Tulla Rd and unnamed local roads.

Construction traffic is expected to be the dominant source of greenhouse gas emissions as a result of the Proposed Development. Construction vehicles and machinery will give rise to CO_2 and N_2O emissions during construction of the Proposed Development. The Institute of Air Quality Management document *'Guidance on the*

Assessment of Dust from Demolition and Construction' (IAQM, 2014) states that site traffic and plant is unlikely to make a significant impact on climate.

Initial commissioning activities will involve testing of the data centre back-up generators and energy centre engines with fuel oil on site in a similar manner to the operational phase testing, i.e. the first testing sequence will be commissioning of the standby generators. The operational modelling has considered testing of the generators on a monthly basis and this does not result in a significant impact to air quality. Therefore, it is predicted that the initial commissioning tests will result in an ***imperceptible*** impact to air quality in the ***short-term***.

It is important to note that the potential impacts associated with the construction phase of the Proposed Development are short-term in nature. When the dust minimisation measures detailed in the mitigation section (see Section 8.6) of this chapter are implemented, fugitive emissions of dust from the site will not be significant and will pose no nuisance at nearby receptors. Due to the duration and nature of the construction activities, CO_2 and N_2O emissions from construction vehicles and machinery will have a ***short-term*** and ***imperceptible*** impact on climate.

8.5.2 Operational Phase

8.5.2.1 Air Quality

The potential impact to air quality during the operational phase of the Proposed Development is a breach of the ambient air quality standards as a result of air emissions from the data centre back-up diesel generators and the energy centre engines. However, as outlined in Section 8.6, an iterative stack height determination was undertaken as part of the air dispersion modelling study to ensure that an adequate release height was selected for all emission points to aid dispersion of the plume and ensure compliance with the ambient air quality limit values beyond the site boundary.

8.5.2.2 Climate

The back-up diesel generators modelled for the purpose of this assessment will only be used in the event of a power failure at the site and for testing purposes. During normal operations at the facility, the electricity will be supplied by the energy centre on site, which is powered by natural gas. The predicted impact is stated in section 8.7.2.2.

8.5.3 Decommissioning Phase

8.5.3.1 Air Quality & Climate

The greatest potential impact on air quality during the decommissioning phase of the Proposed Development is from dust emissions as a result of demolition works and associated landscaping activities and truck movements to and from the facility. This leads to the potential for nuisance dust.

Traffic associated with decommissioning is expected to be the dominant source of greenhouse gas emissions as a result of the decommissioning phase of the Proposed Development. Vehicles and machinery will give rise to CO_2 and N_2O emissions during decommissioning of the Proposed Development. The Institute of Air Quality Management document *'Guidance on the Assessment of Dust from Demolition and Construction'* (IAQM, 2014) states that site traffic and plant is unlikely to make a significant impact on climate.

It is important to note that the potential impacts associated with the decommissioning phase of the Proposed Development are short-term in nature. When the dust minimisation measures detailed in the mitigation section (see Section 8.6) of this chapter are implemented, fugitive emissions of dust from the site will not be significant and will pose no nuisance at nearby receptors. Due to the duration and nature of the decommissioning activities, CO_2 and N_2O emissions from construction vehicles and machinery will have a ***short-term*** and ***imperceptible*** impact on climate.

8.6 REMEDIAL AND MITIGATION MEASURES

8.6.1 Construction Phase

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

- 'Guidance on the Assessment of Dust from Demolition and Construction' (IAQM, 2014);
- 'Planning Advice Note PAN50 Annex B: Controlling The Environmental Effects Of Surface Mineral Workings Annex B: The Control of Dust at Surface Mineral Workings' (The Scottish Office, 1996);
- 'Controlling the Environmental Effects of Recycled and Secondary Aggregates Production Good Practice Guidance' (UK Office of Deputy Prime Minister, 2002);
- 'Controlling Particles, Vapours & Noise Pollution From Construction Sites' (BRE, 2003);
- 'Fugitive Dust Technical Information Document for the Best Available Control Measures' (USEPA, 1997); and
- 'Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition' (periodically updated) (USEPA, 1986).

8.6.1.1 Site Management

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

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

Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2 mm/day, dust generation is generally suppressed (UK Office of Deputy Prime Minister (2002), BRE (2003)). The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7 m above ground) to release loose material from storage piles and other exposed materials (USEPA, 1986). Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods where care will be needed to ensure that dust nuisance does not occur. The following measures shall be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions:

- The Principal Contractor or equivalent will monitor all subcontractors' performance to ensure that the proposed mitigation measures are implemented, and that dust impacts and nuisance are minimised;
- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions;
- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board will also include head/regional office contact details;
- Community engagement shall be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out;
- It is the responsibility of the contractor at all times to demonstrate full compliance with the dust control conditions herein; and
- The procedures put in place will be reviewed at regular intervals and monitoring conducted and recorded by the principal contractor. It is recommended that reviews are conducted on a monthly basis as a minimum.

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

8.6.1.2 Site Roads / Haulage Routes

Movement of construction trucks along site roads (particularly unpaved roads) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80% (UK Office of Deputy Prime Minister, 2002). The following measures shall be taken in order to avoid dust nuisance occurring:

- A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles using unpaved site roads;
- Access gates to the site will be located at least 10m from sensitive receptors where possible;
- Bowsers or suitable watering equipment will be available during periods of dry weather throughout the construction period. Research has found that watering can reduce dust emissions by 50% (USEPA, 1997). Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use; and

- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.

8.6.1.3 Land Clearing / Earth Moving

Land clearing/earth-moving works during periods of high winds and dry weather conditions can be a significant source of dust. The following measures shall be taken in order to avoid dust nuisance occurring:

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

8.6.1.4 Storage Piles

The location and moisture content of storage piles are important factors which determine their potential for dust emissions. The following measures will be implemented to minimise dust formation from storage piles:

- Overburden material will be protected from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles will be located downwind of sensitive receptors;
- Regular watering will take place to ensure the moisture content is high enough to increase the stability of the soil and thus suppress dust. The regular watering of stockpiles has been found to have an 80% control efficiency (UK Office of Deputy Prime Minister, 2002); and
- Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.

8.6.1.5 Site Traffic on Public Roads

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

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

8.6.1.6 Summary of Dust Mitigation Measures

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

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

8.6.2 Operational Phase

The stack heights of the data centre back-up diesel generators and energy centre engines for the Proposed Development have been designed in an iterative fashion to ensure that an adequate height has been selected to aid dispersion of the emissions and achieve compliance with the EU ambient air quality standards beyond the site boundary (including background concentrations). No additional mitigation measures are proposed for the operational phase of the Proposed Development.

In terms of climate, the opportunity to export heat from the data halls to a proposed Vertical Farm is considered. These farms require heating to the soil to promote growth internally, and so the heat from the data centres would be ideal and would not require the temperatures to be elevated any further, so no additional energy input.

8.6.3 Decommissioning Phase

The objective of dust control at the site during the decommissioning phase is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, a dust minimisation plan will be formulated for the decommissioning phase of the Proposed Development to ensure no dust nuisance occurs at nearby sensitive receptors.

8.7 PREDICTED IMPACTS OF THE DEVELOPMENT

8.7.1 Construction Phase

8.7.1.1 Air Quality

When the dust mitigation measures detailed in the mitigation section (section 8.6.1) of this report are implemented, fugitive emissions of dust and particulate matter from the site will be ***negative***, ***short-term*** and ***imperceptible*** in nature, posing no nuisance at nearby receptors.

8.7.1.2 Climate

The Institute of Air Quality Management *document 'Guidance on the Assessment of Dust from Demolition and Construction'* (IAQM, 2014) states that site traffic and plant is unlikely to make a significant impact on climate. Based on the scale and temporary nature of the construction works and the intermittent use of equipment, the potential impact on climate change and transboundary pollution from the Proposed Development is deemed to be ***short-term***, ***negative*** and ***imperceptible*** in relation to Ireland's obligations under the EU 2030 target.

8.7.1.3 Human Health

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

8.7.2 Operational Phase

8.7.2.1 Air Quality

Proposed Development (Worst-Case) Scenario (USEPA Methodology)

The NO_2 modelling results at the worst-case location at and beyond the site boundary are detailed in Table 8.5 using the USEPA methodology outlined within the guidance document titled *'Additional Clarification Regarding Application of Appendix W Modelling Guidance for the 1-Hour National Ambient Air Quality Standard'* (USEPA, 2011). This scenario involved the continuous operation of the energy centre gas engines, using SCR to reduce mass emissions to meet limits. It also included the emergency operation of 84 no. data centre back-up diesel generations associated the Proposed Development for 100 hours per year and emergency operation of the natural gas engines on backup diesel fuel oil for 24 hours per year, as well as considering scheduled testing for all 84 no. data centre back-up generators and 18 no. energy centre engines using back-up fuel oil. This is considered a worst-case assessment as historical data suggests that back-up diesel generators would typically only be required for 22 hours over a five-year period.

The results indicate that the ambient ground level concentrations are in compliance with the relevant air quality standards for NO_2. For the worst-case year modelled, emissions from the site lead to an ambient NO_2 concentration (including background) which is 72% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 92% of the annual limit value at the worst-case off-site receptor. Concentrations decrease with distance from the site boundary. The geographical variations in the 1 hour mean (99.8th percentile) and annual mean NO_2 ground level concentrations for the Proposed Development Scenario are illustrated as concentration contours in Figures 8.2 and 8.3.

Table 8.5 *NO_2 Dispersion Model Results – Proposed Development (Worst-Case) Scenario*

Pollutant/ Year	Averaging Period	Process Contribution NO_2 (µg/m^3)	Background Concentration (µg/m^3)	Predicted Environmental Concentration NO_2 (µg/m^3)	Limit Value (µg/m^3)	PEC as a % of Limit Value
NO_2 / 2016	Annual mean	19.6	14	33.6	40	84%
	99.8th%ile of 1-hr Means	112.2	28	140.2	200	70%
NO_2 / 2017	Annual mean	22.7	14	36.7	40	92%
	99.8th%ile of 1-hr Means	111.5	28	139.5	200	70%
NO_2 / 2018	Annual mean	21.1	14	35.1	40	88%
	99.8th%ile of 1-hr Means	108.3	28	136.3	200	68%
NO_2 / 2019	Annual mean	20.7	14	34.7	40	87%
	99.8th%ile of 1-hr Means	113.8	28	141.8	200	71%
NO_2 / 2020	Annual mean	22.2	14	36.2	40	91%
	99.8th%ile of 1-hr Means	116.1	28	144.1	200	72%

For this scenario the emissions of continuous operations and non-continuous operations have also been modelled separately. Table 8.6 details the NO_2 modelling results for the continuous operation of the energy centre gas engines. Table 8.7 details the NO_2 modelling results for the emergency operation and testing of the data centre backup generators, and the emergency operation and testing of the energy centre engines in diesel mode.

The results indicate that the ambient ground level concentrations are in compliance with the relevant air quality standards for NO_2. For the worst-case year modelled, emissions from the continuous operation of the energy centre gas engines lead to an ambient NO_2 concentration (including background) which is 50% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 72% of the annual limit value at the worst-case off-site receptor. Emissions from the emergency and testing operations lead to an ambient NO_2 concentration (including background) which is 86% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 72% of the annual limit value at the worst-case off-site receptor.

Table 8.6 *NO_2 Dispersion Model Results – Proposed Development (Worst-Case) Scenario: Continuous Operation of Energy Centre Gas Engines*

Pollutant/ Year	Averaging Period	Process Contribution NO_2 (µg/m³)	Background Concentration (µg/m³)	Predicted Environmental Concentration NO_2 (µg/m³)	Limit Value (µg/m³)	PEC as a % of Limit Value
NO_2 / 2016	Annual mean	13.2	14	27.2	40	68%
	99.8th%ile of 1-hr Means	71.3	28	99.3	200	50%
NO_2 / 2017	Annual mean	15.0	14	29.0	40	72%
	99.8th%ile of 1-hr Means	71.0	28	99.0	200	50%
NO_2 / 2018	Annual mean	14.0	14	28.0	40	70%
	99.8th%ile of 1-hr Means	70.8	28	98.8	200	49%
NO_2 / 2019	Annual mean	13.4	14	27.4	40	69%
	99.8th%ile of 1-hr Means	71.0	28	99.0	200	50%
NO_2 / 2020	Annual mean	15.4	14	29.4	40	73%
	99.8th%ile of 1-hr Means	71.1	28	99.1	200	50%

Table 8.7 *NO_2 Dispersion Model Results – Proposed Development (Worst-Case) Scenario: Emergency Operation and Testing*

Pollutant/ Year	Averaging Period	Process Contribution NO2 (µg/m3)	Background Concentration (µg/m3)	Predicted Environmental Concentration NO2 (µg/m3)	Limit Value (µg/m3)	PEC as a % of Limit Value
NO2 / 2016	Annual mean	17.8	14	31.8	40	79%
	99.8th%ile of 1-hr Means	111.7	28	139.7	200	70%
NO2 / 2017	Annual mean	20.3	14	34.3	40	86%
	99.8th%ile of 1-hr Means	111.0	28	139.0	200	69%
NO2 / 2018	Annual mean	19.2	14	33.2	40	83%
	99.8th%ile of 1-hr Means	107.8	28	135.8	200	68%
NO2 / 2019	Annual mean	19.3	14	33.3	40	83%
	99.8th%ile of 1-hr Means	113.8	28	141.8	200	71%
NO2 / 2020	Annual mean	19.7	14	33.7	40	84%
	99.8th%ile of 1-hr Means	115.8	28	143.8	200	72%

This scenarios assumed all six data halls and all 18 energy centre engines are operational simultaneously. In reality the Proposed Development will become operational in phases over a period of 4 – 5 years, with two data centre halls and six energy centre engines in operation for each phase. Initial emissions will therefore be lower than those reported here. Overall, the operational phase impact of the Proposed Development is considered ***long-term***, ***localised***, ***negative*** and ***slight***.

Proposed Development (Likely Average Operation) Scenario (USEPA Methodology)

This scenario involved the continuous operation of the energy centre gas engines, using SCR to reduce mass emissions by 95%. It also included the emergency operation of 84 no. data centre back-up diesel generations associated the Proposed Development for 100 hours per year and emergency operation of the natural gas engines on backup diesel fuel oil for 24 hours per year, as well as considering scheduled testing for all 84 no. data centre back-up generators and 18 no. energy centre engines using back-up fuel oil. The NO_2 modelling results at the worst-case location at and beyond the site boundary are detailed in Table 8.8.

The results indicate that the ambient ground level concentrations are in compliance with the relevant air quality standards for NO_2. For the worst-case year modelled, emissions from the site lead to an ambient NO_2 concentration (including background) which is 72% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 86% of the annual limit value at the worst-case off-site receptor. Concentrations decrease with distance from the site boundary.

Table 8.8 NO_2 Dispersion Model Results – Proposed Development (Likely Average Operation) Scenario

Pollutant/ Year	Averaging Period	Process Contribution NO_2 (µg/m^3)	Background Concentration (µg/m^3)	Predicted Environmental Concentration NO_2 (µg/m^3)	Limit Value (µg/m^3)	PEC as a % of Limit Value
NO_2 / 2016	Annual mean	18.1	14	32.1	40	80%
	99.8th%ile of 1-hr Means	112.1	28	140.1	200	70%
NO_2 / 2017	Annual mean	20.6	14	34.6	40	86%
	99.8th%ile of 1-hr Means	111.2	28	139.2	200	70%
NO_2 / 2018	Annual mean	19.6	14	33.6	40	84%
	99.8th%ile of 1-hr Means	108.1	28	136.1	200	68%
NO_2 / 2019	Annual mean	19.6	14	33.6	40	84%
	99.8th%ile of 1-hr Means	113.8	28	141.8	200	71%
NO_2 / 2020	Annual mean	20.1	14	34.1	40	85%
	99.8th%ile of 1-hr Means	115.8	28	143.8	200	72%

For this scenario the emissions of continuous operations and non-continuous operations have also been modelled separately. Table 8.9 details the NO_2 modelling results for the continuous operation of the energy centre gas engines. Table 8.10 details the NO_2 modelling results for the emergency operation and testing of the data centre backup generators, and the emergency operation and testing of the energy centre engines in diesel mode.

The results indicate that the ambient ground level concentrations are in compliance with the relevant air quality standards for NO_2. For the worst-case year modelled, emissions from the continuous operation of the energy centre gas engines lead to an ambient NO_2 concentration (including background) which is 27% of the maximum ambient 1-hour limit value (measured as a 99.8^{th} percentile) and 44% of the annual limit value at the worst-case off-site receptor. Emissions from the emergency and testing operations lead to an ambient NO_2 concentration (including background) which is 72% of the maximum ambient 1-hour limit value (measured as a 99.8^{th} percentile) and 86% of the annual limit value at the worst-case off-site receptor.

Table 8.9 *NO_2 Dispersion Model Results – Proposed Development (Likely Average Operation) Scenario: Continuous Operation of Energy Centre Gas Engines*

Pollutant/ Year	Averaging Period	Process Contribution NO_2 (µg/m³)	Background Concentration (µg/m³)	Predicted Environmental Concentration NO_2 (µg/m³)	Limit Value (µg/m³)	PEC as a % of Limit Value
NO_2 / 2016	Annual mean	2.9	14	16.9	40	42%
	99.8th%ile of 1-hr Means	25.6	28	53.6	200	27%
NO_2 / 2017	Annual mean	3.5	14	17.5	40	44%
	99.8th%ile of 1-hr Means	26.4	28	54.4	200	27%
NO_2 / 2018	Annual mean	3.1	14	17.1	40	43%
	99.8th%ile of 1-hr Means	26.2	28	54.2	200	27%
NO_2 / 2019	Annual mean	3.1	14	17.1	40	43%
	99.8th%ile of 1-hr Means	26.2	28	54.2	200	27%
NO_2 / 2020	Annual mean	3.3	14	17.3	40	43%
	99.8th%ile of 1-hr Means	26.0	28	54.0	200	27%

Table 8.10 *NO_2 Dispersion Model Results – Proposed Development (Likely Average Operation) Scenario: Emergency Operation and Testing*

Pollutant/ Year	Averaging Period	Process Contribution NO_2 (µg/m^3)	Background Concentration (µg/m^3)	Predicted Environmental Concentration NO_2 (µg/m^3)	Limit Value (µg/m^3)	PEC as a % of Limit Value
NO_2 / 2016	Annual mean	17.9	14	31.9	40	80%
	99.8th%ile of 1-hr Means	112.0	28	140.0	200	70%
NO_2 / 2017	Annual mean	20.4	14	34.4	40	86%
	99.8th%ile of 1-hr Means	111.2	28	139.2	200	70%
NO_2 / 2018	Annual mean	19.3	14	33.3	40	83%
	99.8th%ile of 1-hr Means	108.0	28	136.0	200	68%
NO_2 / 2019	Annual mean	19.4	14	33.4	40	83%
	99.8th%ile of 1-hr Means	113.8	28	141.8	200	71%
NO_2 / 2020	Annual mean	19.8	14	33.8	40	84%
	99.8th%ile of 1-hr Means	115.8	28	143.8	200	72%

This scenarios assumed all six data halls and all 18 energy centre engines are operational simultaneously. In reality the Proposed Development will become operational in phases over a period of 4 – 5 years, with two data centre halls and six energy centre engines in operation for each phase. Initial emissions will therefore be lower than those reported here. Overall, the operational phase impact of the Proposed Development on human health is considered ***long-term***, ***localised***, ***negative*** and ***slight***.

<u>*Proposed Development (Worst-Case) Scenario (UK Environment Agency Methodology)*</u>

The methodology, based on considering the statistical likelihood of an exceedance of the NO_2 hourly limit value assuming a hypergeometric distribution and which identifies the number of hours the back-up generators can operate before there is a likelihood of an exceedance, has been undertaken at the worst-case residential receptor for the Proposed Development Scenario. This scenario involved the emergency operation of 84 no. data centre back-up generators on the site. This methodology allows a comparison to be made between the maximum number of hours which the back-up generators can operate without exceeding the ambient air quality standards and the historical frequency of power outage. As outlined below the maximum number of hours the back-up generators can operate is 99 hours per year whilst the historical data suggests that back-up operation of the generators is only likely to be required for 22 hours overs a five-year period. Thus, the assessment shows there is adequate flexibility to allow for the operation of the back-up generators during any foreseeable power outages.

The cumulative hypergeometric distribution of 19 and more hours per year is computed and the probability of an exceedance determined as outlined in Table 8.11. The results have been compared to the 98th percentile confidence level to indicate if an exceedance is likely at various operational hours for the back-up diesel generators. The results indicate that in the worst-case year, the emergency generators for the Proposed Development can operate for up to 99 hours per year before there is a likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level). Figure 8.4 shows the statistical distribution predicted for the 98th percentile (based on 99 hours of operation per year). However, the UK guidance recommends that there should be no running time restrictions placed on back-up generators which provide power on site only during an emergency power outage.

Table 8.11 Hypergeometric Statistical Results at Worst-Case Residential Receptor – NO_2 Proposed Development (Worst-Case) Scenario

Pollutant/ Year	Hours of operation (Hours) (98th%ile) Allowed Prior To Exceedance Of Limit Value	UK Guidance – Probability Value = 0.02 (98th%ile) Note 1
NO_2 / 2016	133	0.02
NO_2 / 2017	99	
NO_2 / 2018	123	
NO_2 / 2019	119	
NO_2 / 2020	128	

Note 1 Guidance Outlined In UK EA publication "Diesel Generator Short-term NO_2 Impact Assessment" (EA, 2016)

8.7.2.2 Climate

Climate change has the potential to alter weather patterns and increase the frequency of rainfall in future years. As a result of this there is the potential for flooding related impacts on site in future years. A detailed flood risk assessment has been undertaken as part of this planning application and adequate attenuation and drainage have been provided for to account for increased rainfall in future years. Therefore, the impact will be ***imperceptible***.

Electricity providers form part of the EU-wide Emission Trading Scheme (ETS) and thus greenhouse gas emissions from these electricity generators are not included when determining compliance with the targeted 30% reduction in the non-ETS sector i.e. electricity associated greenhouse gas emissions will not count towards the Effort Sharing Decision target. Thus, any necessary increase in electricity generation due to data centre demand will have no impact on Ireland's obligation to meet the EU Effort Sharing Decision. Under this scenario, as outlined in the Regulation, the new electricity provider will be treated as a "new entrant" under Phase IV of the ETS (i.e. an electricity generator obtaining a greenhouse gas emissions permit for the first time after 30th June 2018). The new electricity provider will be required to purchase allocations in the same manner as existing players in the market using the European Energy Exchange. EU leaders have also decided that during Phase IV (2021-2030) 90% of the revenue from the auctions will be allocated to the Member States on the basis of their share of verified emissions with 10% allocated to the least wealthy EU member states. The revised EU ETS Directive has enshrined in law the requirement that at least 50% of the auctioning revenues or the equivalent in financial value should be used for climate and energy related purposes.

In 2018, the market reported a fall of 4.1% (73 million tonnes CO_2eq) from 2017, the EU noted that much of the revenue raised by the cap and trade scheme is going towards climate and energy objectives (European Commission, 2019):

"In 2018, a strengthened carbon price signal led to a record amount of revenues for Member States from the selling of ETS allowances. The generated amount equalled some EUR 14 billion - more than doubling the revenues generated in 2017. Member States spent or planned to spend close to 70% of these revenues on advancing climate and energy objectives - well above the 50% required in the legislation"

In terms of the Proposed Development, as the facility generates over the threshold of 20 MW, a greenhouse gas emission permit will be required which will be regulated under the ETS scheme also. Thus, whether the facility is operated by electricity or gas engines onsite, the emissions are not included when determining compliance with the targeted 30% reduction in the non-ETS sector. In addition, on a EU-wide basis, where the ETS market in 2018 is approximately 1,655 million tonnes CO_2eq, the impact of the emissions associated with the proposed development will be less than 0.040% of the total EU-wide ETS market which is imperceptible.

In terms of wider energy policy, as outlined in the EPA publication "*Ireland's Greenhouse Gas Projections 2019-2040*" (EPA, 2020e) under the With Additional Measures scenario, emissions from the energy industries sector are projected to decrease by 34% to 7 Mt CO_2eq over the period 2019 to 2030 including the proposed increase in renewable energy generation to approximately 70% of electricity consumption:

- "*In this scenario it is assumed that for 2020 there is a 36.3% share of renewable energy in electricity generation. In 2030 it is estimated that renewable energy generation increases to approximately 70% of electricity consumption. This is mainly a result of further expansion in wind energy (comprising 3.5 GW offshore and approximately 8.2 GW onshore). Expansion of other renewables (e.g. solar photovoltaics) also occurs under this scenario;*
- *Under the With Additional Measures scenario two peat stations are assumed to run on 100% peat to the end of 2020 but PSO support finishes at the end of 2019. For 2020 the operation of the peat plants is determined by the electricity market. The third peat station operates to the end of 2023 with 30% co-firing;*
- *In this scenario the Moneypoint power station is assumed to operate in the market up to end 2024 at which point it no longer generates electricity from coal as set out in the Climate Action Plan; and*
- *In terms of inter-connection, it is assumed that the Greenlink 500MW interconnector to the UK to come on stream in 2025 and the Celtic 700MW interconnector to France to come on stream in 2026*". (EPA, 2020e)

Data centres are typically 84% more efficient than on-premises servers and the GHG savings associated with this are not included in the GHG emissions total. In addition, in terms of total forecasted capacity, it is predicted that 1,700MW of data centres capacity will be operational by 2025 in Ireland. However, the carbon intensity of electricity is predicted to decrease from 331 gCO_2/kWh in 2019 to 100 gCO_2/kWh in 2030 as a result of the increase in renewables to 70% of the electricity market by 2030. Overall, it is predicted that data centres will peak at 2.2% of total GHG emissions in 2024 and will fall or level off after this date.

The indirect CO_2 emissions from electricity to operate the facility will not be significant in relation to Ireland's national annual CO_2 emissions. A Report titled *'Energy Related CO_2 Emissions In Ireland 2005 – 2018 (2019 Report)'* published by the Sustainable Energy Authority of Ireland (SEAI, 2020) states the average CO_2 emission factor for electricity generated in Ireland was 375 gCO_2/kWh in 2018. This average CO_2 emission factor is based on the national power generating portfolio. On the basis that the Proposed Development will consume 200 MW of power this equates to 1752 GWh annually based on the assumption of the national fuel mix. This translates to approximately 657,000 tonnes of CO_2eq per year. This will have an ***indirect***, ***long-term***, ***negative*** and ***slight*** impact on climate.

In terms of air quality it is appropriate to limit the cumulative assessment to regions where there will be significant overlap between the facilities and thus the cumulative assessment was limited to the site. In terms of climate, again it is appropriate to review the facility. As emissions from the onsite energy centre and electricity purchased will both form part of the EU-wide ETS scheme, the relevant cumulative impact would be the EU as a whole rather than Ireland. However, as highlighted above, the facility's impact will be less than 0.040% of the total EU-wide ETS market thus the cumulative impact will lead to an ***indirect***, ***long-term***, ***negative*** and ***slight*** impact on climate.

In addition, in terms of total forecasted capacity, it is predicted that 1,700MW of data centres capacity will be operational by 2025. However, the carbon intensity of electricity is predicted to decrease from 331 gCO_2/kWh in 2019 to 100 gCO_2/kWh in 2030 as a result of the increase in renewables to 70% of the electricity market by 2030. Overall, it is predicted that data centres will peak at 2.2% of total GHG emissions in 2024 and will fall or level off after this date (Host In Ireland, 2020).

8.7.2.3 Regional Air Quality

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 National Emission Ceiling Directive 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 and $PM_{2.5}$ as detailed in Section 8.2.1.3.

Assuming that 200 MW is generated using the national fuel mix for the data centre, the NO_X emissions associated with this electricity over the course of one year (i.e. 1,752 GWh based on 200MW for 8,760 hours per annum) will equate to 584 tonnes per annum which is 0.90% of the National Emission Ceiling limit for Ireland from 2020 onwards. Similarly, SO_2 emissions associated this electricity over the course of one year (1,752 GWh) will equate to 221 tonnes per annum which is 0.53% of the National Emission Ceiling limit for Ireland from 2020. Additionally, NMVOC emissions associated this electricity over the course of one year (1,752 GWh) will equate to 664 tonnes per annum which is 1.21% of the National Emission Ceiling limit for Ireland from 2020. This range of increases (0.5 – 1.2%) in concentrations of NO_X, SO_2 and NMVOC indirect emissions associated with the operation of the Proposed Development is considered ***indirect***, ***long-term***, ***negative*** and ***slight*** with regards to regional air quality.

As discussed in Chapter 2 of this EIA Report, the Proposed Development's energy sources also consist of energy from solar panels to be installed where feasible on data centre buildings and heat pumps serving both the energy and data centres, as well as the main supply of natural gas. With these sources the Proposed Development is in compliance with the Building Regulations Technical Guidance Document (TGD) Part L 2017 (NZEB) Part L 2017 - Conservation of Fuel and Energy – 'Buildings other than Dwellings'.

8.7.2.4 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. The construction and decommissioning phases of the development will not lead to exceedances of the relevant ambient air quality standards and thus will not have a significant effect on human health.

In terms of the operational phase, as demonstrated by the dispersion modelling results, emissions from the site, assuming scheduled testing as well as emergency operation of the back-up generators, are compliant with all National and EU ambient air quality limit values and, therefore, will not result in a significant impact on human health. In relation to the spatial extent of air quality impacts from the site, ambient concentrations will decrease significantly with distance from the site boundary. Further details of the potential impacts on human health associated with the Proposed Development are discussed in Chapter 4 of this EIA Report.

8.7.2.5 Impact of NO_X on Designated Habitat Sites

The impact of emissions of NO_X within 20 km of the Proposed Development and existing emission points on ambient ground level concentrations within the following designated habitat sites was assessed using AERMOD. The 20km distance was selected based on maximum extent of the impact zone from the air emissions onsite. After 20km, the ambient air concentration of NO_X due to emissions from the facility are imperceptible.

- **Proposed Natural Heritage Areas (pNHA)** – Ballycar Lough pNHA, Cahircalla Wood pNHA, Dromoland Lough pNHA, Durra Castle pNHA, Fergus Estuary And Inner Shannon pNHA, North Shore pNHA, Fin Lough (Clare) pNHA, Inchicronan Lough pNHA, Lough Cleggan pNHA, Lough Cullaunyheeda pNHA, Newpark House (Ennis) pNHA, Poulnagordon Cave (Quin) pNHA, Rosroe Lough pNHA;
- **Natural Heritage Areas (NHA)** – Maghere Mountain Bogs NHA, Oysterman's Marsh NHA;
- **Special Areas of Conservation (SAC)** – Ballyallia Lake SAC/pNHA, Ballycullinan Lake SAC/pNHA, Ballycullinan Old Domestic Building SAC, Dromore Woods And Loughs SAC/pNHA, East Burren Complex SAC/pNHA, Knockanira House SAC, Lower River Shannon SAC, Moyree River System SAC/pNHA, Newgrove House SAC, Newhall And Edenvale Complex SAC/pNHA, Old Domestic Building (Keevagh) SAC/pNHA, Old Domestic Buildings, Rylane SAC, Old Farm Buildings, Ballymacrogan SAC, Pouladatig Cave SAC/pNHA, Poulnagordon Cave (Quin) SAC, Toonagh Estate SAC; and
- **Special Protection Area (SPA)** – Ballyallia Lough SPA, Corofin Wetlands SPA, River Shannon and River Fergus Estuaries SPA, and Slieve Aughty Mountains SPA.

An annual limit value of 30 $\mu g/m^3$ for NO_X is specified within EU Directive 2008/50/EC for the protection of ecosystems. The NO_X limit value is applicable only in highly rural areas away from major sources of NO_X such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex III of EU Directive 2008/50/EC identifies that monitoring to demonstrate compliance with the NO_X limit value for the protection of vegetation should be carried out distances greater than:

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

There are sections of designated sites which are near the Proposed Development that are within an urban setting, so the limit value for NO_X for the protection of ecosystems is not technically applicable at these sites. Regardless, the annual average concentrations for NO_X from all emission points at the Proposed Development were predicted at receptors within the designated sites for all five years of meteorological data modelled (2016 – 2020). The receptor spacing ranged from 25 m to 100 m with 2,486 discrete receptors modelled in total within the sensitive ecosystems.

The NO_X modelling results are detailed in Table 8.12. Emissions from the facility lead to an ambient NO_X concentration (excluding background) which ranges from 6 – 7% of the annual limit value at the worst-case location within the designated sites over the five years of meteorological data modelled. In addition, modelling results based on conservative assumptions indicate that the Proposed Development combined with background concentrations will have an slight impact on NO_X concentrations within the sensitive ecosystems contributing at most 70% of the limit value at the worst-case location in the worst-case year modelled.

Table 8.12 *Modelled NO_X Concentrations (µg/m³) Within the Modelled Ecological Receptors for all Emission Points at the Proposed Development*

Pollutant/ Year	Averaging Period	Process Contribution NO_X (µg/m³)	Background Concentration (µg/m³)	Predicted Environmental Concentration NO_X (µg/m³)	Limit Value (µg/m3) Note 1	PEC as a % of Limit Value
NO_X / 2016	Annual mean	2.0	19	21.0	30	70%
NO_X / 2017	Annual mean	1.9	19	20.9	30	70%
NO_X / 2018	Annual mean	1.8	19	20.8	30	69%
NO_X / 2019	Annual mean	1.8	19	20.8	30	69%
NO_X / 2020	Annual mean	1.5	19	19.0	30	68%

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

In order to consider the effects of nitrogen deposition owing to emissions from the Proposed Development on the designated habitat sites, the NO_X concentrations determined above in Table 8.12 must be converted firstly into a dry deposition flux using the equation below which is taken from UK Environment Agency publication "AGTAG06 – Technical Guidance On Detailed Modelling Approach For An Appropriate Assessment For Emissions To Air" (EA, 2014):

Dry deposition flux (µg/m²/s) = ground-level concentration (µg/m³) x deposition velocity (m/s)

The deposition velocities for NO_X are outlined in AQTAG06 (EA, 2014). A deposition velocity of 0.0015 m/s for grassland has been used. The dry deposition flux is then multiplied by a conversion factor of 95.9 (taken from AQTAG06 (EA, 2014)) to convert it to a nitrogen (N) deposition flux (kg/ha/yr).

The N deposition flux for the worst-case year is 3.02 kg/ha/yr and is below the range in worst-case critical loads for the various vegetation types of 5-10 kg/ha/yr (UNECE, 2010). Consultation with the ecologist confirms that the effects of nitrogen deposition on designated sites due to the Proposed Scheme are not significant.

Overall, the operational phase impact of the Proposed Development on designated habitat sites is considered ***long-term***, ***localised***, ***negative*** and ***imperceptible***.

8.7.2.6 Impact of NO_X on Onsite Sensitive Habitats

There are also sensitive habitats without National or European designations within the site boundary. As outlined above, the annual limit value of 30 µg/m³ for NO_X is specified within EU Directive 2008/50/EC for the protection of ecosystems. However, this standard should not be applied to areas which fall into the following categories:

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

Thus, onsite levels of NO_X are exempt from the application of the EU standard for the protection of ecosystems. Nevertheless, the results from the assessment are outlined below.

The NO_X modelling results are detailed in Table 8.13, to demonstrate the worst-case change in ambient concentration of NO_X these habitats are predicted to experience due to the Proposed Development. Emissions from the facility lead to an ambient NO_X concentration (excluding background) which ranges from 43.6 - 56.4 µg/m³ at the worst-case location within the site over the five years of meteorological data modelled. In addition, modelling results based on conservative assumptions indicate that the Proposed Development combined with background concentrations lead to an ambient NO_X concentration which ranges from 62.6 - 75.4 µg/m³ at the worst-case location within the site over the five years of meteorological data modelled

In terms of deposition, the habitat onsite includes rich fen (including Alkaline fens), wet grassland (including Molinia meadows), marsh, reed and large sedge swamps and various types of woodland (see Chapter 7 (Biodiversity) for further details). The maximum Nitrogen (N) deposition flux for the worst-case year is 10.86 kg/ha/yr. This can be compared to the range of critical loads for the various onsite habitats outlined in the UNECE 2010 Report "Empirical Critical Loads And Dose-Response Relationships". Rich fen critical loads range from 15-30 kg/ha/yr, wet grassland range from 10-20 kg/ha/yr, Molinia meadows ranged from 15-25 kg/ha/yr, marshes range from 20-30 kg/ha/yr whilst woodland ranged from 10-20 kg/ha/yr (UNECE, 2010). Thus the maximum critical load of N is below the upper ranges of all habitats onsite and also below most of the lower ranges of the onsite habitat sites also.

Table 8.13 *Modelled NO_X Concentrations (µg/m³) Within the On-Site Modelled Ecological Receptors for all Emission Points at the Proposed Development*

Pollutant/ Year	Averaging Period	Process Contribution NO_X (µg/m³)	Background Concentration (µg/m³)	Predicted Environmental Concentration NO_X (µg/m³)
NO_X / 2016	Annual mean	55.3	19	74.3
NO_X / 2017	Annual mean	44.5	19	63.5
NO_X / 2018	Annual mean	48.0	19	67.0
NO_X / 2019	Annual mean	56.4	19	75.4
NO_X / 2020	Annual mean	43.6	19	62.6

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

8.8 CUMULATIVE IMPACTS

A review of licensed facilities in the surrounding area has been conducted and none have been identified with the potential for cumulative impact with the Proposed Development. Consideration of all developments identified in Chapter 3 Appendix 3.1 was also undertaken and no potential for cumulative impact with the Proposed Development was identified as the planned developments have no or negligible potential for NO_2 emissions.

In terms of climate, emissions from the onsite energy centre and electricity purchased will both form part of the EU-wide ETS scheme, the relevant cumulative impact would be the EU as a whole rather than Ireland. However, the facility's impact will be less than 0.040% of the total EU-wide ETS market thus the cumulative impact will lead to an ***indirect***, ***long-term***, ***negative*** and ***slight*** impact on climate.

8.9 RESIDUAL IMPACTS

Once the mitigation measures outlined in Section 8.6 are implemented, the residual impacts on air quality or climate from the construction of the Proposed Development will be ***short-term*** and ***imperceptible***. In terms of human health, the operational phases of the Proposed Development will be ***long-term***, ***negative*** and ***slight***. In relation to designated habitat sites, the construction and operational phase impacts of the Proposed Development on designated habitat sites is considered ***long-term***, ***localised***, ***negative*** and ***imperceptible***.

Interactions are presented in Chapter 15.

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FIGURES

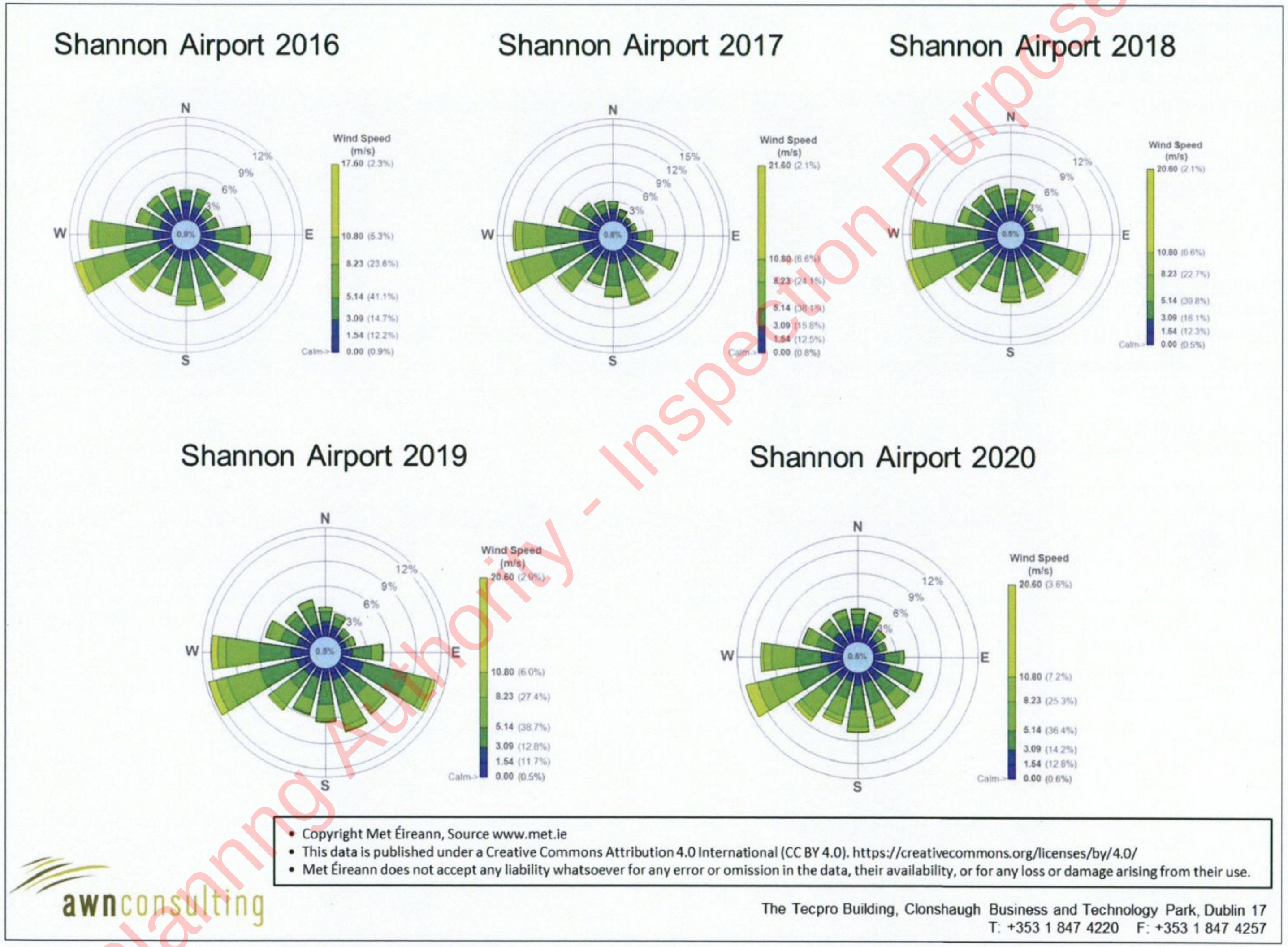

Figure 8.1 *Shannon Airport Windrose 2016 – 2020*

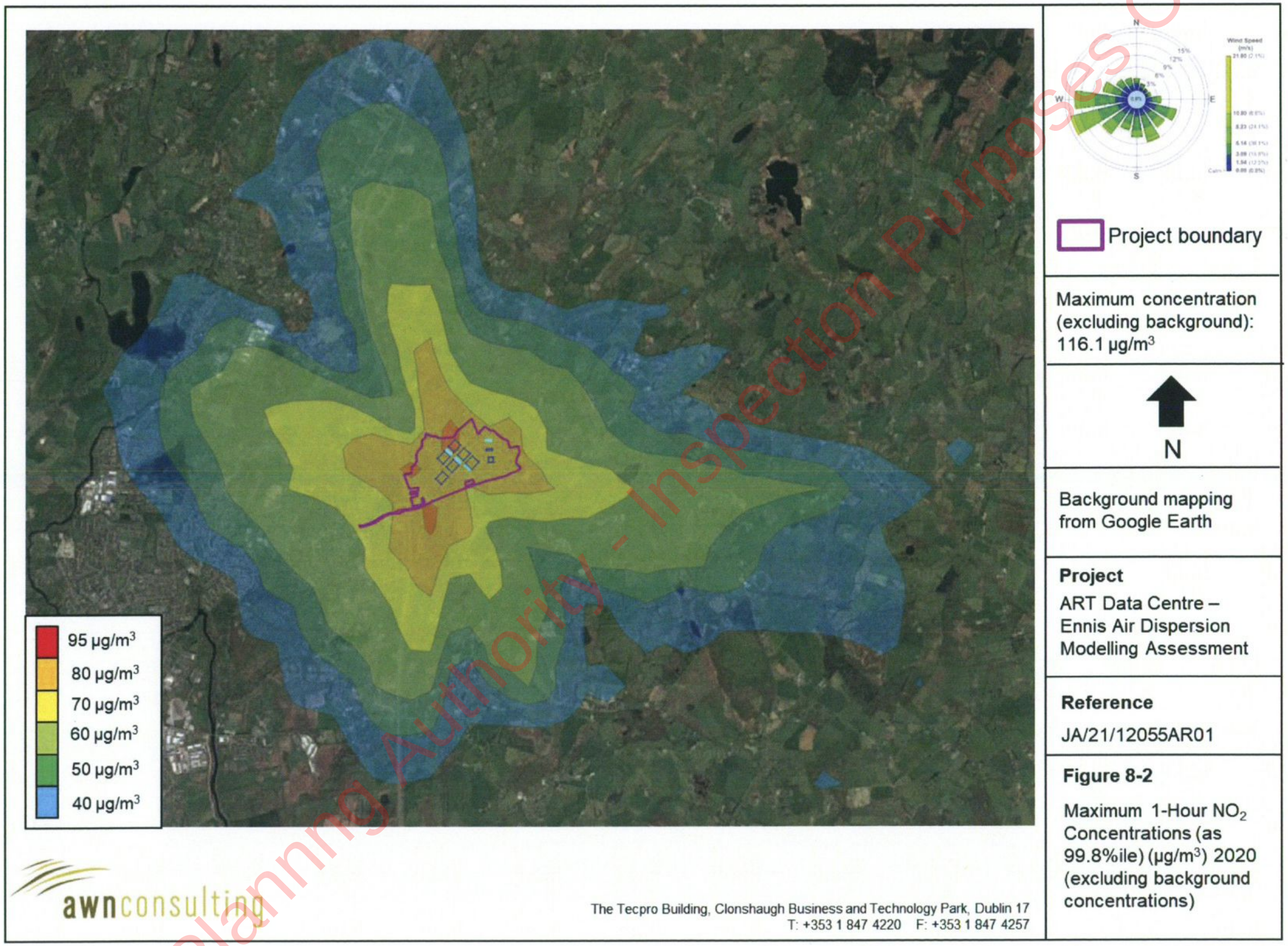

Figure 8.2 *Maximum 1-Hour NO_2 Concentrations (as 99.8%ile) (µg/m^3) 2020 (excluding background concentrations)*

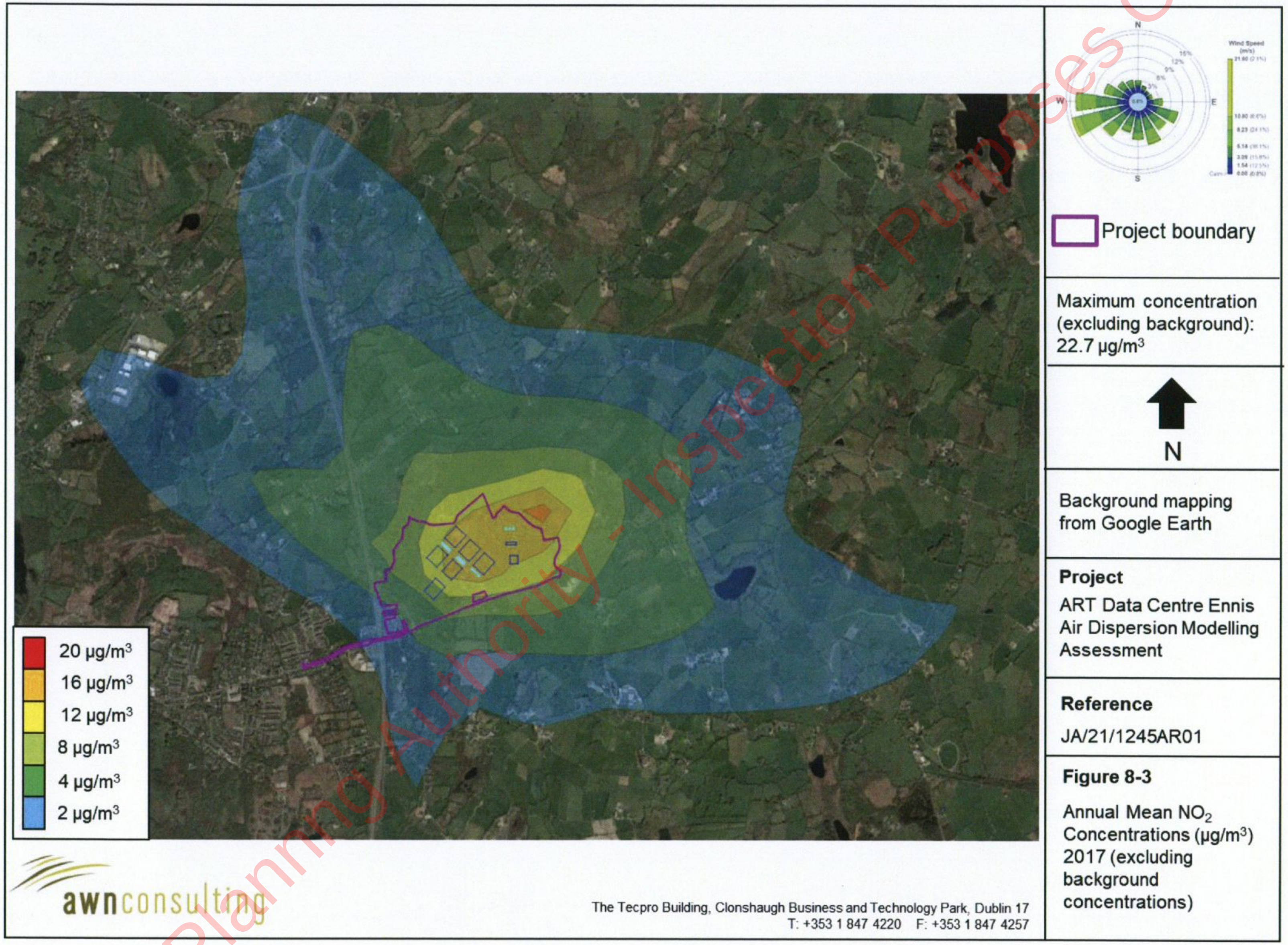

Figure 8.3 *Annual Mean NO_2 Concentrations (µg/m³) 2017 (excluding background concentrations)j*

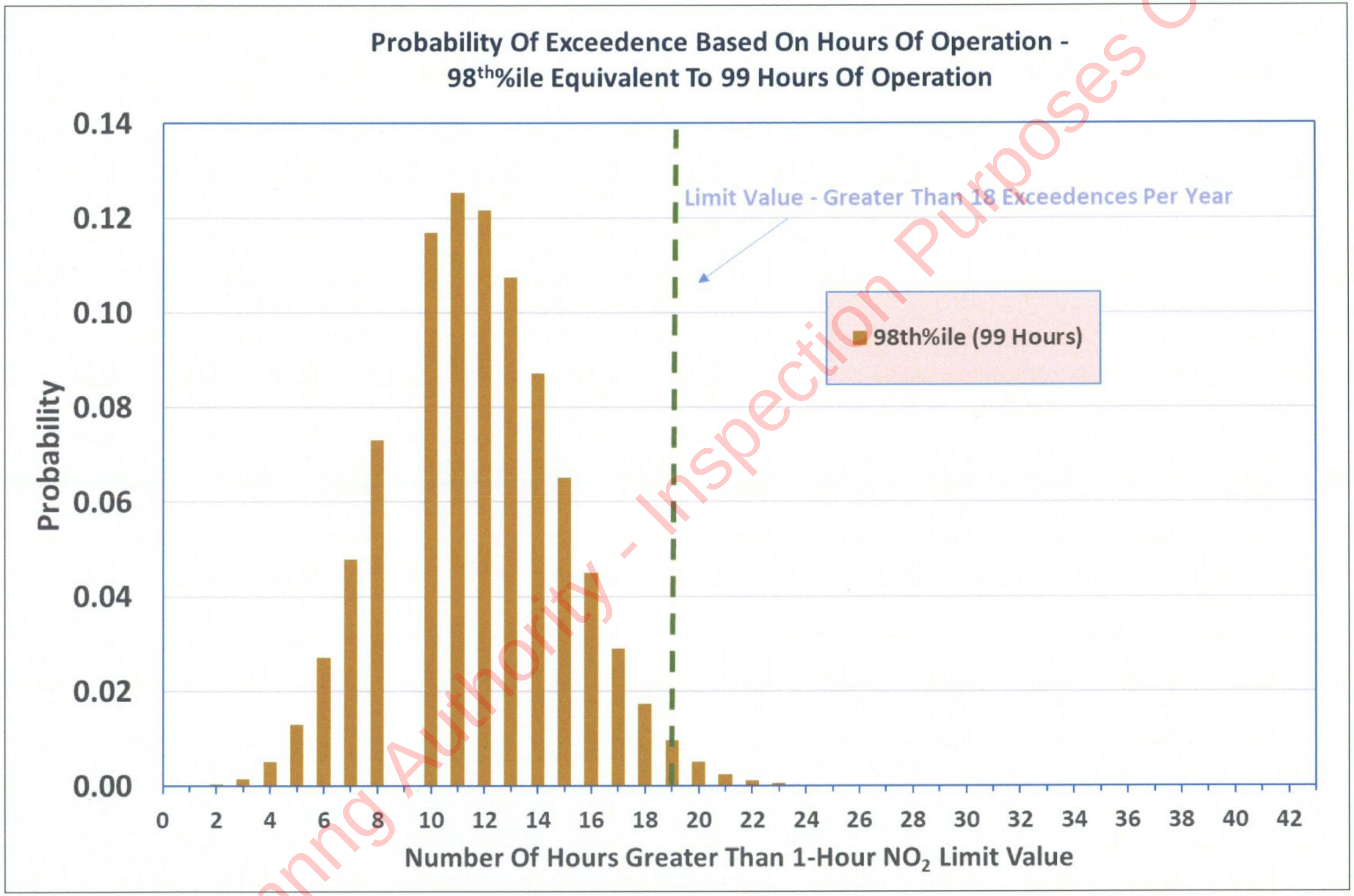

Figure 8.4 *Probability of Exceedance of 1-Hour NO_2 Ambient Air Quality Limit Value based on Hours of Operation for Emergency Generators for Proposed Development*