Appropriate Assessment Screening Report

For the Google Ireland Data Centre IE Licence Application

prepared for PM Group

on behalf of Google Ireland

Scott Cawley, College House, 71 – 73 Rock Road, Blackrock, Co. Dublin, A94 F9X9, Ireland

Tel+353(1)676-9815 Fax +353(1) 676-9816

Document Control

Project Title	Google Ireland Data Centre IE Licence Application		Project No.	220085
Document Title	Appropriate Assessment Screening Report		**Status**	Final
Revision	**Issue Date**	**Author**	**Reviewed By**	**Approved By**
I1	22/11/2022	KWB	CK	AS

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1 Introduction

1 This report, which contains information required for the competent authority to undertake a screening for Appropriate Assessment (AA), has been prepared by Scott Cawley Ltd. on behalf of the applicant. It provides information on, and assesses the potential for, the project to impact on the Natura 2000 network (hereafter referred to as European sites). The Natura 2000 network is a European network of important ecological sites, as defined under Article 3 of the Habitats Directive 92/43/EEC, which comprises both special areas of conservation and special protection areas. Special conservation areas are sites hosting the natural habitat types listed in Annex I, and habitats of the species listed in Annex II, of the Habitats Directive, and are established under the Habitats Directive itself. Special protection areas are established under Article 4 of the Birds Directive 2009/147/EC for the protection of endangered species of wild birds. The aim of the network is to aid the long-term survival of Europe's most valuable and threatened species and habitats. In Ireland these sites are designed as European sites - defined under the Planning Acts and/or the Birds and Habitats Regulations as:

- A candidate site of Community importance
- A site of Community importance
- A candidate special area of conservation
- A special area of conservation
- A candidate special protection area, or
- A special protection area.

2 These are commonly referred to in Ireland as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

3 The project consists of an Industrial Emissions (IE) licence application to the Environmental Protection Agency (EPA) for the operation of the existing Google Ireland Data Centre in Grange Castle Business Park South, Baldonnel Rd, Dublin 22, D22 X602.

4 An AA is required if significant effects on European sites arising from the project cannot be ruled out at the screening stage, either alone or in combination with other plans or projects. It is the responsibility of the competent authority to make a decision as to whether or not the project is likely to have significant effects on European sites, either individually or in combination with other plans or projects.

For the reasons set out in detail in this AA Screening Report, an **Appropriate Assessment of the project is not required in this instance** as it can be concluded, on the basis of objective information, that the project, either individually or in combination with other plans or projects, will not have a significant effect on any European sites.

2 Methodology

2.1 Guidance

5 This Appropriate Assessment Screening Report has been prepared with regard to the following guidance documents, as relevant:

- *OPR Practice Note PN01. Appropriate Assessment Screening for Development Management* (Office of the Planning Regulator, 2021)
- *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities*. (Department of Environment, Heritage and Local Government, 2010 revision)
- *Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities*. Circular NPW 1/10 & PSSP 2/10

- *Assessment of Plans and Projects in Relation to Natura 2000 sites: Methodological Guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (European Commission, 2021)
- *Communication from the Commission on the precautionary principle* (European Commission, 2000), and
- *Managing Natura 2000 Sites: The Provisions of Article 6 of the Habitat's Directive 92/43/EEC* (European Commission, 2019)

2.2 Assessment Methodology

6 The above referenced guidance sets out a staged process for carrying out Appropriate Assessment. To determine if an Appropriate Assessment is required, documented screening is required. Screening identifies the potential for effects on the conservation objectives of European sites, if any, which would arise from a proposed plan or project, either alone or in combination with other plans and projects (i.e. likely significant effects).

7 Significant effects on a European site are those that would undermine the conservation objectives supporting the favourable conservation condition of the Qualifying Interest (QI) habitats and/or the QI/Special Conservation Interest (SCI) species of a European site(s).

8 Screening for Appropriate Assessment involves the following steps:

Determining whether the project is directly connected with, or necessary to the conservation management of, any European site(s)

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Describing the details of the project

↓

Describing the receiving environment

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Assessment of effects on European sites

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Identifying all the potential impacts of the project on the receiving environment

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Defining the zone of influence of the project on the receiving environment

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Identifying the European site(s) within the zone of influence of the project

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Assessing whether the potential impacts associated with the project will undermine the conservation objectives of any European site(s),

either alone or in combination with other plans or projects

↓

Conclusions of screening assessment process

9 If the conclusions at the end of screening are that there is no likelihood of significant effects occurring on any European sites as a result of the proposed plan or project, either alone or in combination with other plans and projects, then there is no requirement to undertake an Appropriate Assessment.

10 In establishing which European sites are potentially at risk (in the absence of mitigation) from the project, a source-pathway-receptor approach was applied. In order for an impact to occur, there must be a risk enabled by having a source (e.g. water abstraction or construction works), a receptor (e.g. a European site or its QI(s) or SCI(s)[1]), and a pathway between the source and the receptor (e.g. pathway by air for airborne pollution, or a pathway by a watercourse for mobilisation of pollution). For an impact to occur, all three elements must exist; the absence or removal of one of the elements means there is no possibility for the impact to occur.

11 The identification of source-pathway-receptor connection(s) between the project and European sites essentially is the process of identifying which European sites are within the Zone of Influence (ZoI) of the project, and therefore potentially at risk of significant effects. The ZoI is the area over which the project could affect the receiving environment such that it could potentially have significant effects on the QI habitats or QI/SCI species of a European site, or on the achievement of their conservation objectives[2].

12 The identification of a source-pathway-receptor link does not automatically mean that significant effects will arise. The likelihood for significant effects will depend upon the characteristics of the source (e.g. extent and duration of construction works), the characteristics of the pathway (e.g. direction and strength of prevailing winds for airborne pollution) and the characteristics of the receptor (e.g. the sensitivities of the European site and its QIs/SCIs).

13 The ‘likely significant effects’ test is based on the precautionary principle[3]. The precautionary principle means that, based on the most reliable available information, where there is uncertainty or doubt as to the absence of significant effects, the project cannot be screened out and an appropriate assessment must be carried out.

2.3 Desktop Data Review

14 The desktop data sources used to inform the assessment presented in this report are as follows (accessed on the 27th September 2022):

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[1] The term qualifying interest is used when referring to the habitats or species for which an SAC is designated; the term special conservation interest is used when referring to the bird species (or wetland habitats) for which an SPA is designated.

[2] As defined in the *Guidelines for Ecological Impact Assessment in the UK and Ireland* (CIEEM, 2018)

[3] The precautionary principle is a guiding principle that derives from Article 191 of the Treaty on the Functioning of the European Union and has been developed in the case law of the European Court of Justice (e.g. ECJ case C-127/02 – Waddenzee, Netherlands).

The guidance document *Communication from the Commission on the Precautionary Principle* (European Commission, 2000) notes that the precautionary principle “*covers those specific circumstances where scientific evidence is insufficient, inconclusive or uncertain and there are indications through preliminary objective scientific evaluation that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the chosen level of protection*”..

- Online data available on European sites and protected habitats/species as held by the National Parks and Wildlife Service (NPWS) from www.npws.ie[4], including conservation objectives documents
- Online data available on protected species as held by the National Biodiversity Data Centre (NBDC) from www.biodiversityireland.ie
- Information on the surface water network and surface water quality in the area available from www.epa.ie
- Information on groundwater resources and groundwater quality in the area available from www.epa.ie and www.gsi.ie
- Ordnance Survey of Ireland mapping and aerial photography available from www.osi.ie
- Information on the location, nature and design of the project supplied by the applicant's design team
- Google Ireland Cumulative Air Quality Modelling Assessment produced by AWN (2022)[5]

3 Provision of Information for Screening for Appropriate Assessment

15 The following sections provide information to facilitate the Appropriate Assessment screening of the project to be undertaken by the competent authority.

16 A description of the project and the receiving environment is provided to identify the potential ecological impacts. The environmental baseline conditions are discussed, as relevant to the assessment of ecological impacts where they may highlight potential pathways for impacts associated with the project to affect the receiving ecological environment (e.g. air quality, hydrogeological and hydrological data).

17 The potential impacts are examined in order to define the potential zone of influence of the project on the receiving environment. This then informs the assessment of whether the project will result in significant effects on any European sites; i.e. affect the conservation objectives supporting the favourable conservation condition of the European site's QIs or SCIs.

3.1 Description of the Project

18 Google Ireland Data Centre, intend to apply to the Environmental Protection Agency (EPA) for an Industrial Emissions (IE) licence at Google Ireland Data Centre, Grange Castle Business Park South, Baldonnel Rd, Dublin 22, D22 X602.

19 The IE licence is for the use of existing backup-generators in the on-site Data Centres including Building 1 (planning ref. SD11A/0121) constructed in 2012 and Building 2 (planning ref. SD14A/0023 and SD14A/0284) was constructed between 2016-2019 in two phases.

20 These generators would be used to power the data centres in a backup capacity where the normal supply of power was not available. The generators are not operational during normal operations, only for testing and maintenance purposes. Full details of proposed backup-generator usage is provided within *Google Ireland Cumulative Air Quality Modelling Assessment* produced by AWN Consulting (2022). This is included in Appendix II of this AA Screening.

Site Drainage

21 There will be no changes to the surface water loading as a result of the project.

22 There will be no changes to the foul water loading as a result of the project.

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[4] The following SAC and SPA GIS boundary datasets are the most recently available at the time of writing: SAC_ITM_2022_08 and SPA_ITM_2021_10.

[5] AWN Consulting (2022) *Google Ireland Cumulative Air Quality Modelling Assessment* is included in Attachment 7-1-3-2-Emissions Impact Assessment of the Google Ireland Data Centre IE Licence Application (Application ref. No. LA010409).

3.2 Overview of the Receiving Environment

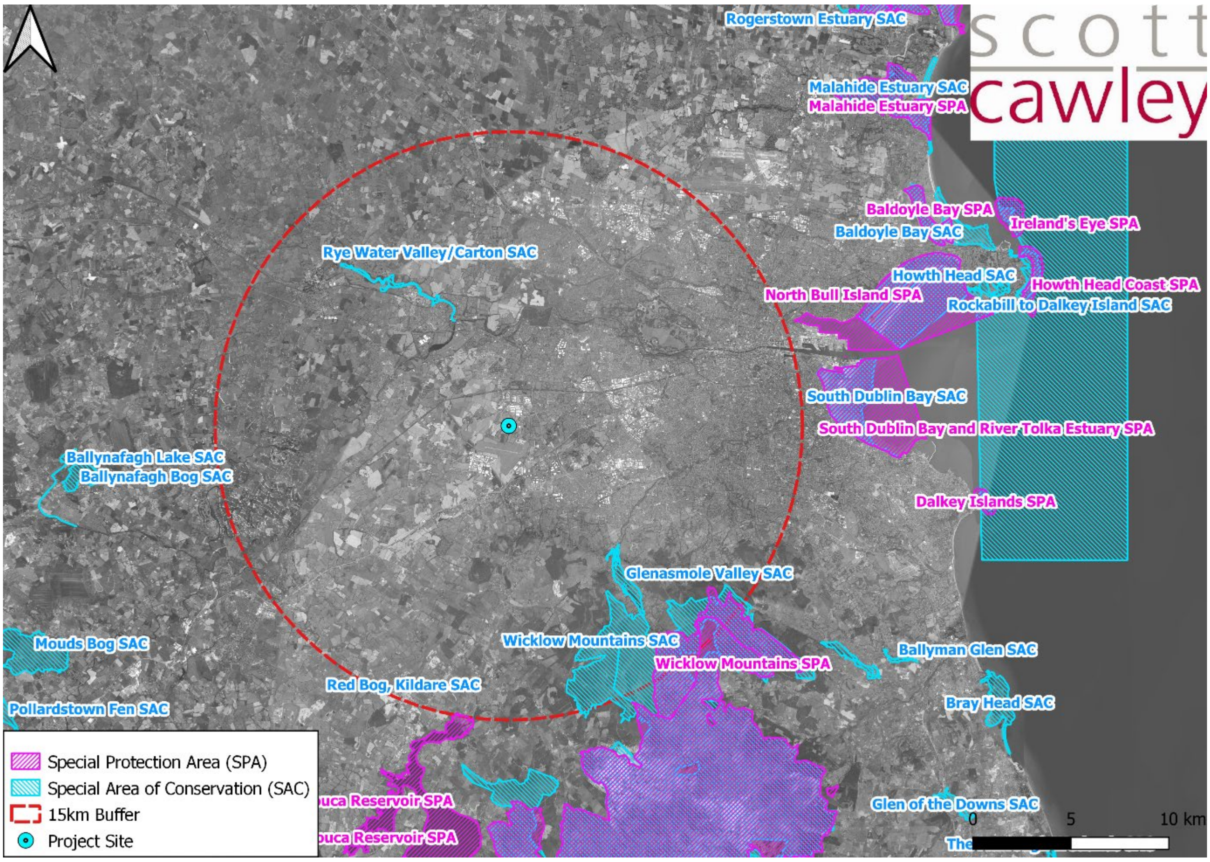
3.2.1 European sites

23 The project site does not overlap with any European site. There are 5 European sites within 15km of the project site. The nearest European site is Rye Water Valley/Carton SAC, located c. 6.3km to the northwest of the project subject site.

24 The culverted stream Milltown_09 is located c. 40m north of the project site. This flows into the Griffeen river, which flows for c. 5.5km until it discharges into the River Liffey at Lucan Weir. The Liffey in turn flows c. 20km downstream in an easterly direction, where it outfalls into Dublin Bay. There are eight European Sites located in Dublin Bay, which are hydrologically connected to the project site via the River Liffey. These European Sites are: North Dublin Bay SAC, South Dublin Bay SAC, North Bull Island SPA, South Dublin Bay and River Tolka Estuary SPA, Howth Head SAC, Howth Head SPA, Rockabill to Dalkey Island SAC and Dalkey Islands SPA.

25 All of the European sites present in the vicinity of the project site are shown on Figure 1 below. The QIs/SCIs of the European sites in the vicinity of the project site are provided in Appendix I.

Figure 1 European sites in the vicinity of the project site



3.2.2 Habitats

26 The project site is located at grid reference O 03238 30468 within the Ordnance Survey of Ireland (OSI) 10km Grid Square O03. The project site is industrial in nature, and the habitats present within the project site are dominated by buildings and artificial surfaces.

27 The project site was visited in 2019. The following habitat types of the Heritage Council classification system (Fossitt, 2000) were identified within the project site over the course of the survey:

- Buildings and artificial surfaces (BL3) (Aerial imagery now confirms this as Amenity grassland (GA2)
- Recolonising bare ground (ED2)
- Hedgerows (WL1)
- Drainage ditches (FW4)
- Dry meadows and grassy verges (GS2)

28 The following habitat types were identified in the areas immediately surrounding the project site over the course of the desk study:

- Buildings and artificial surfaces (BL3)
- Improved Agricultural grassland (GA1)
- Amenity Grassland (GA2)
- Treelines (WL2)
- Hedgerows (WL1)
- Spoil and Bare Ground (ED2)
- Recolonised Bare Ground (ED3)

29 There are no Annex I habitats present on the project site and there is no potential for the project site to provide a supporting role to Annex I habitats from nearby European sites, the majority of which are coastal in nature.

3.2.3 Flora and Fauna Species

30 The 2019 site walkover survey and desk study found no records of protected plant species listed under the Flora (Protection) Order, 2022; rare plant species contained within Ireland Red List No. 10 Vascular Plants (Wyse Jackson et al., 2016)[6], or species listed on Irelands Red List No. 8: Bryophytes (Lockhart et al., 2012)[7] within c. 2km of the project site.

31 There were no records, from the results of the desktop study, of non-native invasive plant species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 (as amended) from within the project site. However, records for four non-native invasive plant species exist within c. 2km of the project site:

- Indian balsam *Imaptiens glandulifera*
- Japanese knotweed *Reynoutria japonica*
- Spanish Bluebell *Hyacinthoides hispanica*

[6] Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. & Wright, M. (2016) Ireland Red List No. 10: Vascular Plants. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland.

[7] Lockhart, N., Hodgetts, N. & Holyoak, D. (2012) Ireland Red List No.8: Bryophytes. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

- Three-cornered garlic *Allium triquetrum*

The above records are from Corkagh Park, 1km east of the project. The site walkover surveys confirmed that no non-native invasive species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 were present on the lands within 2019.

3.2.3.1 Birds

32 The desk study returned no records for Special Conservation Interest (SCI) bird species within c. 2km of the project site, for which sites in Appendix I are designated.

33 The project site is urban in nature comprised of built structures, with its surrounding environs largely dominated by existing buildings and areas of hard standing. It therefore does not contain any suitable habitat to support the Special Conservation Interest species of any nearby European sites.

3.2.3.2 Terrestrial mammals

34 The NBDC desk study found no records for terrestrial mammal Qualifying Interest (QI) species within c. 2km of the project site, for which European sites listed in Appendix I are designated.

35 The Milltown Stream and Baldonnel Stream, are the nearest waterbodies to the subject site with connectivity to the River Liffey which is known to support otter populations. Otter are Annex I species and designated as a Qis for European sites within the wider vicinity of the project.

36 The project site is urban in nature comprised of built structures, with its surrounding environs dominated by existing buildings and areas of hard standing. It therefore is not considered to contain any suitable habitat to support otter, a QI species for which Wicklow Mountains SAC, located approximately 9.5km south of the subject site, is designated. Furthermore, the Milltown Stream and Baldonnel Stream water bodies adjacent to the project site, are largely culverted under existing development within the Grange Castle Business Park.

37 The project site is located within Liffey_SC_090 catchment. While the River Liffey and its tributaries are known to support otter, current guidance in respect of the hydrological distance that territorial otters roam suggest a range of approximately 7.5km for females and 21km for male otters along a water body (O'Neill et al., 2008)[8]. Although Wicklow Mountains SAC is located within this range, as the crow flies, the hydrological distance is much greater as Wicklow Mountains SAC is located within a different sub-catchment (Dodder_SC_010) to the project (Liffey_SC_090). Thus, watercourses in close proximity to the project site are not considered to be associated with QI populations associated with the Wicklow Mountains SAC.

3.2.4 Hydrology

38 According to the EPA online Map Viewer[9] the project site lies within the Liffey and Dublin Bay Catchment (Hydrometric Area 09) and the River Liffey sub-catchment (WFD name: Liffey_SC_090), and in the Liffey_170 sub-basin (IE_EA_09L012100).

39 There are no surface water features located within the project site. The nearest waterbody to the project site is the stream Milltown 09 (IE_EA_09L012100) located c. 40m north of the project site, which joins the Griffeen River (IE_EA_09L012100) and discharges into the River Liffey at Lucan Weir (See Figure 2). The River Liffey then discharges into Dublin Bay (IE_EA_090_0000) coastal waterbody via the Liffey Estuary Upper and Liffey Estuary Lower.

40 The Milltown 09, Baldonnel, and Griffeen River, are categorised under the Water Framework Directive (WFD) (2000/60/EC) name Liffey_170. According to the EPA online Map Viewer, the WFD status of the

[8] O'Neill L. (2008) *Population dynamics of the Eurasian otter in Ireland. Integrating density and demography into conservation planning.* PhD thesis. Trinity College, Dublin.

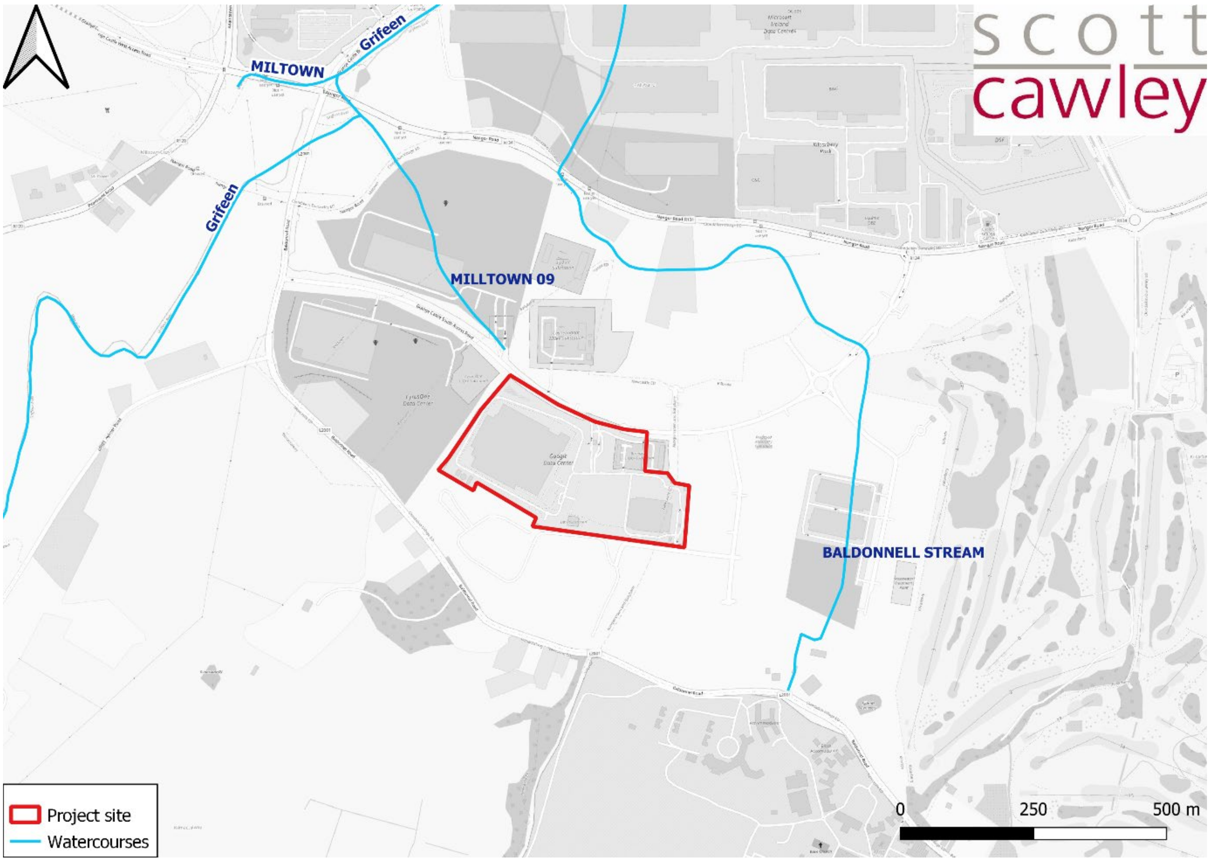
[9] EPA Mapviewer https://gis.epa.ie/EPAMaps/ (accessed 1st July 2022)

Liffey_170 waterbody is ‘Moderate’ for the 2013 – 2018 monitoring period, and is classified as ‘At Risk’ of not meeting its WFD objectives.

41 The WFD status for the 2013 – 2018 monitoring period of the Liffey Estuary Upper and Liffey Estuary Lower Transitional Waterbodies are classified as ‘Good’ status and, therefore, are ‘Not at Risk’ of not meeting the WFD objectives.

42 The WFD (2000/60/EC) status 2013-2018 of the ‘Irish Sea Dublin’ Coastal Waterbody is ‘Good Status’ and is ‘Not at Risk’ of not meeting the WFD objectives. Water Quality data from 2018-2020 indicate that the coastal waterbody is ‘Unpolluted’.

Figure 2 Watercourses in vicinity of the project



3.2.5 Hydrogeology

43 GSI data indicates that the project site is underlain by a “locally important” aquifer, that is described as “bedrock which is Moderately Productive only in Local Zones”. The Groundwater Body (GWB) underlying the project site is the “Dublin IE_EA_G_008” GWB, which is currently classified by the EPA as having “Good” groundwater status and the groundwater risk is currently under “review”. The GSI (2017) Interim Vulnerability Map presently classifies the aquifer at the location of the project site as “Extremely Vulnerable”.

44 There is one European site, Rye Water Valley/Carton SAC, designated for groundwater dependent terrestrial habitat and/or species, located within the same groundwater body as the project site.

3.2.6 Air Quality

45 The Project is located within air quality Zone A, under the implementation of S.I. No. 271/2002 - Air Quality Standards Regulations 2002.

46 In 2020 the EPA reported that Ireland was compliant with EU legal limits at all locations, however this was largely due to the reduction in traffic due to Covid-19 restrictions[10]. The EPA report details the effect that the Covid-19 restrictions had on stations, which included reductions of up to 50% at some monitoring stations for which traffic would be a dominant source. The report also notes that CSO figures show that while traffic volumes are still slightly below 2019 levels, they have significantly increased since 2020 levels. 2020 concentrations are therefore predicted to be an exceptional year and not consistent with long-term trends. The annual mean, and percentile concentrations of NO_x, SO_2, and Particulate Matter (PM_{10} & $PM_{2.5}$) are provided in Appendix II.

47 Existing emission details for the project are included in Table 1.

Table 1 Process Emission Details for Existing Diesel Generators at Existing Data Centres

Stack Reference	NO_x		SO_2		PM_{10} / $PM_{2.5}$	
	Concentration (mg/Nm^3 at 15% Ref. O_2)	Mass Emission (g/s)	Concentration (mg/Nm^3 at 15% Ref. O_2)	Mass Emission (g/s)	Concentration (mg/Nm^3 at 15% Ref. O_2)	Mass Emission (g/s)
Building 1	1,298	0.084 Note 1 / 4.91 Note 2	3.7	0.00024Note 1 / 0.014 Note 2	3.7	0.00024Note 1 / 0.014 Note 2
Building 2	1,046	0.110 Note 1 / 6.44 Note 2	3.7	0.00039 Note 1 / 0.023 Note 2	3.7	0.00039 Note 1 / 0.023 Note 2

Note 1 Reduced emission rates based on USEPA protocol (assuming 150 hours / annum) used to model emissions during annual testing of the back-up operation of generators (100% load)

Note 2 Maximum emission rates for diesel generators (based on 100% load) used to model emissions during emergency operation of generators for UK EA assessment methodology

3.3 Assessment of Effects on European Sites

48 This section identifies all the potential impacts associated with the project, examines whether there are any European sites within the ZoI of effects from the project, and assesses whether there is any risk of the project resulting in a significant effect on any European site, either alone or in combination with other plans or projects.

49 In assessing the potential for the project to result in a significant effect on any European sites, any measures intended to avoid or reduce the harmful effects of the project on European sites are not taken into account.

3.3.1 Habitat loss and fragmentation

50 The project does not overlap with the boundary of any European site. Therefore, there are no European sites at risk of direct habitat loss impacts.

51 As the project does not traverse any European sites there is no potential for habitat fragmentation to occur.

52 The project site does not support populations of any fauna species linked with the QI/SCI populations of any European site(s).

In Combination

53 As the project will not result in habitat loss or habitat fragmentation within any European site, there is no potential for any in combination effects to occur in that regard.

3.3.2 Habitat degradation as a result of hydrological impacts

54 Surface water run-off and discharges from the project will drain to the existing local surface water drainage network. Foul waters from the project will be discharged to Ringsend WWTP for treatment, via the existing foul water drainage network, prior to discharge into the Liffey Estuary/Dublin Bay. Therefore, the Zone of Influence (ZoI) of potential effects on water quality from the project could extend to Dublin Bay.

[10] Environmental Protection Agency (2022) *Air Quality Monitoring Report 2021* (& previous reports)

Surface Water

55 Surface water run-off and discharges from the proposed development will enter the downstream receiving environment via the existing surface water drainage network.

56 The proposed development does not involve the construction of new infrastructure and will not increase the amount of impermeable surface area within the site, therefore will not alter the existing hydrological regime or have any measurable effects on water quality in Dublin Bay or the Irish Sea.

Foul Water

57 Foul water, comprising sewage and industrial effluent (and some surface water run-off), from the Dublin area has historically been, and will continue to be, treated at Ringsend WwTP prior to discharge to Dublin Bay. The most recent information from Irish Water indicates that the plant is operating above its capacity of 1.64 million P.E. (Irish Water, 2020)[11], with a current operational loading of c.2.2 million P.E. Ringsend WwTP operates under a discharge licence from the EPA (D0034-01) and must comply with the licence conditions.

58 Despite the capacity issues associated with the Ringsend WwTP, Dublin Bay is currently classified by the EPA as being of "Unpolluted" water quality status[12]. The Liffey Estuary Lower is currently classified by the EPA as being of "Intermediate" water quality status and the Tolka Estuary as "Eutrophic". The pollutant content of future foul water discharges to Dublin Bay is considered likely to decrease in the long-term for following the current undertaking of a major upgrade of the Ringsend WwTP to increase the plant's wastewater treatment capacity to a population equivalent of 2.4 million, which is programmed for completion in 2025[13].

59 As the proposed development does not involve the construction of new infrastructure and will not increase the foul water load of the facility, it is concluded that the proposed development will not impact on the overall water quality status of Dublin Bay.

60 Therefore, there is no possibility of the proposed development undermining the conservation objectives of any of the qualifying interests or special conservation interests of the European sites in, or associated with, Dublin Bay as a result of foul water discharges.

In Combination

61 As the project will not result in any increase to surface or foul water loading on existing hydrological services, it is concluded that the possibility of any other plans or projects acting in combination with the project to give rise to significant effects on any European site, as a result of hydrological effects, in, or associated with, Dublin Bay can be excluded.

3.3.3 Habitat degradation as a result of hydrogeological impacts

62 The project lies within the Dublin Groundwater Body (Dublin GWB). The only European site within the Dublin GWB that is designated for groundwater dependant habitats and/or species is the Rye Water Valley/Carton SAC. All of the qualifying interests of the Rye Water Valley/Carton SAC, the priority Annex I habitat Petrifying springs and the two Annex II whorl snail species, are dependent upon the existing condition and functioning of the groundwater regime. Based on information published by Geological Survey Ireland (GSI) on the Dublin GWB[14], 'The general groundwater flow direction in this aquifer is towards the coast and also towards the River Liffey and Dublin City'.

[11] *Annual Environmental Report, Ringsend D0034-01* (Irish Water, 2020)

[12] Transitional and Coastal Surface Water Quality data (2018-2020) accessed from the EPA Envision Mapviewer www.gis.epa.ie/Envision (accessed November 2022)

[13] https://www.water.ie/projects/local-projects/ringsend/ (accessed November 2022)

[14] https://secure.dccae.gov.ie/GSI_DOWNLOAD/Groundwater/Reports/GWB/DublinGWB.pdf (accessed November 2022)

63 As the project will not involve the construction of new infrastructure and will not increase the amount of impermeable surface area within the site, it will not interact with the underlying groundwater body. As such, the project will not influence groundwater conditions in any European site.

In Combination

64 Therefore, there is no possibility of the project undermining the conservation objectives of any of the qualifying interests or special conservation interests of any European sites, either alone or in combination with any other pans or projects, as a result of hydrogeological effects.

3.3.4 Habitat degradation as a result of introducing/spreading non-native invasive species

65 The project site comprises existing hard standing that is not considered to support any non-native invasive species which could be accidentally spread or be introduced to downstream habitats within European sites.

66 Furthermore, as there is no construction element within the project, there is no potential for invasive species to be introduced to or spread from the site during construction related activities.

In Combination

67 As the project will not result in the introduction or accidental spread of non-native invasive species, to any European site, there is no potential for any in combination effects to occur in that regard.

3.3.5 Disturbance and displacement impacts

68 As there is no construction element within the project, there is no potential for construction-related disturbance. The operational stage will involve the continued use of existing diesel generators and any maintenance under the existing management programme. As such, noise levels are not considered to vary from existing baseline levels. Therefore, the project will not result in the disturbance/displacement of the qualifying/special conservation interest species of any European site.

In Combination

69 As the project will not result in the disturbance/displacement of the qualifying/special conservation interest species of any European site, there is no potential for any in combination effects to occur in that regard.

3.3.6 Air Quality

70 The standby diesel generators at the Google Ireland Data Centre are not operational during normal operations, only for testing and maintenance purposes. They would also be used to power the data centre in a backup capacity where the normal supply of power was not available.

71 The cumulative impact of the operation of the Google Ireland standby diesel generators during normal and abnormal (i.e. worst case) scenarios, as well as the existing IED licenced sites, and other neighbouring operational data storage and onsite energy centre facilities in the vicinity of the site was assessed by AWN (2022). Full details of the assessment is provided within the *Google Ireland Cumulative Air Quality Modelling Assessment* produced by AWN Consulting (2022) (Appendix II).

72 The Air Dispersion Modelling has been completed in accordance with the requirements of the EPA's Air Dispersion Modelling Guidance (AG4) which recommends the United States Environmental Protection Agency's regulated model AERMOD as a suitable air dispersion model. The EPA AG4 Guidance also refers to the USEPA methodology and UK Environment Agency (UK EA) methodology for air dispersion modelling of backup generators.

73 The cumulative modelling of air emissions from the site was carried out to assess concentrations of nitrogen dioxide (NO2) at a variety of locations beyond the site boundary. Additional modelling of the Google Ireland facility was conducted for emissions of sulphur dioxide (SO2), nitrogen oxides (NOX) and PM10/PM2.5.

74 The cumulative scenario involved the scheduled testing of 24 no. standby diesel generators based on a detailed site-specific testing schedule, emergency operations of the standby diesel generators, licenced emissions from the IE licenced sites of Takeda, Pfizer and Grange Backup Power, as well as emissions from neighbouring proposed and operational data storage facilities and energy centres.

75 A methodology has been published by the UK Environment Agency (UK EA) and is based on considering the statistical likelihood of an exceedance of the NO2 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 standby generators. The guidance also states that there should be no running time restrictions on generators when providing power on site during an emergency. Both the methodology advised in 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 standby generators.

76 Modelling has been undertaken using five years of historical data from Casement Aerodrome (2017 – 2021). Future meteorological data is not available; however, it is accepted that by using five years of historical data an accurate prediction of worst-case future emissions can be made.

Ambient Air Quality Standards

77 In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC. The ambient air quality standards applicable for NO_2 are outlined in this Directive.

78 Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. These standards have been used in the current assessment to determine the potential impact of NO_2, NO_X, SO_2 and PM10/$PM_{2.5}$ emissions from the facility on ambient air quality.

79 Air quality limit values are provided in Table 2. There are no limit values for the protection of vegetation for SO_2 or PM, as such human health values are used.

Table 2 Air Quality Standards Regulations 2011 (Based on Directive 2008/50/EC and S.I. 180 of 2011)

Pollutant	Regulation Note 1	Limit Type	Value
Nitrogen Dioxide (NO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 μg/m³
		Annual limit for protection of human health	40 μg/m³
NO_X	2008/50/EC	Critical level for protection of vegetation	30 μg/m³ NO + NO_2
Sulphur Dioxide (SO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 μg/m³
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 μg/m³
		Critical limit for the protection of ecosystems	20 μg/m³
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 μg/m³
		Annual limit for protection of human health	40 μg/m³
Particulate Matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 μg/m³

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

Source: AWN 2022

NO_2

80 The NO_2 modelling results are detailed in Section 6.1 and 6.2 of the Air Quality Modelling Assessment (AWN, 2022). For the worst-case year, emissions from the site lead to an ambient NO2 concentration (including background) which is 78% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 92% of the annual limit value at the most impacted off-site sensitive receptor.

81 The cumulative NO2 modelling results are detailed in Section 6.5 of the Air Quality Modelling Assessment (AWN, 2022). For the worst-case year, emissions from the site and nearby emission sources lead to an ambient NO2 concentration (including background) which is 78% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 100% of the annual limit value at the worst-case off-site sensitive receptor.

SO_2

82 The SO2 modelling results are detailed in Section 6.3 of the Air Quality Modelling Assessment (AWN, 2022). The modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for SO_2. For the worst-case year, emissions from the site lead to an ambient SO_2 concentration (including background) which is 2.5% of the maximum ambient 1-hour limit value (measured as a 99.7th percentile) and 5.2% of the maximum ambient 24-hour limit value (measured as a 99.2nd percentile) at the most impacted off-site sensitive receptor.

Particulate Matter (PM_{10} & $PM_{2.5}$)

83 The PM_{10} & $PM_{2.5}$ modelling results are detailed in Section 6.3 of the Air Quality Modelling Assessment (AWN, 2022). The results indicate that the ambient ground level concentrations are below the relevant air quality standards for both PM_{10} and $PM_{2.5.}$ For the worst-case year, emissions from the site lead to an ambient PM_{10} concentration (including background) which is 52% of the maximum ambient 24-hour limit value (measured as a 90th percentile) and 38% of the annual mean limit value at the most impacted off-site sensitive receptor. In addition, for the worst-case year, emissions from the site lead to an ambient PM2.5 concentration (including background) which is 42% of the annual mean limit value at the most impacted off-site sensitive receptor.

Distances to background levels

84 A zone of influence (ZoI) has been defined within the Air Quality Modelling Assessment (AWN, 2022). When pollutants are emitted from the emission sources onsite, they will disperse in the atmosphere and will eventually be indistinguishable from background levels. In this context, a level below 0.1 mg/m^3 is defined as being indistinguishable from background levels. The distance needed to achieve this is given below for each of the parameters (NO_X, SO_2, PM_{10}). Irrespective of the distance below, all pollutants at all times remain below the ambient standard for the protection of vegetation in any of the nearby ecological sensitive areas:

- NO_X = 12,200 metres,
- SO_2 = 15 metres,
- PM_{10} = 15 metres.

85 In terms of SO_2 and PM, there are no European sites within the above distances required for the project to be indistinguishable from background levels, nor will there be any reduction in the permanent area occupied by European sites as a result of the project.

86 In terms of NO_X, there are three European sites within the 12.2km required for the project to be indistinguishable from background levels. These include Glenasmole Valley SAC (*c.* 7.8km); Rye Water Valley/Carton SAC (*c.* 6.29km); and Wicklow Mountains SAC (*c*. 9.5km).

87 Wicklow Mountains SAC is the nearest European site designated for QI habitats that are dependent on air quality standards for the achievement of favourable conservation status. These include European dry heaths [4030], and Alpine and Boreal heaths [4060]. Wicklow Mountains is location 9.5km south-east of

the project. Levels for NO_X in 2021 in suburban Dublin are averaging between 15.4 – 23.3 $\mu g/m^3$ [15], the worst case modelled increase of 0.83 $\mu g/m^3$ will not result in any exceedances of the 30 $\mu g/m^3$ limit value for the protection of vegetation (AWN, 2022). Therefore, the project will not lead to air quality impacts to vegetation associated with Wicklow Mountains SAC, or any other European site.

In Combination

88 A cumulative impact assessment of NO_X (AWN, 2022) is provided for the closest European site to the project, the Rye Water Valley/Carton SAC (located *c.* 6.29km from the project). A worst-case background value has been added to the results based on suburban locations in Dublin based on a review of the EPA NOx monitoring data(17). Modelling results based on conservative assumptions indicate that the facility and nearby cumulative emission points will have an imperceptible impact on NO_x concentrations within the sensitive ecosystems (Rye Water Valley/Carton SAC [001398]) contributing at most 2% of the limit value (not including background levels) at the worst-case location in the worst-case year modelled. It is therefore inferred that that is respective of a worst case scenario at Glenasmole Valley SAC (*c.* 7.8km) and Wicklow Mountains SAC (*c*. 9.5km) as these are located at a greater distance from the project.

89 The NO_2 deposition flux for the worst-case year is 2.64 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)[16]. As such, it is not considered to result in the reduction of air quality of the qualifying/special conservation interest species/habitats of any European site. There is no potential for any in combination effects to occur.

90 As the project indistinguishable from background levels at 15m from the site boundary, and there are no other contributing sources of PM or SO_2 within this distance, there is no potential for any in combination effects to occur in that regard.

3.3.7 Summary

91 The potential impacts associated with the project do not have the potential to affect the receiving environment and, consequently, do not have the potential to affect the conservation objectives supporting the qualifying interest/special conservation interests of any European sites. Therefore, the project is not likely to have significant effects on any European sites.

92 As the project itself will not have any effects on the QIs/SCIs or conservation objectives of any European sites, and taking into account the policies and objectives of the statutory plans referred to above, it is concluded that there is no potential for any other plan or project to act in combination with it to result in significant effects on any European sites.

93 The potential impacts of the project on the receiving environment, their ZoI, and the European sites at risk of significant effects are summarised in Table 1 below. In assessing the potential for the project to result in a significant effect on any European sites, any measures intended to avoid or reduce the harmful effects of the project on European sites are not taken into account.

Table 3 Summary of Analysis of Likely Significant Effects on European sites

Potential Direct, Indirect In Combination Effects and the ZoI of the Potential Effects	Are there any European sites within the ZoI of the project?
Habitat loss The project does not involve any habitat loss	No
Habitat degradation as a result of hydrological impacts	No

15 Environmental Protection Agency (2022) Air Quality Monitoring Report 2021 (& previous reports)

16 United Nations Economic Commission for Europe (UNECE) (2010) Empirical Critical Loads & DoseResponse Relationships

Potential Direct, Indirect In Combination Effects and the ZoI of the Potential Effects	Are there any European sites within the ZoI of the project?
Habitats and species downstream of the project site and the associated surface water drainage discharge points, and downstream of offsite wastewater treatment plants.	There are no European sites at risk of hydrological effects associated with the project
Habitat degradation as a result of hydrogeological impacts Groundwater-dependant habitats, and the species those habitats support, in the local area that lie downgradient of the project site.	No There are no European sites at risk of hydrogeological effects associated with the project
Habitat degradation as a result of introducing/spreading non-native invasive species The project does not involve any construction which could introduce or lead to the accidental spread of non-native species	No
Disturbance and displacement impacts The project does not involve any construction which could disturbance or displacement impacts	No
Air Quality The project does not result in the increase of NO_X, SO_2, or PM concentrations above limit values for the protection of vegetation or ecosystems	No

4 Conclusions of Screening Assessment Process

94 Following an examination, analysis and evaluation of the best available information, and applying the precautionary principle, it can be concluded that the possibility of any significant effects on any European sites, whether arising from the project alone or in combination with other plans and projects, can be excluded, for the reasons set out in Section 3.3 above. In reaching this conclusion, the nature of the project and its potential relationship with all European sites within the zone of influence, and their conservation objectives, have been fully considered.

95 Therefore, it is the professional opinion of the authors of this report that the application for consent for the project does not require an Appropriate Assessment or the preparation of a Natura Impact Statement (NIS).

Appendix I

The Qualifying Interests (QIs) and Special Conservation Interests (SCIs) of the European sites in the vicinity of the project site (see Figure 1)

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Project Site
Special Area of Conservation (SAC)	
Rye Water Valley/Carton SAC [001398] 7220 Petrifying springs with tufa formation (*Cratoneurion*)* 1014 Narrow-mouthed Whorl Snail *Vertigo angustior* 1016 Desmoulin's Whorl Snail *Vertigo moulinsiana* *S.I. No. 494/2018 - European Union Habitats (Conservation of Wild Birds (Rye Water Valley/Carton Special Area of Conservation 001398)) Regulations 2018.* NPWS (2021) *Conservation Objectives: Rye Water Valley/Carton SAC 001398. Version 1.* National Parks and Wildlife Service, Department of Housing, Local Government and Heritage.[17]	*c.* 6.29km north west of the project site
North Dublin Bay SAC [000206] 1140 Mudflats and sandflats not covered by seawater at low tide 1210 Annual vegetation of drift lines 1310 *Salicornia* and other annuals colonising mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 1395 Petalwort *Petalophyllum ralfsii* 1410 Mediterranean salt meadows (*Juncetalia maritimi*) 2110 Embryonic shifting dunes 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) 2130 Fixed coastal dunes with herbaceous vegetation (grey dunes) 2190 Humid dune slacks *S.I. No. 524/2019 - European Union Habitats (North Dublin Bay Special Area of Conservation 000206) Regulations 2019* NPWS (2013) *Conservation Objectives: North Dublin Bay SAC 000206.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	*c.* 18 km northeast of the project site
South Dublin Bay SAC [000210] 1140 Mudflats and sandflats not covered by seawater at low tide 1210 Annual vegetation of drift lines 1310 *Salicornia* and other annuals colonising mud and sand 2110 Embryonic shifting dunes *S.I. No. 525/2019 - European Union Habitats (South Dublin Bay Special Area of Conservation 000210) Regulations 2019* NPWS (2013) *Conservation Objectives: South Dublin Bay SAC 000210.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	*c.* 15.8km northeast of the project site

[17] The versions of the conservation objectives documents referenced in this table are the most recent published versions at the time of writing

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Project Site
Baldoyle Bay SAC [000199] 1140 Mudflats and sandflats not covered by seawater at low tide 1310 *Salicornia* and other annuals colonizing mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 1410 Mediterranean salt meadows (*Juncetalia maritimi*) *S.I. No. 472/2021 - European Union Habitats (Baldoyle Bay Special Area of Conservation 000199) Regulations 2021* NPWS (2012) *Conservation Objectives: Baldoyle Bay SAC 000199.* Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht	*c.* 22.4km north east of the project site
Red Bog, Kildare SAC [000397] 7140 Transition mires and quaking bogs *S.I. No. 76/2018 - European Union Habitats (Red Bog, Kildare Special Area of Conservation 000397) Regulations 2019* NPWS (2019) *Conservation Objectives: Red Bog, Kildare SAC 000397*. Version 1. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht.	*c.* 14.25km south of the project site
Howth Head SAC [000202] 1230 Vegetated sea cliffs of the Atlantic and Baltic coasts 4030 European dry heaths *S.I. No. 524/2021 - European Union Habitats (Howth Head Special Area of Conservation 000202) Regulations 2021* NPWS (2016) *Conservation Objectives: Howth Head SAC 000202.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	*c.* 23.8km northeast of the project site
Rockabill to Dalkey Island SAC [003000] 1170 Reefs 1351 Harbour porpoise *Phocoena phocaena* *S.I. No. 94/2019 - European Union Habitats (Rockabill To Dalkey Island Special Area Of Conservation 003000) Regulations 2019* NPWS (2013) *Conservation Objectives: Rockabill to Dalkey Island SAC 003000.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	*c.* 23.5 km east of the project site
Glenasmole Valley SAC [001209] 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) 7220 Petrifying springs with tufa formation (*Cratoneurion*)* *S.I. No. 345/2021 - European Union Habitats (Glenasmole Valley Special Area of Conservation 001209) Regulations 2021*	*c.* 7.8km south east of the project

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Project Site
NPWS (2021) *Conservation Objectives: Glenasmole Valley SAC 001209. Version 1.* National Parks and Wildlife Service, Department of Housing, Local Government and Heritage.	
Ireland's Eye SAC [002193] 1220 Perennial vegetation of stony banks 1230 Vegetated sea cliffs of the Atlantic and Baltic coasts *S.I. No. 501/2017 - European Union Habitats (Ireland's Eye Special Area of Conservation 002193) Regulations 2017* NPWS (2017) *Conservation Objectives: Ireland's Eye SAC 002193.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	*c.* 26.8km northeast of the project site
Wicklow Mountains SAC [002122] 3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) 3160 Natural dystrophic lakes and ponds 4010 Northern Atlantic wet heaths with *Erica tetralix* 4030 European dry heaths 4060 Alpine and Boreal heaths 6130 *Calaminarian* grasslands of the *Violetalia calaminariae* 6230 Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) 7130 Blanket bogs (* if active bog) 8110 Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) 8210 Calcareous rocky slopes with chasmophytic vegetation 8220 Siliceous rocky slopes with chasmophytic vegetation 91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles 1355 *Lutra lutra* (Otter) NPWS (2017) *Conservation Objectives: Wicklow Mountains SAC 002122.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	*c.* 9.5km southeast of the project
Special Protection Area (SPA)	
North Bull Island SPA [004006] A046 Light-bellied Brent Goose *Branta bernicla hrota* A048 Shelduck *Tadorna tadorna* A052 Teal *Anas crecca* A054 Pintail *Anas acuta* A056 Shoveler *Anas clypeata* A130 Oystercatcher *Haematopus ostralegus* A140 Golden Plover *Pluvialis apricaria* A141 Grey Plover *Pluvialis squatarola* A143 Knot *Calidris canutus*	*c.* 18km northeast of the project

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Project Site
A144 Sanderling *Calidris alba* A149 Dunlin *Calidris alpina* A156 Black-tailed Godwit *Limosa limosa* A157 Bar-tailed Godwit *Limosa lapponica* A160 Curlew *Numenius arquata* A162 Redshank *Tringa totanus* A169 Turnstone *Arenaria interpres* A179 Black-headed Gull *Chroicocephalus ridibundus* A999 Wetlands & Waterbirds *S.I. No. 211/2010 - European Communities (Conservation of Wild Birds (North Bull Island Special Protection Area 004006)) Regulations 2010.* NPWS (2015) *Conservation Objectives: North Bull Island SPA 004006.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	
South Dublin Bay and River Tolka Estuary SPA [004024] A046 Light-bellied Brent Goose *Branta bernicla hrota* A130 Oystercatcher *Haematopus ostralegus* A137 Ringed Plover *Charadrius hiaticula* A141 Grey Plover *Pluvialis squatarola* A143 Knot *Calidris canutus* A144 Sanderling *Calidris alba* A149 Dunlin *Calidris alpina* A157 Bar-tailed Godwit *Limosa lapponica* A162 Redshank *Tringa totanus* A179 Black-headed Gull *Chroicocephalus ridibundus* A192 Roseate Tern *Sterna dougallii* A193 Common Tern *Sterna hirundo* A194 Arctic Tern *Sterna paradisaea* A999 Wetland and Waterbirds *S.I. No. 212/2010 - European Communities (Conservation of Wild Birds (South Dublin Bay and River Tolka Estuary Special Protection Area 004024)) Regulations 2010.* NPWS (2015) *Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024*. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	*c.* 15km east of the project
Baldoyle Bay SPA [004016] A046 Light-bellied Brent Goose *Branta bernicla hrota* A048 Shelduck *Tadorna tadorna* A137 Ringed Plover *Charadrius hiaticula* A140 Golden Plover *Pluvialis apricaria* A141 Grey Plover *Pluvialis squatarola* A157 Bar-tailed Godwit *Limosa lapponica* A999 Wetland and Waterbirds	*c.* 23km northeast of the project

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Project Site
S.I. No. 275/2010 - European Communities (Conservation of Wild Birds (Baldoyle Bay Special Protection Area 004016)) Regulations 2010. NPWS (2013) *Conservation Objectives: Baldoyle Bay SPA 004016. Version 1.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	
Wicklow Mountains SPA [004040] A098 Merlin *Falco columbarius* A103 Peregrine *Falco peregrinus* *S.I. No. 586/2012 - European Communities (Conservation of Wild Birds (Wicklow Mountains Special Protection Area 004040)) Regulations 2012.* NPWS (2022) *Conservation objectives for Wicklow Mountains SPA [004040].* Generic Version 9.0. Department of Housing, Local Government and Heritage.	*c.* 12.5km southeast of the project
Ireland's Eye SPA [004117] A017 Cormorant *Phalacrocorax carbo* A184 Herring Gull *Larus argentatus* A188 Kittiwake *Rissa tridactyla* A199 Guillemot *Uria aalge* A200 Razorbill *Alca torda* *S.I. No. 240/2010 - European Communities (Conservation of Wild Birds (Ireland's Eye Special Protection Area 004117)) Regulations 2010.* NPWS (2022) *Conservation objectives for Ireland's Eye SPA [004117].* Generic Version 9.0. Department of Housing, Local Government and Heritage.	*c.* 26km northeast of the project
Howth Head Coast SPA [004113] A188 Kittiwake *Rissa tridactyla* *S.I. No. 185/2012 - European Communities (Conservation of Wild Birds (Howth Head Coast Special Protection Area 004113)) Regulations 2012.* NPWS (2022) *Conservation objectives for Howth Head Coast SPA [004113].* Generic Version 9.0. Department of Housing, Local Government and Heritage.	*c.* 26.3km northeast of the project
Dalkey Islands SPA [004172] A192 Roseate Tern *Sterna dougallii* A193 Common Tern *Sterna hirundo* A194 Arctic Tern *Sterna paradisaea* *S.I. No. 238/2010 - European Communities (Conservation of Wild Birds (Dalkey Islands Special Protection Area 004172)) Regulations 2010.* NPWS (2022) *Conservation objectives for Dalkey Islands SPA* [004172]. Generic Version 9.0. Department of Housing, Local Government and Heritage.	*c.* 23km east of the project

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Project Site
Poulaphouca Reservoir SPA [004063] A043 Greylag Goose *Anser anser* A183 Lesser Black-backed Gull *Larus fuscus* *S.I. No. 73/2010 - European Communities (Conservation of Wild Birds (Poulaphouca Reservoir Special Protection Area 004063)) Regulations 2010.* NPWS (2022) *Conservation objectives for Poulaphouca Reservoir SPA* [004063]. Generic Version 9.0. Department of Housing, Local Government and Heritage.	*c.* 14.9km south of the project

Appendix II

Google Ireland Cumulative Air Quality Modelling Assessment produced by AWN Consulting (2022)

The Tecpro Building,
Clonshaugh Business & Technology Park,
Dublin 17, Ireland.

T: + 353 1 847 4220
F: + 353 1 847 4257
E: info@awnconsulting.com
W: www.awnconsulting.com

GOOGLE IRELAND CUMULATIVE AIR QUALITY MODELLING ASSESSMENT

Technical Report Prepared For

PM GROUP

Technical Report Prepared By

Dr. Edward Porter
Director (Air Quality)

Our Reference

EP/227501.0590AR01

Date Of Issue

18 November 2022

Cork Office
Unit 5, ATS Building,
Carrigaline Industrial Estate,
Carrigaline, Co. Cork.
T: +353 21 438 7400
F: +353 21 483 4606

AWN Consulting Limited
Registered in Ireland No. 319812
Directors: F Callaghan, C Dilworth,
T Donnelly, E Porter
Associate Director: D Kelly

Document History

Document Reference		Original Issue Date	
EP/227501.0590AR01		18 November 2022	
Revision Level	Revision Date	Description	Sections Affected

Record of Approval

Details	Written by	Checked by
Signature		
Name	Dr. Edward Porter	Ciara Nolan
Title	Director (Air Quality)	Senior Air Quality Consultant
Date	18 November 2022	18 November 2022

EXECUTIVE SUMMARY

This report presents a cumulative air quality assessment of the Google Ireland data centre facility located off the Nangor Road, Grangecastle, Co. Dublin. There are a total of 24 no. diesel generators at the Google Ireland data centre, which will provide power to the site when power from the National Grid is not available. The cumulative impact of the Google Ireland standby diesel generators, as well as the existing IED licenced sites, and other neighbouring operational data storage and onsite energy centre facilities in the vicinity of the site was assessed. Air dispersion modelling of operational stage emissions was carried out using the United States Environmental Protection Agency's regulated model AERMOD. The cumulative 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. Additional modelling of the Google Ireland facility was conducted for emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_X) and PM_{10}/$PM_{2.5}$. Through modelling, it is demonstrated that the project does not result in an increase in NO_2 concentrations above ambient limit values for the protection of vegetation or ecosystems in the region of the Google Ireland Data Centre facility nor at further distances away from the facility including the locations of European Sites. In accordance with the EPA's Air Dispersion Modelling Guidance (AG4), ensuring compliance with the ambient Air Quality Standards for NO_2 for the cumulative scenario will ensure compliance for all other pollutants (SO_2, PM_{10}/$PM_{2.5}$) which are all emitted at much lower emission concentrations.

The cumulative scenario involved the scheduled testing of 24 no. standby diesel generators based on a detailed site-specific testing schedule, back-up operations of the standby diesel generators, licenced emissions from the IE licenced sites of Takeda, Pfizer and Grange Backup Power, as well as emissions from neighbouring proposed and operational data storage facilities and energy centres.

A methodology has been published by the UK Environment Agency (UK EA) and 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 standby generators. The guidance also states that there should be no running time restrictions on generators when providing power on site during a power outage. Both the methodology advised in 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 standby generators.

Assessment Summary

Under the USEPA methodology NO_2 emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards. Emissions under this scenario lead to an ambient NO_2 concentration that is 78% of the ambient 1-hour limit value (measured as a 99.8th percentile) and 92% of the ambient annual mean limit value at the worst-case off-site receptor for the worst case year.

The UK Environment Agency assessment methodology determined that in the worst-case year, the Google Ireland standby diesel generators could operate for a maximum of 1,110 hours before there is a likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level). In addition, the UK guidance recommends that there should be no running time restrictions placed on standby generators which provide power on site only during a power outage.

SO_2 emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards. Emissions under this scenario lead to an ambient SO_2 concentration that is 2.5% of the ambient 1-hour limit value (measured as a 99.7th

percentile) and 5.2% of the ambient 24-hour limit value (measured as a 99.2nd percentile) at the worst case off-site receptor for the worst case year.

PM_{10} emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards. Emissions under this scenario lead to an ambient PM_{10} concentration that is 52% of the ambient 24-hour limit value (measured as a 90th percentile) and 38% of the annual mean limit value at the worst-case off-site receptor for the worst case year. $PM_{2.5}$ emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards. Emissions under this scenario lead to an ambient $PM_{2.5}$ concentration that is 42% of the annual mean limit value at the worst-case off-site receptor for the worst case year.

NO_X emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards for the protection of ecosystems. Emissions under this scenario lead to an ambient NO_X concentration, not including background concentrations, that is 2.8% of the annual mean limit value at the worst case ecologically sensitive receptor (Granal Canal pHNA) for the worst-case year whilst levels at the Rye Water Valley/Carton SAC [001398] contributing at most 2.1% of the limit value (not including background levels).

SO_2 emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards for the protection of ecosystems. Emissions under this scenario lead to an ambient SO_2 concentration, excluding background, that is 0.014% of the annual mean limit value at the worst case ecologically sensitive receptor for the worst case.

PM_{10} emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards for the protection of human health in the Grand Canal pNHA. Emissions under this scenario lead to an ambient PM_{10} concentration, excluding background, that is 0.003% of the annual mean limit value at the worst case ecologically sensitive receptor for the worst case.

When pollutants are emitted from the emission sources onsite, they will disperse in the atmosphere and will eventually be indistinguishable from background levels. In this context, a level below 0.1 mg/m^3 is defined as being indistinguishable from background levels. The distance needed to achieve this is given below for each of the parameters (NO_X, SO_2, PM_{10} / $PM_{2.5}$). Irrespective of the distance below, all pollutants at all times remain below the ambient standard for the protection of vegetation in any of the nearby ecological sensitive areas:

- NO_X = 12,200 metres,
- SO_2 = 15 metres,
- PM_{10} = 15 metres,
- $PM_{2.5}$ = 15 metres.

Modelling has been undertaken using five years of historical data from Casement Aerodrome (2017 – 2021). Future meteorological data is not available, however, it is accepted that by using five years of historical data an accurate prediction of worst-case future emissions can be made.

Under the USEPA methodology NO_2 emissions associated with the cumulative assessment of the Google Ireland standby diesel generators, as well as the existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the site are in compliance with the air quality standards. The cumulative assessment involved modelling the Google Ireland standby diesel generators, as well as the continuous operation of existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the site. There are many nearby emission sources and several local maxima across the modelling domain. In order to determine the cumulative impact due to Google Ireland and other nearby facilities, the worst-case receptor due to emissions from Google Ireland has been identified. This off-site receptor has then been modelled based on the operation of all nearby facilities with the cumulative NO_2 modelling results at this worst-case off-site receptor reported.

For the worst-case year, emissions from the site and nearby emission sources lead to an ambient NO_2 concentration (including background) which is 78% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 100% of the annual limit value at the worst-case off-site sensitive receptor. However, based on historical usage of backup generators, the modelling assessment is very conservative and will likely be lower in reality. In addition, there has been conservative assumptions made in regards to all nearby data centre operations also. In addition, the contribution due to NO_2 emissions from Google Ireland at the maximum cumulative offsite receptor is equivalent to only 0.4% of the ambient annual mean NO_2 standard and 56% of the ambient annual mean NO_2 standard. Thus, in line with the cumulative assessment approach outlined in EPA guidance document AG4, the cumulative impact from Google Ireland is not significant.

There are other local maxima in the modelling domain with the overall maxima located 1.3 km to the northwest of the Google Ireland facility. The contribution due to NO_2 emissions from Google Ireland at the maximum cumulative offsite receptor is 0.17 $\mu g/m^3$ which is equivalent to 0.4% of the ambient annual mean NO_2 standard. Likewise, at the maximum offsite receptor due to NO_2 emissions from Google Ireland, the contribution from Google Ireland is 56% of the ambient annual mean NO_2 standard whilst the overall cumulative NO_2 concentration at the Google Ireland maximum location is 65% of the ambient standard (not including background). Thus, in line with the cumulative assessment approach outlined in EPA guidance document AG4 (EPA, 2020), the cumulative impact from Google Ireland is not significant.

The UK Environment Agency assessment methodology determined that in the worst-case year, the Google Ireland standby diesel generators, as well as the existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the site, could operate for a maximum of 263 hours in addition to the site's annual testing regime before there is a likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level) at the worst-case identified receptor near Google Ireland. In addition, the UK guidance recommends that there should be no running time restrictions placed on standby generators which provide power on site only during a power outage.

Summary

Under the USEPA methodology NO_2 emissions associated with the Google Ireland standby diesel generators and based on a cumulative assessment of nearby sites are in compliance with the air quality standards. The UK Environment Agency assessment methodology has determined that in the worst-case year, the Google Ireland standby diesel generators could operate for a maximum of 1,110 hours before there is a likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level).

Cumulative impacts on ambient air quality due to NO_2 emissions from the Google Ireland facility, as well as the existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the facility, has determined based on the UK Environment Agency assessment methodology, that in the worst-case year, the Google Ireland and nearby standby diesel generators could operate for a maximum of 263 hours in addition to the site's annual testing regime before there is a likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level). In addition, the UK guidance recommends that there should be no running time restrictions placed on standby generators which provide power on site only during a power outage.

Through modelling, it is demonstrated that the project does not result in an increase in NO_2 concentrations above ambient limit values for the protection of vegetation or ecosystems in the region of the Google Ireland Data Centre facility nor at further distances away from the facility including the locations of European Sites.

Modelling results based on conservative assumptions indicate that the facility and nearby cumulative emission points will have an imperceptible impact on NO_x concentrations within the sensitive ecosystems (Rye Water Valley/Carton SAC [001398]) contributing at most 2.1% of the limit value (not including background levels) at the worst-case location in the worst-case year modelled and 2.8% of the annual mean limit value at the Grand Canal pHNA for the worst-case year.

In accordance with the EPA's Air Dispersion Modelling Guidance (AG4), ensuring compliance with the ambient Air Quality Standards for NO_2 for the cumulative scenario will ensure compliance for all other pollutants (SO_2, PM_{10}/$PM_{2.5}$) which are all emitted at much lower emission concentrations.

CONTENTS Page

1.0 INTRODUCTION

This report presents a cumulative air quality assessment of the Google Ireland data centre facility located off the Nangor Road, Grangecastle, Co. Dublin. There are a total of 24 no. diesel generators at the Google Ireland data centre, which will provide power to the site when power from the National Grid is not available. The cumulative impact of the Google Ireland standby diesel generators, as well as the existing IED licenced sites, and other neighbouring operational data storage and onsite energy centre facilities in the vicinity of the site was assessed. Air dispersion modelling of operational stage emissions was carried out using the United States Environmental Protection Agency's regulated model AERMOD. The cumulative 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. Additional modelling of the Google Ireland facility was conducted for emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_X) and PM_{10}/$PM_{2.5}$ although due to the lack of relevant information no cumulative modelling of these pollutants was undertaken.

The cumulative scenario involved the scheduled testing of 24 no. standby diesel generators, back-up operations of the standby diesel generators as per the USEPA methodology, licenced emissions from the IE licenced sites of Takeda, Pfizer and Grange Backup Power, as well as emissions from neighbouring proposed and operational data storage facilities and energy centres.

A methodology has been published by the UK Environment Agency (UK EA) and 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 standby generators. The guidance also states that there should be no running time restrictions on generators when providing power on site during a power outage. Both the methodology advised in 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 standby generators.

The site is located in Grange Castle International Business Park, Clondalkin, Dublin 22 which is approximately 13km from Dublin city centre. Most of the land surrounding the site is occupied by industrial campuses including pharmaceutical, data centre, manufacturing and commercial uses (see Figure 1).

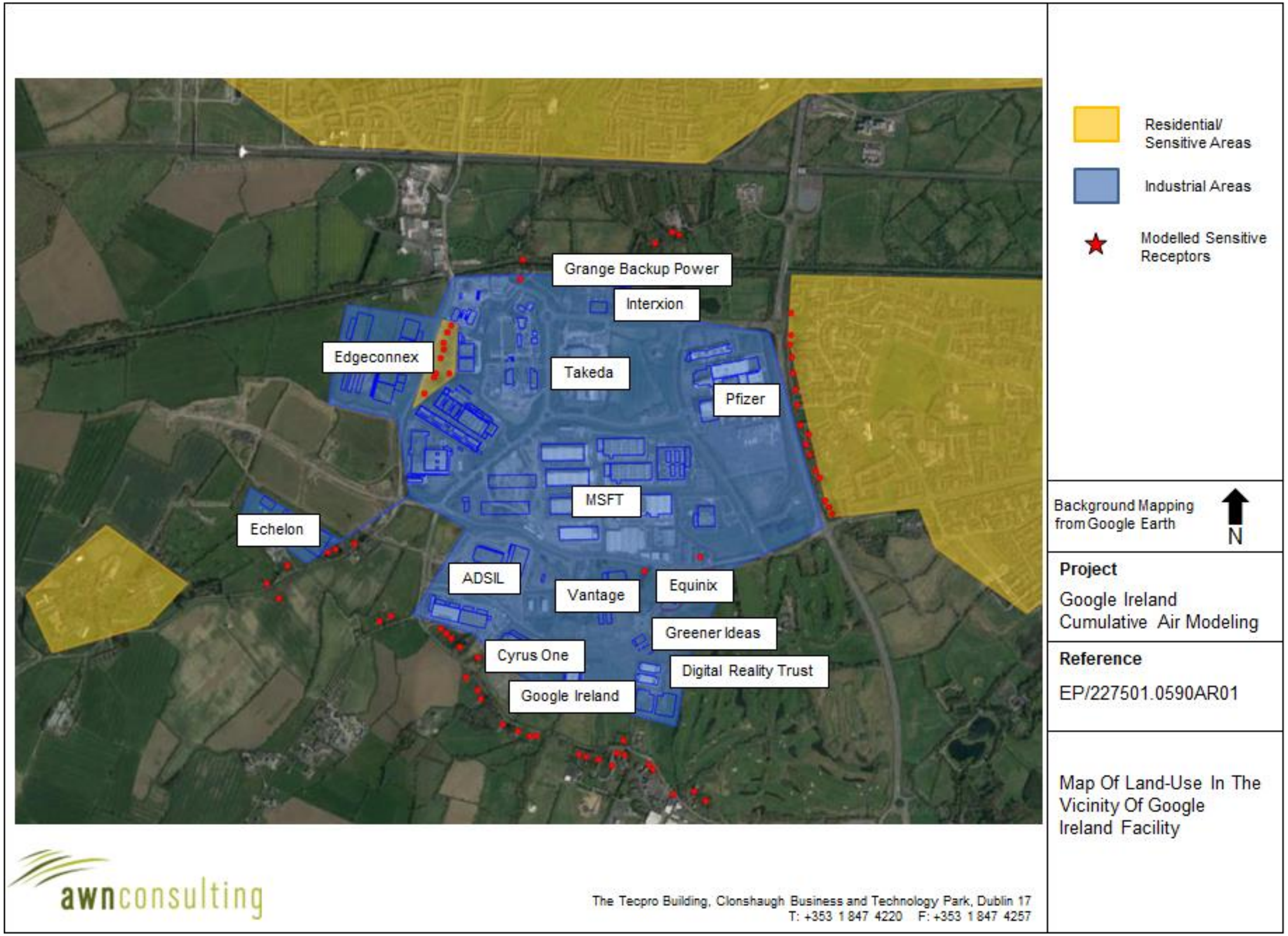


Figure 1 Map Of Land-Use In The Vicinity Of Google Ireland Facility

2.0 ASSESSMENT CRITERIA

2.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or “Air Quality Standards” are health or environmental-based levels for which additional factors may be considered. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC (see **Error! Reference source not found.**). The ambient air quality s tandards applicable for NO_2 are outlined in this Directive.

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. These standards have been used in the current assessment to determine the potential impact of NO_2, NO_X, SO_2 and PM_{10}/$PM_{2.5}$ emissions from the facility on ambient air quality.

Table 1 Air Quality Standards Regulations 2011 (Based on Directive 2008/50/EC and S.I. 180 of 2011)

<table>
<tr><th>Pollutant</th><th>Regulation Note 1</th><th>Limit Type</th><th>Value</th></tr>
<tr><td rowspan="2">Nitrogen Dioxide (NO_2)</td><td rowspan="2">2008/50/EC</td><td>Hourly limit for protection of human health - not to be exceeded more than 18 times/year</td><td>200 µg/m^3</td></tr>
<tr><td>Annual limit for protection of human health</td><td>40 µg/m^3</td></tr>
<tr><td>NO_X</td><td>2008/50/EC</td><td>Critical level for protection of vegetation</td><td>30 µg/m^3 NO + NO_2</td></tr>
<tr><td rowspan="3">Sulphur Dioxide (SO_2)</td><td rowspan="3">2008/50/EC</td><td>Hourly limit for protection of human health - not to be exceeded more than 24 times/year</td><td>350 µg/m^3</td></tr>
<tr><td>Daily limit for protection of human health - not to be exceeded more than 3 times/year</td><td>125 µg/m^3</td></tr>
<tr><td>Critical limit for the protection of ecosystems</td><td>20 µg/m^3</td></tr>
<tr><td rowspan="2">Particulate Matter (as PM_{10})</td><td rowspan="2">2008/50/EC</td><td>24-hour limit for protection of human health - not to be exceeded more than 35 times/year</td><td>50 µg/m^3</td></tr>
<tr><td>Annual limit for protection of human health</td><td>40 µg/m^3</td></tr>
<tr><td>Particulate Matter (as $PM_{2.5}$)</td><td>2008/50/EC</td><td>Annual limit for protection of human health</td><td>25 µg/m^3</td></tr>
</table>

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

3.0 ASSESSMENT METHODOLOGY

Emissions from the facility have been modelled using the AERMOD dispersion model (Version 22112) which has been developed by the U.S. Environmental Protection Agency (USEPA)[1] and following guidance issued by the EPA[2]. The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources and has replaced ISCST3[3] as the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain[4-6]. The model has more advanced algorithms and gives better agreement with monitoring data in extensive validation studies[6-10]. An overview of the AERMOD dispersion model is outlined in Appendix I.

The air dispersion modelling input data consisted of information on the physical environment (including building dimensions and terrain features), design details from all emission points on-site and five years of appropriate hourly meteorological data. Using this input data the model predicted ambient ground level concentrations beyond the site boundary for each hour of the modelled meteorological years. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration was then added to the background concentration to give the worst-case predicted environmental concentration (PEC). The PEC was then compared with the relevant ambient air quality standard to assess the significance of the releases from the site.

The modelling aims to achieve compliance with the guidance outlined within Appendix K of the EPA document *AG4 Guidance for Air Dispersion Modelling*[2] .

Throughout this study a conservative approach was taken. This will most likely lead to an over-estimation of the levels that will arise in practice. The conservative assumptions are outlined below:

- Maximum predicted concentrations were reported in this study, even if no residential receptors were near the location of this maximum;
- Conservative background concentrations were used in the assessment;
- The effects of building downwash, due to on-site buildings, has been included in the model;
- For the cumulative assessment, onsite gas generators at neighbouring facilities were assumed to be in continuous operation 24 hours per day, 365 days per year;
- A conservative assumption has been made for the purpose of the air dispersion modelling assessment that the offsite standby generators associated with other data storage facilities will be tested weekly with one generator tested within any one hour;
- The number of allowable operational hours for back-up operations was determined using the UK Environment Agency (UK EA) methodology as outlined in Section 6.6. The UK EA modelling found that for the cumulative scenario, the back-up generators could operate for 263 hours per year.
- For the USEPA methodology, a default 150 hours of operation was assumed; and
- IE Licensed emission points for the Takeda, Pfizer and Grange Backup Power sites were assumed to be in operation 24 hours per day, 365 days per year.

3.1 Air Dispersion Modelling Methodology

The United States Environmental Protection Agency (USEPA) approved AERMOD dispersion model has been used to predict the ground level concentrations (GLC) of compounds emitted from the principal emission sources on-site.

The modelling incorporated the following features:

- Two receptor grids were created at which concentrations would be modelled. Receptors were mapped with sufficient resolution to ensure all localised “hot-spots” were identified without adding unduly to processing time. The receptor grids were based on Cartesian grids with the site at the centre. Modelling was carried out covering an area of 8 km x 8 km with the site at the centre. An outer grid was mapped with 200 m resolution. The inner (fine) grid consisted of receptors every 100 m extended to 2.0 km from the site. The total calculation points for the gridded modelling including boundary receptors and discrete receptors are 4,932.

- Discrete receptors were also added to the model to represent nearby residential 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.

- Detailed terrain has been mapped into the model using SRTM data with 30m resolution. The site is located in an area of complex terrain. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP[11].

- Hourly-sequenced meteorological information has been used in the model. Meteorological data over a five year period (Casement Aerodrome 2017 – 2021) was used in the model (see Figure 2 and Appendix II).

- The source and emissions data, including stack dimensions, gas volumes and emission temperatures have been incorporated into the model.

3.2 Terrain

The AERMOD air dispersion model has a terrain pre-processor AERMAP[11] which was used to map the physical environment in detail over the receptor grid. The digital terrain input data used in the AERMAP pre-processor was obtained from SRTM. This data was run to obtain for each receptor point the terrain height and the terrain height scale. The terrain height scale is used in AERMOD to calculate the critical dividing streamline height, H_{crit}, for each receptor. The terrain height scale is derived from the Digital Elevation Model (DEM) files in AERMAP by computing the relief height of the DEM point relative to the height of the receptor and determining the slope. If the slope is less than 10%, the program goes to the next DEM point. If the slope is 10% or greater, the controlling hill height is updated if it is higher than the stored hill height.

In areas of complex terrain, AERMOD models the impact of terrain using the concept of the dividing streamline (H_c). As outlined in the AERMOD model formulation[1] a plume embedded in the flow below H_c tends to remain horizontal; it might go around the hill or impact on it. A plume above H_c will ride over the hill. Associated with this is a tendency for the plume to be depressed toward the terrain surface, for the flow to speed up, and for vertical turbulent intensities to increase.

AERMOD model formulation states that the model "captures the effect of flow above and below the dividing streamline by weighting the plume concentration associated with two possible extreme states of the boundary layer (horizontal plume and terrain-following). The relative weighting of the two states depends on: 1) the degree of atmospheric stability; 2) the wind speed; and 3) the plume height relative to terrain. In stable conditions, the horizontal plume "dominates" and is given greater weight while in neutral and unstable conditions, the plume traveling over the terrain is more heavily weighted"[4].

3.3 Meteorological Data

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA[1]. A primary requirement is that the data used should have a data capture of greater than 90% for all parameters. Casement Aerodrome meteorological station, which is located approximately 1.5 km south of the site, collects data in the correct format and has a data collection of greater than 90%. Long-term hourly observations at Casement Aerodrome meteorological station provide an indication of the prevailing wind conditions for the region (see Figure 2 and Appendix II)[12]. Results indicate that the prevailing wind direction is westerly to south-westerly in direction over the period 2017 – 2021. The mean wind speed is approximately 5.5 m/s over the period 2017 – 2021.

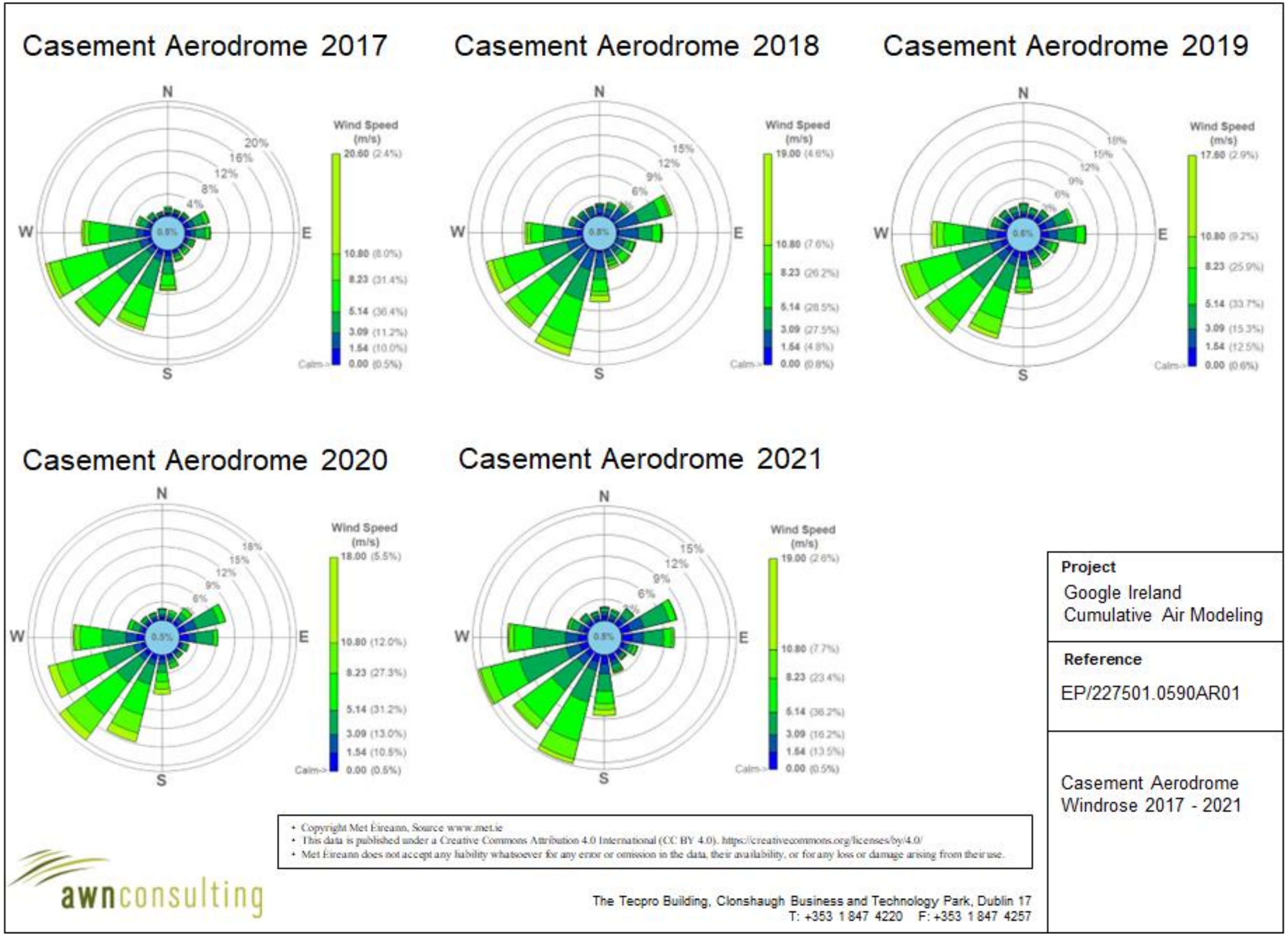


Figure 2 Casement Aerodrome Windrose 2017-2021

3.4 Geophysical Considerations

AERMOD simulates the dispersion process using planetary boundary layer (PBL) scaling theory[1]. PBL depth and the dispersion of pollutants within this layer are influenced by specific surface characteristics such as surface roughness, albedo and the availability of surface moisture. Surface roughness is a measure of the aerodynamic roughness of the surface and is related to the height of the roughness element. Albedo is a measure of the reflectivity of the surface whilst the Bowen ratio is a measure of the availability of surface moisture.

AERMOD incorporates a meteorological pre-processor AERMET[13] to enable the calculation of the appropriate parameters. The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and albedo and to a distance of 1km for surface roughness in line with USEPA recommendations[13,14] as outlined in Appendix II.

In relation to AERMOD, detailed guidance for calculating the relevant surface parameters has been published[15]. The most pertinent features are:

- The surface characteristics should be those of the meteorological site (Casement Aerodrome) rather than the installation;
- Surface roughness should use a default 1km radius upwind of the meteorological tower and should be based on an inverse-distance weighted geometric mean. If land use varies around the site, the land use should be sub-divided by sectors with a minimum sector size of 30º;
- Bowen ratio and albedo should be based on a 10km grid. The Bowen ratio should be based on an un-weighted geometric mean. The albedo should be based on a simple un-weighted arithmetic mean.

AERMOD has an associated pre-processor, AERSURFACE[14] which has representative values for these parameters depending on land use type. The AERSURFACE pre-processor currently only accepts NLCD92 land use data which covers the USA. Thus, manual input of surface parameters is necessary when modelling in Ireland. Ordnance survey discovery maps (1:50,000) and digital maps such as those provided by the EPA, National Parks and Wildlife Service (NPWS) and Google Earth® are useful in determining the relevant land use in the region of the meteorological station. The Alaska Department of Environmental Conservation has issued a guidance note for the manual calculation of geometric mean for surface roughness and Bowen ratio for use in AERMET[15]. This approach has been applied to the current site with full details provided in Appendix II.

3.5 Building Downwash

When modelling emissions from an industrial installation, stacks which are relatively short can be subjected to additional turbulence due to the presence of nearby buildings. Buildings are considered nearby if they are within five times the lesser of the building height or maximum projected building width (but not greater than 800m).

The USEPA has defined the “Good Engineering Practice” (GEP) stack height as the building height plus 1.5 times the lesser of the building height or maximum projected building width. It is generally considered unlikely that building downwash will occur when stacks are at or greater than GEP[16].

When stacks are less than this height, building downwash will tend to occur. As the wind approaches a building it is forced upwards and around the building leading to the formation of turbulent eddies. In the lee of the building these eddies will lead to downward mixing (reduced plume centreline and reduced plume rise) and the creation of a cavity zone (near wake) where re-circulation of the air can occur. Plumes released from short stacks may be entrained in this airflow leading to higher ground level concentrations than in the absence of the building.

Given that the facility stacks are less than 2.5 times the lesser of the building height or maximum projected building width, building downwash will need to be taken into account and the PRIME algorithm run prior to modelling with AERMOD. The dominant building for each relevant stack will vary as a function of wind direction and relative building heights.

4.0 BACKGROUND CONCENTRATIONS OF POLLUTANTS

Air quality monitoring programmes have been undertaken in recent years by the EPA and Local Authorities(17). The most recent annual report on air quality "*Air Quality in Ireland 2021*" (17), 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(17). 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, Grangecastle is categorised as Zone A(17).

In 2020 the EPA reported(17) that Ireland was compliant with EU legal limits at all locations, however this was largely due to the reduction in traffic due to Covid-19 restrictions. The EPA report details the effect that the Covid-19 restrictions had on stations, which included reductions of up to 50% at some monitoring stations which have traffic as a dominant source. The report also notes that CSO figures show that while traffic volumes are still slightly below 2019 levels, they have significantly increased since 2020 levels. 2020 concentrations are therefore predicted to be an exceptional year and not consistent with long-term trends. For this reason, data from 2020 has been included for representative purposes only and has not been used in determining background concentrations in the region of the facility.

With regard to NO_2, continuous monitoring data from the EPA(17), at suburban Zone A background locations in Rathmines, Swords and Ballyfermot show that current levels of NO_2 are below both the annual and 1-hour limit values, with annual average levels ranging from 11 - 14 µg/m^3 in 2021 (see Table 1). Sufficient data is available for the station in Swords to observe long-term trends over the period 2016 – 2021(17), with annual average results ranging from 11 – 16 µg/m^3. The monitoring station at Ballyfermot is 7 km from the Google Ireland facility, however, levels at Ballyfermot are based on a roadside location and thus will overestimate background levels in the region. Based on these results, an estimate of the current background NO_2 concentration in the region of the facility is 14 µg/m^3.

Table 1 Annual Mean and 99.8th Percentile 1-Hour NO_2 Concentrations In Zone A Locations (µg/m^3)

Station	Averaging Period	Year					
		2016	2017	2018	2019	2020	2021
Rathmines	Annual Mean NO_2 (µg/m^3)	20	17	20	22	13	14
	99.8^{tho}%ile 1-hr NO_2 (µg/m^3)	88	86	87	102	-	-
Swords	Annual Mean NO_2 (µg/m^3)	16	14	16	15	11	11
	99.8^{tho}%ile 1-hr NO_2 (µg/m^3)	96	79	85	80	-	-
Ballyfermot	Annual Mean NO_2 (µg/m^3)	17	17	17	20	12	13
	99.8^{tho}%ile 1-hr NO_2 (µg/m^3)	90	112	101	101	-	-

Note 1 Annual average limit value of 40 µg/m^3 and hourly limit value of 200 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011)

Note 2 2020 data shown for representative purposes only, not used in determining background concentrations

Continuous SO_2 monitoring carried out at the suburban background locations of Rathmines, Tallaght and Ringsend showed annual mean concentrations ranging from 1 – 3 µg/m^3 in 2021 (see Table 3), with no exceedances of the hourly limit value of 125 µg/m^3 (3 daily exceedances are permitted per year) and daily limit value of 350 µg/m^3

(24 hourly exceedances are permitted per year)[17]. Based on this information, the estimated background SO_2 concentration in the region of the facility in 2022 is 3 µg/m^3.

Table 3 Annual Mean SO_2 Concentrations In Representative Zone A Locations 2016 - 2021 (µg/m^3)

Year	Rathmines	Tallaght	Ringsend
2016	2	-	-
2017	2	4	4
2018	2	3	3
2019	3	1	1
2020	1	-	2
2021	1	-	3
Average	**2**	**2**	**3**

Note 1 2020 data shown for representative purposes only, not used in determining background concentrations

Continuous PM_{10} monitoring was carried out at the Zone A locations of Rathmines, Dun Laoghaire, Ballyfermot, Phoenix Park and Winetavern Street from 2016 – 2021. Annual mean concentrations range from 9 – 16 µg/m^3 over the five-year period (see Table 4) with at most 9 exceedances of the 24-hour limit value of 50 µg/m^3 in Rathmines and Winetavern Street in 2021, albeit 35 exceedances are permitted per year[17]. Based on the EPA data, a conservative estimate of the current background PM_{10} concentration in the region of the facility is 15 µg/m^3. Based on a review of $PM_{2.5}/PM_{10}$ ratios in Zone A areas, a conservative value of 0.70 has been used giving a background value of 10.5 µg/m^3.

Table 4 Annual Mean And 24-Hr 90th%ile PM_{10} Concentrations In Representative Zone A Locations 2016 - 2021 (µg/m^3)

Station	Averaging Period	Year					
		2016	2017	2018	2019	2020	2021
Ballyfermot	Annual Mean PM_{10} (µg/m^3)	11	12	16	14	12	12
	24-hr Mean > 50 µg/m^3 (days)	0	1	0	7	2	0
Dún Laoghaire	Annual Mean PM_{10} (µg/m^3)	13	12	13	12	12	11
	24-hr Mean > 50 µg/m^3 (days)	0	2	0	2	0	0
Tallaght	Annual Mean PM_{10} (µg/m^3)	14	12	15	12	10	10
	24-hr Mean > 50 µg/m^3 (days)	0	2	1	3	0	0
Rathmines	Annual Mean PM_{10} (µg/m^3)	15	13	15	15	11	12
	24-hr Mean > 50 µg/m^3 (days)	3	5	2	9	2	0
Phoenix Park	Annual Mean PM_{10} (µg/m^3)	11	9	11	11	10	10
	24-hr Mean > 50 µg/m^3 (days)	0	1	0	2	0	0

Note 1 2020 data shown for representative purposes only, not used in determining background concentrations

In summary, existing baseline levels of the pollutants based on extensive long-term data from the EPA are expected to be below ambient air quality limit values in the vicinity of the facility.

The Ozone Limiting Method (OLM) was used to model NO_2 concentrations. The ratio of the moles of O_3 to the moles of NO_X gives the ratio of NO_2/NO_X that is formed after the NO_X leaves the stack. In addition, in relation to diesel backup generators, it has been assumed that 5% of the NO_X in the stack gas is already in the form of NO_2 before the gas leaves the stack (in reality the levels are usually closer to 2%)[18]. Recent data from a report incorporated into the USEPA In-stack Ration Database, authored by EPRI, has found that default values are too conservative, and that real-world ratios of in-stack NO_2/NO_X ratios are in the region of 2% for diesel boilers / generators with levels for gas engines likely to be in the region of 20%(18,19). Thus, for gas generators, a NO_2/NO_X ratio of 0.20 has been used which reflects the higher initial percentage of NO_2 which is released from gas engines. The model has also assumed a final equilibrium ratio for NO_2/NO_X of 0.90 which again is pessimistic and more likely to be in the range 0.7 – 0.8. The equation used in the algorithm to derive the ratio of NO_2/NO_X is:

$$NO_2/NO_X = (\text{moles } O_3/ \text{ moles } NO_X) + 0.10$$

A background ozone concentration of 55 $\mu g/m^3$ was used in the modelling assessment, based on a review of worst case background ozone data for Zone A sites(17).

In relation to the annual averages, the ambient background concentration was added directly to the process concentration. In relation to the short-term peak concentrations, for NO_2 these were assumed to have an ambient background concentration of twice the annual mean background concentration. However, emissions of SO_2 and PM_{10} from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA(20) and EPA(2) advises that for SO_2 an estimate of the maximum combined pollutant concentration can be obtained as shown below:

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

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

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

SO_2 - The 99.2th%ile of total 24-hour mean SO_2 is equal to the maximum of either A or B below:

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

b) 99.2th%ile of 24-hour mean process contribution SO_2 + (2 x annual mean background concentration SO_2).

Guidance from the UK DEFRA(20) and EPA(2) advises that for PM_{10} an estimate of the maximum combined pollutant concentration can be obtained as shown below:

PM_{10} - The 90.4th%ile of total 24-hour mean PM_{10} is equal to the maximum of either A or B below:

a) 90.4th%ile of 24-hour mean background PM_{10} + annual mean process contribution PM_{10}

b) 90.4th%ile 24-hour mean process contribution PM_{10} + annual mean background PM_{10}

5.0 PROCESS EMISSIONS

The Google Ireland data centre has 24 no. diesel generators, which will provide power to the site when power from the National Grid is not available.

Modelling for NO_2, SO_2 and PM_{10}/$PM_{2.5}$ was undertaken in detail for these generators. In relation to CO no detailed modelling was undertaken. Emissions of CO 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 CO. 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 µg/m^3 compared to the 1-hour NO_2 standard of 200 µg/m^3.

Various testing regimes for the back-up generators have also been included in the model as outlined below, all testing was assumed to occur from 8am to 5pm, Monday to Friday only.

- **Test 1 (Monthly Maintenance):** Testing eleven times per year of all 24 no. back-up generators on the campus at 0% load for a maximum of 30 minutes each, one generator at a time, sequentially.
- **Test 2 (Annual Maintenance):** All 24 no. back-up generators will be tested individually for 90 minutes at 100% load once per year.
- **Test 3 (Electrical Maintenance Building 1):** All 7 no. back-up generators on Building 1 will be tested individually for 60 minutes at 100% load once per year. In addition, all Building 1 generators will be tested for 12 hours, with no more than three running together once every three years.
- **Test 3 (Electrical Maintenance Building 2):** All 17 no. back-up generators on Building 2 will be tested, with either eight or nine running together for 24 hours at 100% load once every three years. In addition, all BUILDING1 generators will be tested for 12 hours, with no more than three running together once every three years.
- **Test 4 (MDC Building 1):** All 7 no. back-up generators on Building 1 will be tested together for 12 hours at 100% load once every three years.
- **Test 4 (MDC Building 2):** All 17 no. back-up generators on Building 2 will be tested together for 12 hours at 100% load once every three years.
- **Miscellaneous operation** – an allowance for the operation of all 24 generators to operate 5 hours per year on an individual basis at 100% load each year.

The emission details associated with the generators on Building 1 and Building 2 are shown in Table 5.

Table 5 Process Emission Details for Google Ireland Assessment

Stack Reference	Stack Height Above Ground Level (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temp (K)	Volume Flow (Nm^3/hr at 15% Ref. O_2)	Exit Velocity (m/sec actual)	NO_x		SO_2		PM_{10} / $PM_{2.5}$	
							Concentration (mg/Nm^3 at 15% Ref. O_2)	Mass Emission (g/s)	Concentration (mg/Nm^3 at 15% Ref. O_2)	Mass Emission (g/s)	Concentration (mg/Nm^3 at 15% Ref. O_2)	Mass Emission (g/s)
Building 1	17	0.60	0.28	758	13,622	22.3	1,298	0.084 Note 1 / 4.91 Note 2	3.7	0.00024 Note 1 / 0.014 Note 2	3.7	0.00024 Note 1 / 0.014 Note 2
Building 2	25	0.70	0.39	688	22,146	24.1	1,046	0.110 Note 1 / 6.44 Note 2	3.7	0.00039 Note 1 / 0.023 Note 2	3.7	0.00039 Note 1 / 0.023 Note 2

Note 1 Reduced emission rates based on USEPA protocol (assuming 150 hours / annum) used to model emissions during annual testing of the back-up operation of generators (100% load)

Note 2 Maximum emission rates for diesel generators (based on 100% load) used to model emissions during back-up operation of generators for UK EA assessment methodology and for testing using the USEPA assessment methodology

USEPA Guidance suggests that for back-up operations, an average hourly emission rate should be used rather than the maximum hourly rate[21]. As a result, the maximum hourly emission rates from the back-up generators were reduced by $\frac{150}{8760}$ and the generators were modelled over a period of one full year for the annual testing and maintenance. 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.

A second methodology has been published by the UK Environment Agency. The consultation document is entitled "*Diesel Generator Short-Term NO_2 Impact Assessment*"[22, 23]. This more recent 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 back-up operational hours of the 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 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 a power outage. The assessment produces the allowable hours of operation under backup operations in addition to the site's testing and maintenance regime

Both the methodology advised in the USEPA guidance as well as the approach described in the UK EA guidance have been applied for the scenarios modelled in this study to ensure a robust assessment of predicted air quality impacts from the standby generators. This also follows the guidance outlined in Appendix K of the EPA AG4 guidance[2].

The cumulative impact scenario assessed the combined impact of the facility as outlined above as well as scheduled testing emissions associated with standby diesel generators in the neighbouring proposed and operational data storage facilities obtained from relevant planning permission applications (ADSIL, Cyrus One, Equinix, Interxion, Edgeconnex, Echelon, Microsoft, Digital Reality Trust and Vantage Data Centres Dub 11 Ltd) as well as proposed energy centres (Greener Ideas Limited, Equinix and Vantage Data Centres Dub 11 Ltd). Emissions from nearby IED licensed sites including Pfizer, Takeda and Grange Backup Power were also included in the cumulative modelling. These IED licensed emission points emit air pollutants on an essentially continuous basis over the course of a year. Nearby data storage facilities have emission points (standby diesel generators) which are classified as potential emission points as these will only operate under exceptional circumstances and thus will not be in operation on a day-to-day basis. For this reason, although the testing of these generators has been included in the cumulative scenario, the back-up operations emission points associated with other nearby data storage facilities were not considered for the purpose of this assessment. This approach is in line with the methodology of AG4[2].

The process emissions used for the cumulative scenario are outlined in Table 6.

Table 6 Process Emission Details for Cumulative Assessment

Stack Reference	Height Above Ground Level (m)	Exit Diameter (m)	Temp (K)	Exit Velocity (m/sec actual)	NO_2 Mass Emission (g/s)
Microsoft (DUB03) Generators	31.5	0.6	784.15	26.5	3.77
Microsoft (DUB04) Generators	18.1	0.6	833.15	34.8	8.38
Microsoft (DUB05) Generators	25	0.6	833.15	34.8	2.52
Microsoft (DUB06) Generators	25	0.6	833.15	34.8	2.52
Microsoft (DUB07) Generators	25	0.6	833.15	34.8	2.52
Microsoft (DUB08) Generators	25	0.6	833.15	34.8	2.52
Microsoft (DUB09) Generators	25	0.8	733.85	23.4	1.40
Microsoft (DUB10) Generators	25	0.8	733.85	23.4	1.40
Microsoft (DUB11) Generators	30	0.6	833.15	34.8	2.52
Microsoft (DUB12) Generators	24	0.8	733.85	23.4	1.40
Microsoft (DUB13) Generators	23.25	0.8	733.85	23.4	1.40
Microsoft (DUB14) Gas Generators	25	0.7	633.15	36.9	0.97
Microsoft (DUB15) Generators	30.75	0.8	733.85	23.4	1.40
IE Reg. No. P1170-01 Building A Generators	25	0.508	754.15	46.0	4.39
IE Reg. No. P1170-01 Building B Generators	25	0.508	754.15	46.0	4.39
IE Reg. No. P1170-01 Building C Generators	25	0.508	754.15	46.0	4.39
IE Reg. No. P1184-01 Generators	20	0.555	754.15	46.0	4.39
Cyrus One Generators	20	0.555	754.15	46.0	4.39
IE Reg. No. P1165-01DUB40 Gas Engines	25	1.6	656.15	27.2	1.89
IE Reg. No. P1165-01DUB40 Generators	25	0.6	833.15	33.6	7.29
Edgeconnex Gas Engines	25	0.7	673.15	14.7	0.22
Edgeconnex Phase 1 Generators	15	0.5	805.15	37.5	1.14
Edgeconnex Phase 2 Generators	15	0.5	805.15	37.5	1.14
Edgeconnex Phase 3 Generators	15	0.5	805.15	37.5	1.14
Edgeconnex DUB03 Generators	15	0.41	743	39.34	1.14
Edgeconnex DUB04 Generators	15	0.4	762.15	63	0.48
Edgeconnex DUB05 Generators	25	0.65	773	21.4	0.81
Interxion (DUB03) Generators	17	0.6	500	3.27	0.62

Stack Reference	Height Above Ground Level (m)	Exit Diameter (m)	Temp (K)	Exit Velocity (m/sec actual)	NO_2 Mass Emission (g/s)
Interxion (DUB04) Generators	17	0.5	833.15	44.56	1.49
Digital Reality Trust (DUB13) Generators	20	0.51	881.15	35	0.645
Digital Reality Trust (DUB14) Generators	20	0.51	881.15	35	0.645
Digital Reality Trust (DUB15) Generators	20	0.51	881.15	35	0.645
Digital Reality Trust (DUB16) Generators	20	0.51	881.15	35	0.645
Vantage (DUB11) Gas Generators	30	1.2	633.15	28.4	0.20
Vantage (DUB11) Generators	22.3	0.6	695	10	1.05
Equinix OSPG (Gas Generators)	14	0.4	707.15	50.4	0.38
Equinix DB8 Diesel generators	20	0.6	736.15	20.8	7.30
Pfizer A1-1	45	0.85	441	10.9	0.29
Pfizer A1-2	45	0.85	441	10.9	0.29
Pfizer A1-3	45	0.85	441	10.9	0.29
Pfizer A2-1	45	2	441	9.15	1.33
Pfizer A2-1	45	0.85	441	10.9	1.33
Takeda EP-UT-01	15	0.55	453.15	12.12	0.19
Takeda EP-P1-04	12	0.25	523.15	6.56	0.017
Grange A2-1	25	2.77	663.15	27.6	4.5
Grange A2-2	25	3.2	663.15	27.6	6.0

6.0 RESULTS

6.1 NO_2 - Google Ireland Assessment (USEPA Methodology)

The assessment involved modelling the Google Ireland standby diesel generators in isolation based on 150 hours of back-up operation per year in addition to scheduled testing. The NO_2 modelling results at the worst-case off-site receptor are detailed in Table 7. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for NO_2. For the worst-case year, emissions from the site lead to an ambient NO_2 concentration (including background) which is 78% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 92% of the annual limit value at the most impacted off-site sensitive receptor.

The geographical variations in ground level NO_2 concentrations beyond the facility boundary for the worst-case years modelled are illustrated as concentration contours in Figure 3 and Figure 4.

Table 7 Dispersion Model Results for Nitrogen Dioxide (NO_2) – Google Ireland Assessment

Pollutant / Meteorological Year	Averaging Period	Background ($\mu g/m^3$)	Process Contribution ($\mu g/m^3$)	Predicted Emission Concentration ($\mu g/m^3$)	Standard ($\mu g/m^3$) Note 1	PEC as a % of Limit Value
NO_2 / 2017	99.8th%ile of 1-hr means	28	95.9	123.9	200	62%
	Annual mean	14	22.7	36.7	40	92%
NO_2 / 2018	99.8th%ile of 1-hr means	28	127.8	155.8	200	78%
	Annual mean	14	20.4	34.4	40	86%
NO_2 / 2019	99.8th%ile of 1-hr means	28	91.0	119.0	200	60%
	Annual mean	14	20.2	34.2	40	86%
NO_2 / 2020	99.8th%ile of 1-hr means	28	77.1	105.1	200	53%
	Annual mean	14	20.2	34.2	40	86%
NO_2 / 2021	99.8th%ile of 1-hr means	28	109.0	137.0	200	69%
	Annual mean	14	20.1	34.1	40	85%

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

6.2 NO_2 - Google Ireland Assessment (UK Environment Agency Methodology)

Emissions from the Google Ireland standby diesel generators were assessed using the UK Environment Agency methodology[22,23]. The methodology, based on considering the statistical likelihood of an exceedance of the NO_2 hourly limit value assuming a hypergeometric distribution, has been undertaken at the worst-case residential receptor. The hypergeometric distribution of 19 and more hours per year was computed and the probability of an exceedance determined as outlined in Table . The results have been compared to the 98th percentile confidence level to indicate if an exceedance is likely at various operational hours for the facility. The results indicate that the facility can operate for a maximum of 1,110 hours in any given year without the likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level).

Table 8 Hypergeometric Statistical Results at Worst-Case Residential Receptor – NO_2

Pollutant / Meteorological 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 / 2017	1,680	**0.02**
NO_2 / 2018	2,030	
NO_2 / 2019	1,120	
NO_2 / 2020	1,110	
NO_2 / 2021	1,220	

Note 1 Guidance Outlined In UK EA publication "Diesel Generator Short-Term NO_2 Impact Assessment"[23]

6.3 Google Ireland SO_2 Assessment

The assessment involved modelling the Google Ireland standby diesel generators in isolation based on 150 hours of back-up operation per year in addition to scheduled testing. The SO_2 modelling results at the worst-case off-site receptor are detailed in Table 9. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for SO_2. For the worst-case year, emissions from the site lead to an ambient SO_2 concentration (including background) which is 2.5% of the maximum ambient 1-hour limit value (measured as a 99.7th percentile) and 5.2% of the maximum ambient 24-hour limit value (measured as a 99.2nd percentile) at the most impacted off-site sensitive receptor. The annual mean SO_2 concentration peaks at 15.6% of the limit value for the protection of ecosystems although this standard does not apply at the boundary of the facility.

The geographical variations in ground level SO_2 concentrations beyond the facility boundary for the worst-case years modelled are illustrated as concentration contours in Figure 5 and Figure 6.

Table 9 Dispersion Model Results for Sulphur Dioxide (SO_2) – Google Ireland Assessment

Pollutant / Meteorological Year	**Averaging Period**	**Background (µg/m^3)**	**Process Contribution (µg/m^3)**	**Predicted Emission Concentration (µg/m^3) Note 2, 3**	**Standard (µg/m^3) Note 1**	**PEC as a % of Limit Value**
SO_2 / 2017	99.7th%ile of 1-hr means	6	1.74	7.74	350	2.2%
	99.2th%ile of 24-hr means	6	0.44	6.44	125	5.2%
	Annual Mean	3	0.11	3.11	20	15.6%
SO_2 / 2018	99.7th%ile of 1-hr means	6	2.91	8.91	350	2.5%
	99.2th%ile of 24-hr means	6	0.50	6.50	125	5.2%
	Annual Mean	3	0.098	3.10	20	15.5%
SO_2 / 2019	99.7th%ile of 1-hr means	6	1.59	7.59	350	2.2%
	99.2th%ile of 24-hr means	6	0.42	6.42	125	5.1%
	Annual Mean	3	0.095	3.10	20	15.5%
SO_2 / 2020	99.7th%ile of 1-hr means	6	0.97	6.97	350	2.0%
	99.2th%ile of 24-hr means	6	0.45	6.45	125	5.2%
	Annual Mean	3	0.086	3.09	20	15.4%
SO_2 / 2021	99.7th%ile of 1-hr means	6	1.73	7.73	350	2.2%
	99.2th%ile of 24-hr means	6	0.46	6.46	125	5.2%
	Annual Mean	3	0.094	3.09	20	15.5%

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

Note 2 1-hr Background Concentration (as a 99.7thile) for Rathmines in 2019 = 9.6 μg/m^3.

Note 2 24-hr Background Concentration (as a 99.2thile) for Rathmines in 2019 = 3.7 μg/m^3.

6.4 Google Ireland PM_{10} / $PM_{2.5}$ Assessment

The assessment involved modelling the Google Ireland standby diesel generators in isolation based on 150 hours of back-up operation per year in addition to scheduled testing. The PM_{10} and $PM_{2.5}$ modelling results at the worst-case off-site receptor are detailed in Table and Table 11 respectively. The results indicate that the ambient ground level concentrations are below the relevant air quality standards for both PM_{10} and $PM_{2.5}$. For the worst-case year, emissions from the site lead to an ambient PM_{10} concentration (including background) which is 52% of the maximum ambient 24-hour limit value (measured as a 90th percentile) and 38% of the annual mean limit value at the most impacted off-site sensitive receptor. In addition, for the worst-case year, emissions from the site lead to an ambient $PM_{2.5}$ concentration (including background) which is 42% of the annual mean limit value at the most impacted off-site sensitive receptor.

The geographical variations in ground level PM_{10} concentrations beyond the facility boundary for the worst-case years modelled are illustrated as concentration contours in Figure 7 and Figure 8.

Table 10 Dispersion Model Results for PM_{10} – Google Ireland Assessment

Pollutant / Meteorological Year	Averaging Period	Background ($\mu g/m^3$)	Process Contribution ($\mu g/m^3$)	Predicted Emission Concentration ($\mu g/m^3$) Note 2	Standard ($\mu g/m^3$) Note 1	PEC as a % of Limit Value
PM_{10} / 2017	90th%ile of 24-hr means	25.6	0.14	25.7	50	51%
	Annual mean	15.0	0.11	15.1	40	38%
PM_{10} / 2018	90th%ile of 24-hr means	25.6	0.14	25.7	50	51%
	Annual mean	15.0	0.10	15.1	40	38%
PM_{10} / 2019	90th%ile of 24-hr means	25.6	0.14	25.7	50	51%
	Annual mean	15.0	0.10	15.1	40	38%
PM_{10} / 2020	90th%ile of 24-hr means	25.6	0.15	25.8	50	52%
	Annual mean	15.0	0.09	15.1	40	38%
PM_{10} / 2021	90th%ile of 24-hr means	25.6	0.14	25.7	50	51%
	Annual mean	15.0	0.09	15.1	40	38%

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

Note 2 24-hr Background Concentration (as a 90thile) for Ballyfermot in 2019 = 25.6 $\mu g/m^3$.

Table 11 Dispersion Model Results for $PM_{2.5}$ – Google Ireland Assessment

Pollutant / Meteorological Year	Averaging Period	Background ($\mu g/m^3$)	Process Contribution ($\mu g/m^3$)	Predicted Emission Concentration ($\mu g/m^3$) Note 2	Standard ($\mu g/m^3$) Note 1	PEC as a % of Limit Value
$PM_{2.5}$ / 2017	Annual Mean	10.5	0.11	10.61	25	42%
$PM_{2.5}$ / 2018	Annual Mean	10.5	0.10	10.60	25	42%
$PM_{2.5}$ / 2019	Annual Mean	10.5	0.10	10.60	25	42%
$PM_{2.5}$ / 2020	Annual Mean	10.5	0.09	10.59	25	42%
$PM_{2.5}$ / 2021	Annual Mean	10.5	0.09	10.59	25	42%

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

6.5 NO_2 - Cumulative Assessment (USEPA Methodology)

The cumulative assessment involved modelling the Google Ireland standby diesel generators, as well as the continuous operation of existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the site based on the Scenario outlined in Section 5.0.

There are many nearby emission sources and several local maxima across the modelling domain. In order to determine the cumulative impact due to Google Ireland and other nearby facilities, the worst-case receptor due to emissions from Google Ireland has been identified. This off-site receptor has then been modelled based on the operation of all nearby facilities with the cumulative NO_2 modelling results at this worst-case off-site receptor detailed in Table .

For the worst-case year, emissions from the site and nearby emission sources lead to an ambient NO_2 concentration (including background) which is 78% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 100% of the annual limit value at the worst-case off-site sensitive receptor.

The geographical variations in ground level NO_2 concentrations beyond the facility boundary for the worst-case years modelled are illustrated as concentration contours in Figure 9 and Figure 10.

Table 12 Dispersion Model Results for Nitrogen Dioxide (NO_2) – Cumulative Assessment

Pollutant / Meteorological Year	Averaging Period	Background ($\mu g/m^3$)	Process Contribution NO_2 ($\mu g/m^3$)	Predicted Emission Concentration NO_2 ($\mu g/m^3$)	Standard ($\mu g/m^3$) Note 1	PEC as a % of Limit Value
NO_2 / 2017	99.8th%ile of 1-hr means	28	95.9	123.9	200	62%
	Annual mean	14	26.2	40.2	40	100%
NO_2 / 2018	99.8th%ile of 1-hr means	28	127.9	155.9	200	78%
	Annual mean	14	22.0	36.0	40	90%
NO_2 / 2019	99.8th%ile of 1-hr means	28	91.1	119.1	200	60%
	Annual mean	14	24.8	38.8	40	97%
NO_2 / 2020	99.8th%ile of 1-hr means	28	77.2	105.2	200	53%
	Annual mean	14	24.0	38.0	40	95%
NO_2 / 2021	99.8th%ile of 1-hr means	28	109.1	137.1	200	69%
	Annual mean	14	24.1	38.1	40	95%

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

There are other local maxima in the modelling domain with the overall maxima located 1.3 km to the northwest of the Google Ireland facility as shown in Figure 9 and 10. The contribution due to NO_2 emissions from Google Ireland at the maximum cumulative offsite receptor is 0.17 $\mu g/m^3$ which is equivalent to 0.4% of the ambient annual mean NO_2 standard. Likewise, at the maximum offsite receptor due to NO_2 emissions from Google Ireland, the contribution from Google Ireland is 56% of the ambient annual mean NO_2 standard whilst the overall cumulative NO_2 concentration at the Google Ireland maximum location is 65% of the ambient standard (not including background). Thus, in line with the cumulative assessment approach outlined in EPA guidance document AG4[(2)], the cumulative impact from Google Ireland is not significant.

Table 13 Cumulative Results at Worst-Case Residential Receptor – NO_2 (Worst-case Year 2017) (not including background)

Pollutant	Google Ireland (mg/m^3)	All Emission Sources Except Google Ireland (mg/m^3)	All Emission Sources (mg/m^3)	Limit Value (mg/m^3)
Effect of each source at Google Ireland Maximum – Annual Average NO_2	22.40	3.79	26.19	40
Effect of Google Ireland of maximum at All Sources – Annual Average NO_2	0.17	27.8	28.0	40

6.6 NO_2 - Cumulative Assessment (UK Environment Agency Methodology)

Emissions from the Google Ireland standby diesel generators, as well as the existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the site were assessed using the UK Environment Agency methodology(21). The methodology, based on considering the statistical likelihood of an exceedance of the NO_2 hourly limit value assuming a hypergeometric distribution, has been undertaken at the worst-case residential receptor. The cumulative hypergeometric distribution of 19 and more hours per year was computed and the probability of an exceedance determined as outlined in Table . The results have been compared to the 98th percentile confidence level to indicate if an exceedance is likely at various operational hours for the facility. The results indicate that at the worst-case receptor, the facility and nearby emission sources can operate for a maximum of 263 hours in addition to the site's annual testing regime in any given year without the likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level).

As described earlier, a conservative approach was taken in this study which will most likely lead to an over-estimation of the levels that will arise in practice. Specifically, a conservative assumption has been made for the purpose of the air dispersion modelling assessment that the offsite standby generators associated with other data storage facilities will be tested weekly with one generator tested per hour, and based on an assumption that the IE Licensed emission points for the Takeda, Pfizer and Grange Backup Power sites were in operation 24 hours per day, 365 days per year.

Table 14 Cumulative Hypergeometric Statistical Results at Worst-Case Residential Receptor – NO_2

Pollutant / Meteorological 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 / 2017	352	**0.02**
NO_2 / 2018	342	
NO_2 / 2019	263	
NO_2 / 2020	286	
NO_2 / 2021	300	

Note 1 Guidance Outlined In UK EA publication "Diesel Generator Short-Term NO_2 Impact Assessment"(21)

6.7 Impact of NO_x on Sensitive Ecosystems

The NO_x modelling results are detailed in Table 15. Emissions from the facility lead to an ambient NO_x concentration (excluding background) which ranges from 2.50% – 2.77% of the annual limit value at the worst-case location within the designated sites over the five years of meteorological data modelled. No background value has been added to the results as the background concentration of NO_x exceeds the limit value for the protection of ecosystems at most urban and suburban locations in Dublin based on a review of the EPA NO_x monitoring data(17). Modelling results based on conservative assumptions indicate that the facility in isolation will have an imperceptible impact on NO_x concentrations within the sensitive ecosystems (Grand Canal pNHA) contributing at most 2.8% of the limit value at the worst-case location in the worst-case year modelled.

Table 15 Modelled NO_x Concentrations (µg/m³) excluding background within the Grand Canal pNHA.

Pollutant/ Year	Averaging Period	Process Contribution (µg/m³)	Limit Value (µg/Nm³)	Process Contribution as a % of Limit Value
NO_x / 2017	Annual Mean	0.83	30	2.77%
NO_x / 2018	Annual Mean	0.78	30	2.60%
NO_x / 2019	Annual Mean	0.76	30	2.53%
NO_x / 2020	Annual Mean	0.76	30	2.53%
NO_x / 2021	Annual Mean	0.75	30	2.50%

6.8 Impact of SO_2 on Sensitive Ecosystems

The SO_2 modelling results are detailed in Table 16. Emissions from the facility lead to an ambient SO_2 concentration (excluding background) which ranges from 0.014% – 0.015% of the annual limit value at the worst-case location within the designated sites over the five years of meteorological data modelled. Modelling results based on conservative assumptions indicate that the facility, including background, will have an imperceptible impact on SO_2 concentrations within the sensitive ecosystems (Grand Canal pNHA) contributing at most 15% of the limit value at the worst-case location in the worst-case year modelled.

Table 16 Modelled SO_2 Concentrations (µg/m³) within the Grand Canal pNHA.

Pollutant / Meteorological Year	Averaging Period	Background (µg/m³)	Process Contribution SO_2 (µg/m³)	Predicted Emission Concentration SO_2 (µg/m³) Note 2	Standard (µg/m³) Note 1	PEC as a % of Limit Value
SO_2 / 2017	Annual Mean	3.0	0.0028	3.0028	20	15%
SO_2 / 2018	Annual Mean	3.0	0.0027	3.0027	20	15%
SO_2 / 2019	Annual Mean	3.0	0.0026	3.0026	20	15%
SO_2 / 2020	Annual Mean	3.0.	0.0026	3.0026	20	15%
SO_2 / 2021	Annual Mean	3.0	0.0026	3.0026	20	15%

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

6.9 Impact of PM_{10} on Sensitive Ecosystems

The PM_{10} modelling results are detailed in Table 17. Emissions from the facility lead to an ambient PM_{10} concentration (excluding background) which ranges from 0.0065% – 0.0070% of the annual limit value at the worst-case location within the designated sites over the five years of meteorological data modelled. Modelling results based on conservative assumptions indicate that the facility, including background, will have an imperceptible impact on PM_{10} concentrations within the sensitive ecosystems (Grand Canal pNHA) contributing at most 15% of the limit value at the worst-case location in the worst-case year modelled.

Table 17 Modelled PM_{10} Concentrations ($\mu g/m^3$) within the Grand Canal pNHA.

Pollutant / Meteorological Year	Averaging Period	Background ($\mu g/m^3$)	Process Contribution PM_{10} ($\mu g/m^3$)	Predicted Emission Concentration PM_{10} ($\mu g/m^3$) Note 2	Standard ($\mu g/m^3$) Note 1	PEC as a % of Limit Value
PM_{10} / 2017	Annual Mean	15.0	0.0028	15.0028	40	15%
PM_{10} / 2018	Annual Mean	15.0	0.0027	15.0027	40	15%
PM_{10} / 2019	Annual Mean	15.0	0.0026	15.0026	40	15%
PM_{10} / 2020	Annual Mean	15.0	0.0026	15.0026	40	15%
PM_{10} / 2021	Annual Mean	15.0	0.0026	15.0026	40	15%

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

6.10 Distance To Background Levels For NO_X, SO_2 & PM_{10} / $PM_{2.5}$

When pollutants are emitted from the emission sources onsite, they will disperse in the atmosphere and will eventually be indistinguishable from background levels. In this context, a level below 0.1 mg/m^3 is defined as being indistinguishable from background levels. The distance needed to achieve this is given below for each of the parameters (NO_X, SO_2, PM_{10} / $PM_{2.5}$). Irrespective of the distance below, all pollutants at all times remain below the ambient standard for the protection of vegetation in any of the nearby ecological sensitive areas:

- NO_X = 12,200 metres,
- SO_2 = 15 metres,
- PM_{10} = 15 metres
- $PM_{2.5}$ = 15 metres.

Modelling has been undertaken using five years of historical data from Casement Aerodrome (2017 – 2021). Future meteorological data is not available, however, it is accepted that by using five years of historical data an accurate prediction of worst-case future emissions can be made.

6.11 Impact of Cumulative NO_x on European Sites

The cumulative NO_x modelling results in the nearest designated site (Rye Water Valley/Carton SAC [001398]) are detailed in Table 18. Emissions from the facility lead to an ambient NO_x concentration (including background) which ranges from 60% – 61% of the annual limit value at the worst-case location within the designated sites over the five years of meteorological data modelled. A worst-case background value has been added to the results based on suburban locations in Dublin based on a review of the EPA NO_x monitoring data(17). Modelling results based on conservative assumptions indicate that the facility and nearby cumulative emission points will have an imperceptible impact on NO_x concentrations within the sensitive ecosystems (Rye Water Valley/Carton SAC [001398]) contributing at most 2% of the limit value (not including background levels) at the worst-case location in the worst-case year modelled.

Table 15 Modelled NO_x Concentrations (µg/m^3) excluding background within the Rye Water Valley/Carton SAC [001398].

Pollutant / Year	Averaging Period	Background NO_X Level (µg/m^3) Note 1	Process Contribution (µg/m^3)	PEC (µg/m^3)	Limit Value (µg/Nm^3)
NO_x / 2017	Annual Mean	17.7	0.47	18.2	30
NO_x / 2018	Annual Mean	17.7	0.63	18.3	30
NO_x / 2019	Annual Mean	17.7	0.49	18.2	30
NO_x / 2020	Annual Mean	17.7	0.45	18.2	30
NO_x / 2021	Annual Mean	17.7	0.40	18.1	30

Note 1 Worst-case background NO_X level in Rye Water Valley/Carton SAC [001398] based on NO_X concentration recorded in Ballyfermot in 2021.

The worst-case NO_X concentration determined above in Table 15 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 m^{-2} s^{-1}) = ground-level concentration (µg/m^3) x deposition velocity (m/s)

The deposition velocities for various pollutants are outlined in AQTAG06 (EA, 2014) with a value of 0.0015 m/s the most appropriate for NO_X. In order to convert the dry deposition flux from units of µg m^{-2} s^{-1} to units of kg ha^{-1} year^{-1} the dry deposition flux is multiplied by a conversion factor of 96 (to convert from µg m^{-2} s^{-1} of NO_2 (as N) to kg ha^{-1} year^{-1} (taken from AQTAG06 (EA, 2014)).

The calculation of the worst-case nitrogen critical load based on the default deposition velocity:

Dry deposition flux (µg m^{-2} s^{-1}) = ground-level concentration (NOx Year 2017) (µg/m^3) x deposition velocity (m/s)

$$= 18.3 \ \mu g/m^3 \times 0.0015 \ m/s = 0.0275 \ \mu g \ m^{-2} \ s^{-1}$$

When expressed in units of kg ha^{-1} year^{-1} as N

$$= 0.0275 \times 96 \ kg \ ha^{-1} \ year^{-1}$$

NO_2 dry deposition flux (kg ha^{-1} year^{-1}) = **2.64 kg ha^{-1} year^{-1} as N**

In accordance with the EPA's Air Dispersion Modelling Guidance (AG4), ensuring compliance with the ambient Air Quality Standards for NO_2 for the cumulative scenario will ensure compliance for all other pollutants (SO_2, PM_{10}/$PM_{2.5}$) which are all emitted at much lower emission concentrations.

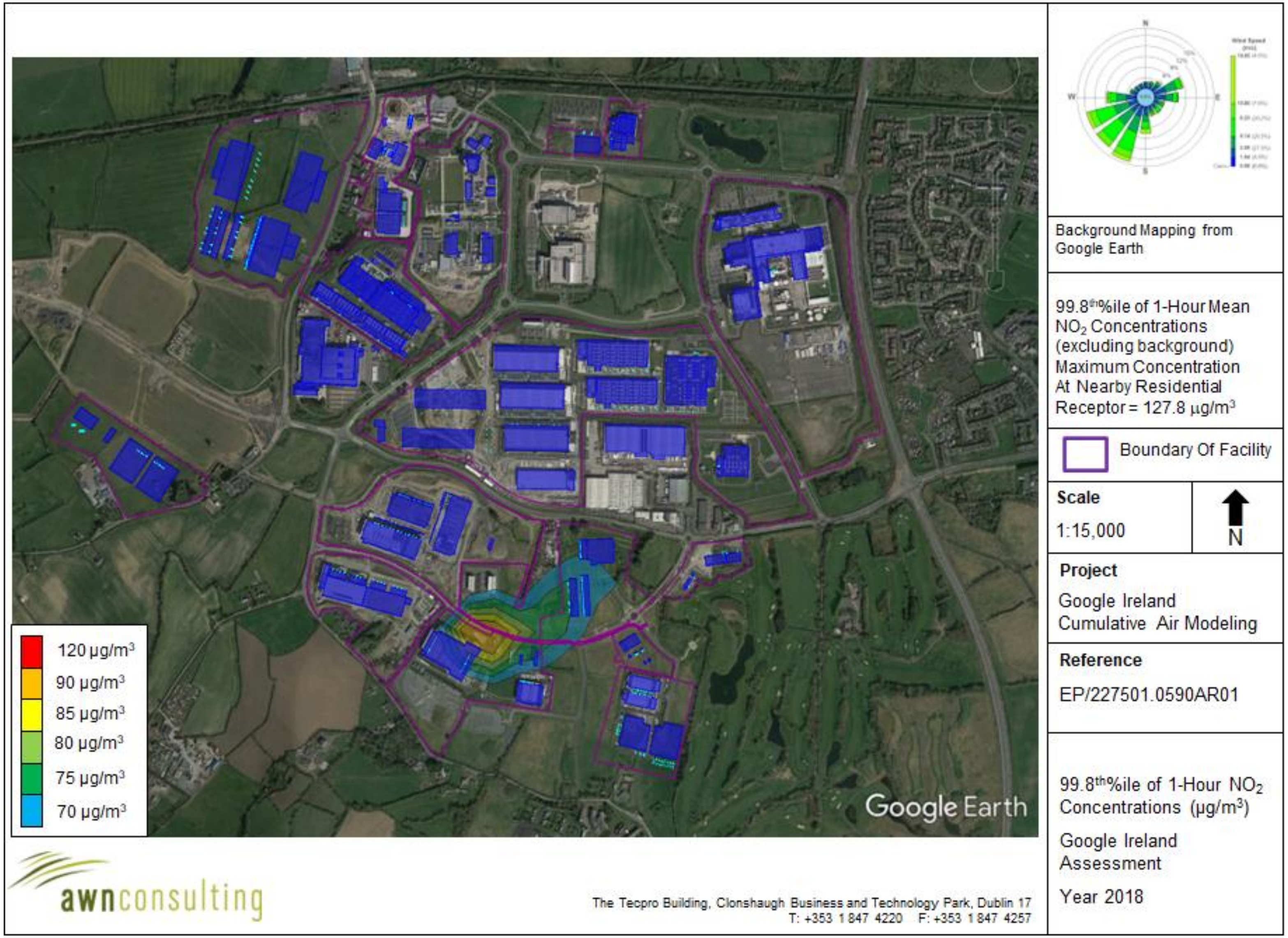


Figure 3 Google Ireland Assessment - Maximum 1-Hour NO_2 Concentrations (as 99.8th%ile) (µg/m^3) 2019 (excluding background concentrations)

Figure 4 Google Ireland Assessment - Annual Mean NO_2 Concentrations (µg/m^3) 2017 (excluding background concentrations)

Figure 5 Google Ireland Assessment - Maximum 1-Hour SO_2 Concentrations (as 99.7th%ile) (µg/m³) 2018 (excluding background concentrations)

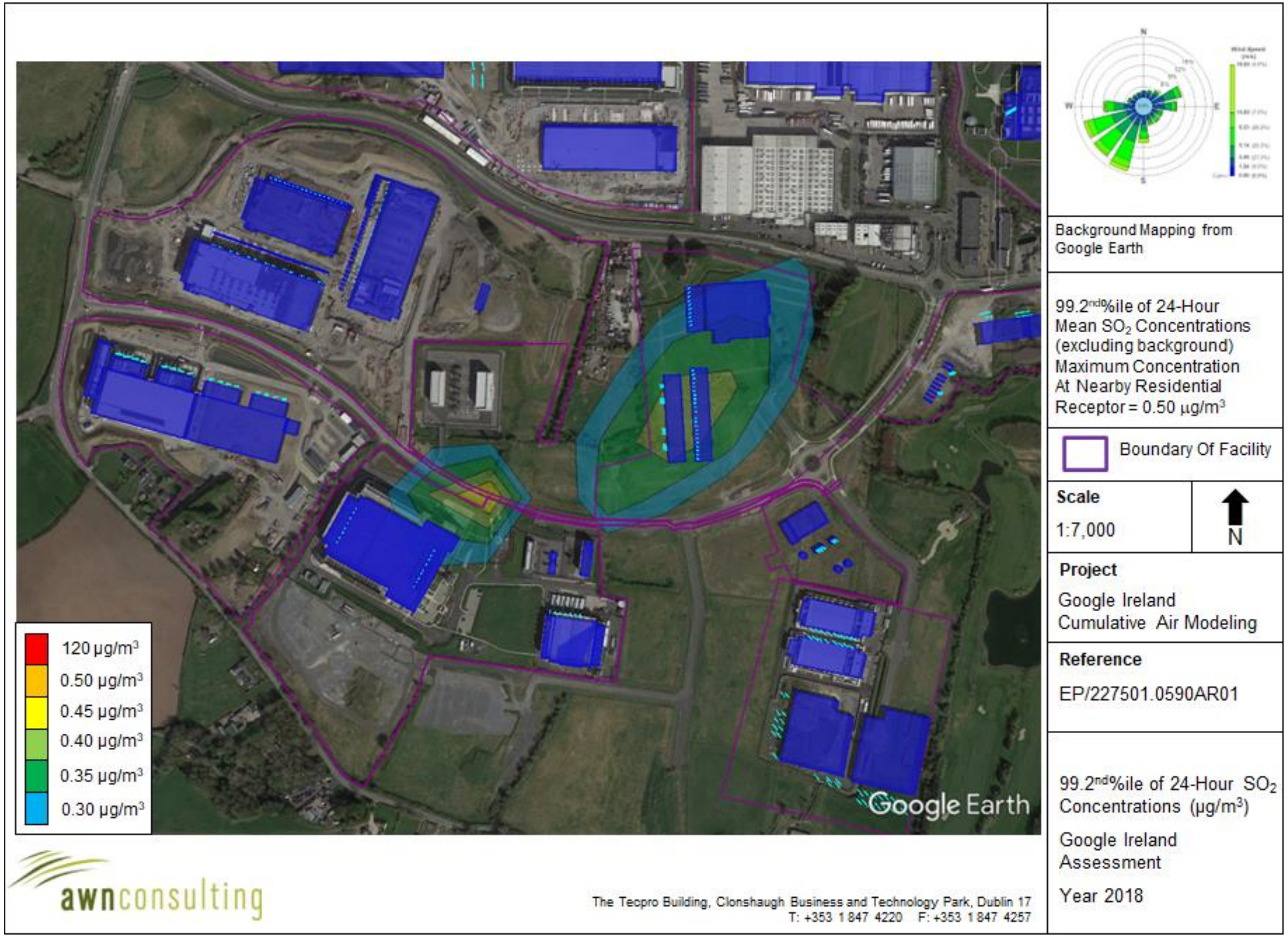


Figure 6 Google Ireland Assessment - Maximum 24-Hour SO_2 Concentrations (as 99.2th%ile) (µg/m³) 2019 (excluding background concentrations)

Figure 7 Google Ireland Assessment - Maximum 24-Hour PM_{10} Concentrations (as 90th%ile) ($\mu g/m^3$) 2017 (excluding background concentrations)

Figure 8 Google Ireland Assessment - Annual Mean PM_{10} Concentrations (µg/m³) 2017 (excluding background concentrations)

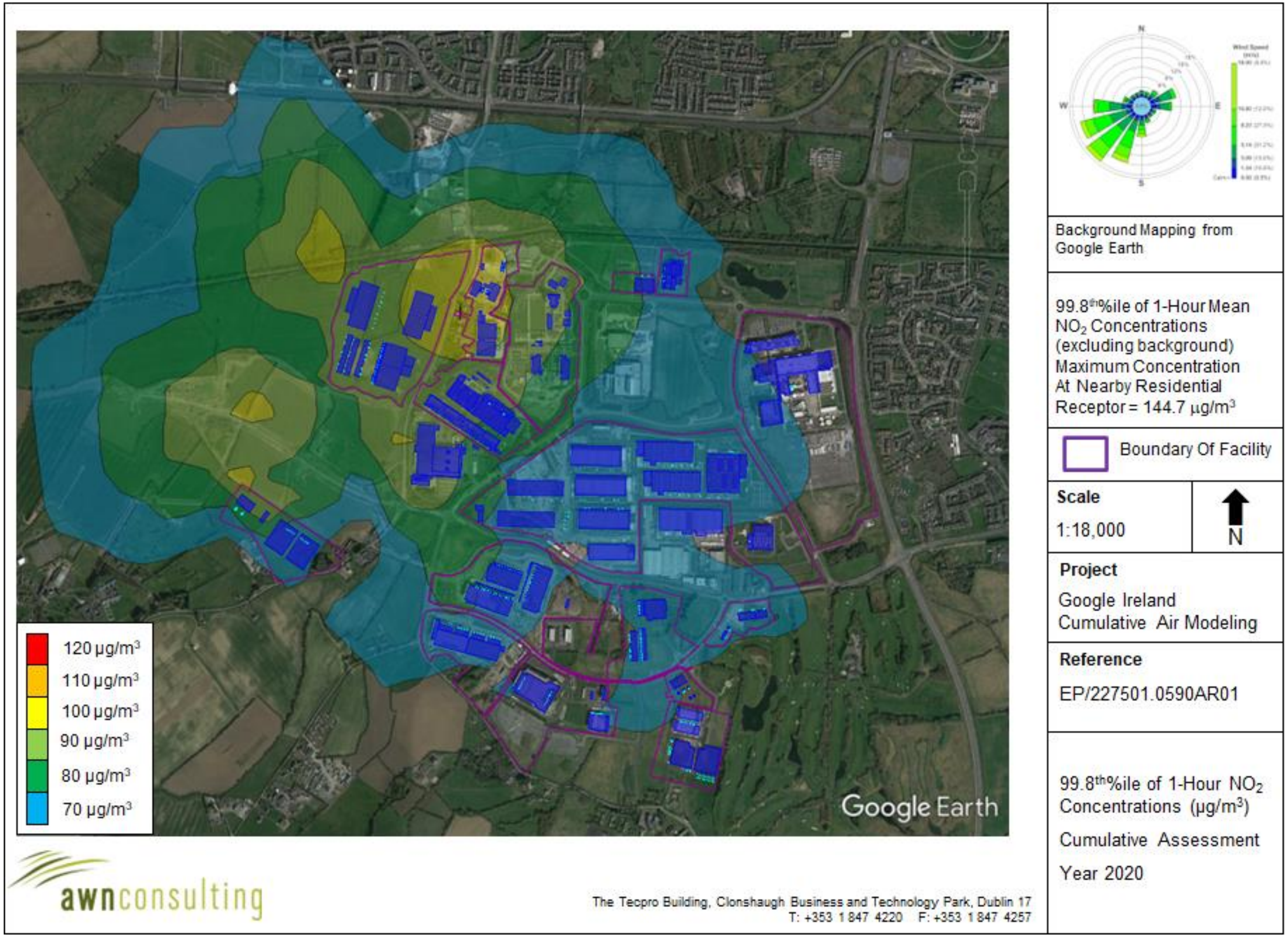


Figure 9 Cumulative Assessment - Maximum 1-Hour NO_2 Concentrations (as 99.8th%ile) (µg/m³) 2017 (excluding background concentrations)

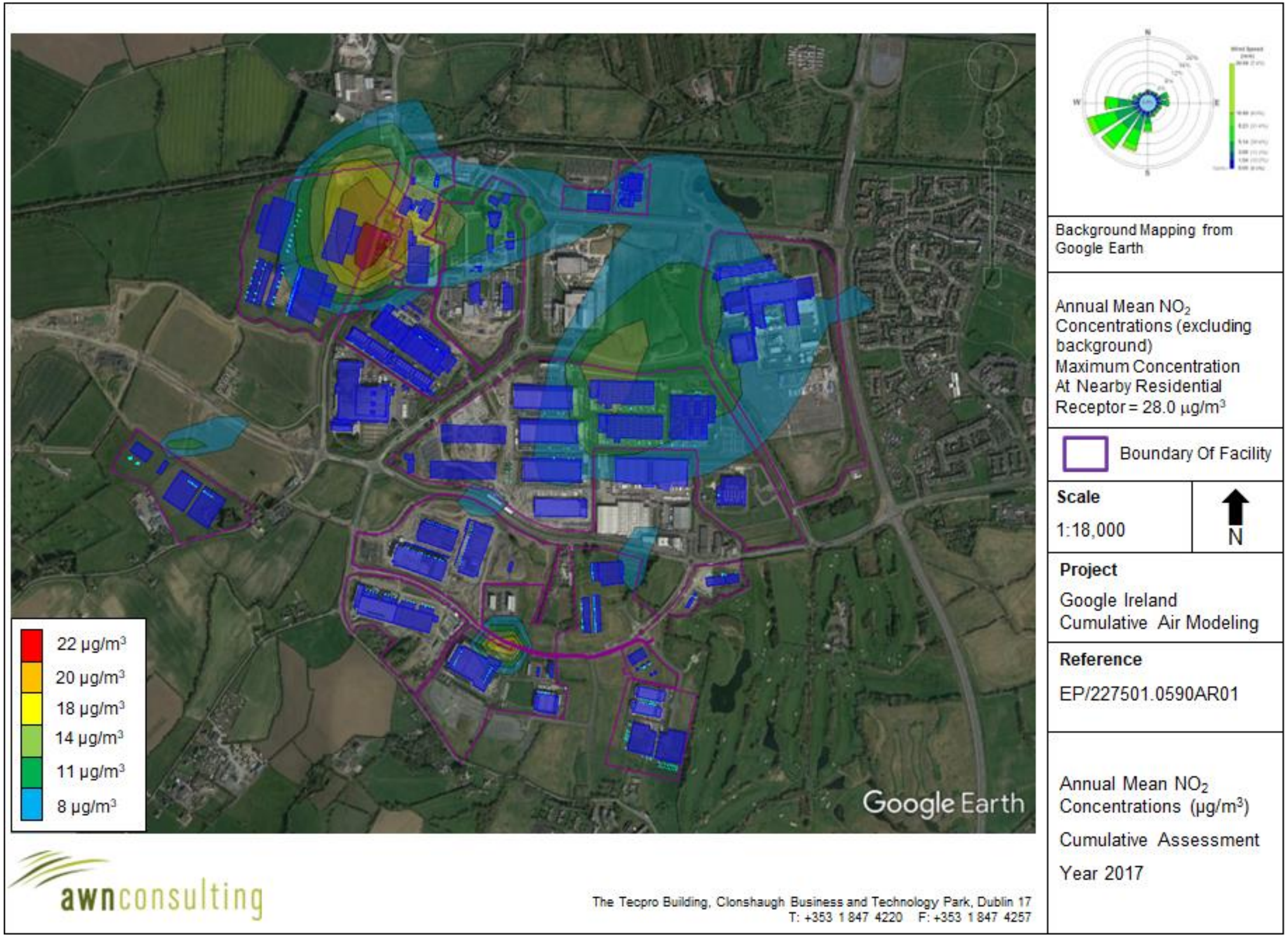


Figure 10 Cumulative Assessment - Annual Mean NO_2 Concentrations (µg/m^3) 2017 (excluding background concentrations)

7.0 ASSESSMENT SUMMARY

Under the USEPA methodology NO_2 emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards. Emissions under this scenario lead to an ambient NO_2 concentration that is 78% of the ambient 1-hour limit value (measured as a 99.8th percentile) and 92% of the ambient annual mean limit value at the worst-case off-site receptor for the worst case year.

The UK Environment Agency assessment methodology determined that in the worst-case year, the Google Ireland standby diesel generators could operate for a maximum of 1,110 hours in addition to the site's annual testing regime before there is a likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level). In addition, the UK guidance recommends that there should be no running time restrictions placed on standby generators which provide power on site only during a power outage.

SO_2 emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards. Emissions under this scenario lead to an ambient SO_2 concentration that is 2.5% of the ambient 1-hour limit value (measured as a 99.7th percentile) and 5.2% of the ambient 24-hour limit value (measured as a 99.2nd percentile) at the worst case off-site receptor for the worst case year.

PM_{10} emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards. Emissions under this scenario lead to an ambient PM_{10} concentration that is 52% of the ambient 24-hour limit value (measured as a 90th percentile) and 38% of the annual mean limit value at the worst-case off-site receptor for the worst case year. $PM_{2.5}$ emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards. Emissions under this scenario lead to an ambient $PM_{2.5}$ concentration that is 42% of the annual mean limit value at the worst-case off-site receptor for the worst case year.

NO_X emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards for the protection of ecosystems. Emissions under this scenario lead to an ambient NO_X concentration, not including background concentrations, that is 2.8% of the annual mean limit value at the worst case ecologically sensitive receptor (Grand Canal pHNA) for the worst-case year whilst levels at the Rye Water Valley/Carton SAC [001398] contributing at most 2.1% of the limit value (not including background levels).

SO_2 emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards for the protection of ecosystems. Emissions under this scenario lead to an ambient SO_2 concentration, excluding background, that is 0.014% of the annual mean limit value at the worst case ecologically sensitive receptor for the worst case.

PM_{10} emissions associated with the Google Ireland standby diesel generators are in compliance with the air quality standards for the protection of human health in the Grand Canal pNHA. Emissions under this scenario lead to an ambient PM_{10} concentration, excluding background, that is 0.003% of the annual mean limit value at the worst case ecologically sensitive receptor for the worst case.

When pollutants are emitted from the emission sources onsite, they will disperse in the atmosphere and will eventually be indistinguishable from background levels. In this context, a level below 0.1 mg/m^3 is defined as being indistinguishable from background levels. The distance needed to achieve this is given below for each of the parameters

(NO_X, SO_2, PM_{10} / $PM_{2.5}$). Irrespective of the distance below, all pollutants at all times remain below the ambient standard for the protection of vegetation in any of the nearby ecological sensitive areas:

- NO_X = 12,200 metres,
- SO_2 = 15 metres,
- PM_{10} = 15 metres,
- $PM_{2.5}$ = 15 metres.

Modelling has been undertaken using five years of historical data from Casement Aerodrome (2017 – 2021). Future meteorological data is not available, however, it is accepted that by using five years of historical data an accurate prediction of worst-case future emissions can be made.

Under the USEPA methodology NO_2 emissions associated with the cumulative assessment of the Google Ireland standby diesel generators, as well as the existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the site are in compliance with the air quality standards. The cumulative assessment involved modelling the Google Ireland standby diesel generators, as well as the continuous operation of existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the site. There are many nearby emission sources and several local maxima across the modelling domain. In order to determine the cumulative impact due to Google Ireland and other nearby facilities, the worst-case receptor due to emissions from Google Ireland has been identified. This off-site receptor has then been modelled based on the operation of all nearby facilities with the cumulative NO_2 modelling results at this worst-case off-site receptor reported.

For the worst-case year, emissions from the site and nearby emission sources lead to an ambient NO_2 concentration (including background) which is 78% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 100% of the annual limit value at the worst-case off-site sensitive receptor.

There are other local maxima in the modelling domain with the overall maxima located 1.3 km to the northwest of the Google Ireland facility. The contribution due to NO_2 emissions from Google Ireland at the maximum cumulative offsite receptor is 0.17 $\mu g/m^3$ which is equivalent to 0.4% of the ambient annual mean NO_2 standard. Likewise, at the maximum offsite receptor due to NO_2 emissions from Google Ireland, the contribution from Google Ireland is 56% of the ambient annual mean NO_2 standard whilst the overall cumulative NO_2 concentration at the Google Ireland maximum location is 65% of the ambient standard (not including background). Thus, in line with the cumulative assessment approach outlined in EPA guidance document AG4 (EPA, 2020), the cumulative impact from Google Ireland is not significant.

The UK Environment Agency assessment methodology determined that in the worst-case year, the Google Ireland standby diesel generators, as well as the existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the site, could operate for a maximum of 263 in addition to the site's annual testing regime hours before there is a likelihood of an exceedance of the ambient air quality standard (at a 98th percentile confidence level) at the worst-case identified receptor near Google Ireland. In addition, the UK guidance recommends that there should be no running time restrictions placed on standby generators which provide power on site only during a power outage.

Summary

Under the USEPA methodology NO_2 emissions associated with the Google Ireland standby diesel generators and based on a cumulative assessment of nearby sites are in compliance with the air quality standards.

The UK Environment Agency assessment methodology has determined that in the worst-case year, the Google Ireland standby diesel generators could operate for a maximum of 1,110 hours before there is a likelihood of an exceedance of the ambient air quality standard (at a 98^{th} percentile confidence level).

Cumulative impacts on ambient air quality due to NO_2 emissions from the Google Ireland facility, as well as the existing IED licenced sites, and other neighbouring proposed and operational data storage and energy centre facilities in the vicinity of the facility, has determined based on the UK Environment Agency assessment methodology, that in the worst-case year, the Google Ireland and nearby standby diesel generators could operate for a maximum of 263 hours in addition to the site's annual testing regime before there is a likelihood of an exceedance of the ambient air quality standard (at a 98^{th} percentile confidence level). In addition, the UK guidance recommends that there should be no running time restrictions placed on standby generators which provide power on site only during a power outage.

Through modelling, it is demonstrated that the project does not result in an increase in NO_2 concentrations above ambient limit values for the protection of vegetation or ecosystems in the region of the Google Ireland Data Centre facility nor at further distances away from the facility including the locations of European Sites.

Modelling results based on conservative assumptions indicate that the facility and nearby cumulative emission points will have an imperceptible impact on NO_x concentrations within the sensitive ecosystems (Rye Water Valley/Carton SAC [001398]) contributing at most 2.1% of the limit value (not including background levels) at the worst-case location in the worst-case year modelled and 2.8% of the annual mean limit value at the Grand Canal pHNA for the worst-case year.

In accordance with the EPA's Air Dispersion Modelling Guidance (AG4), ensuring compliance with the ambient Air Quality Standards for NO_2 for the cumulative scenario will ensure compliance for all other pollutants (SO_2, PM_{10}/$PM_{2.5}$) which are all emitted at much lower emission concentrations.

8.0 REFERENCES

(1) USEPA (2022) AERMOD Description of Model Formulation and Evaluation

(2) EPA (2020) Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)

(3) USEPA (1995) User's Guide for the Industrial Source Complex (ISC3) Dispersion Model Vol I & II

(4) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1

(5) USEPA (2000) Seventh Conference on Air Quality Modelling (June 2000) Vol I & II

(6) USEPA (1998) Human Health Risk Assessment Protocol, Chapter 3: Air Dispersion and Deposition Modelling, Region 6 Centre for Combustion Science and Engineering

(7) USEPA (1999) Comparison of Regulatory Design Concentrations: AERMOD vs. ISCST3 vs. CTDM PLUS

(8) Schulman, L.L; Strimaitis, D.G.; Scire, J.S. (2000) Development and evaluation of the PRIME plume rise and building downwash model. Journal of the Air & Waste Management Association, 50, 378-390.

(9) Paine, R & Lew, F. "Consequence Analysis for Adoption of PRIME: an Advanced Building Downwash Model" Prepared for the EPRI, ENSR Document No. 2460-026-450 (1997).

(10) Paine, R & Lew, F. "Results of the Independent Evaluation of ISCST3 and ISC-PRIME" Prepared for the EPRI, ENSR Document No. 2460-026-3527-02 (1997).

(11) USEPA (2017) AERMAP Users Guide

(12) Met Éireann (2022) Met Éireann Website: www.met.ie

(13) USEPA (2021) User's Guide to the AERMOD Meteorological Preprocessor (AERMET)

(14) USEPA (2008) AERSURFACE User's Guide

(15) Alaska Department of Environmental Conservation (2008) ADEC Guidance re AERMET Geometric Means (http://dec.alaska.gov/air/ap/modeling.htm)

(16) USEPA (1985) Good Engineering Practice Stack Height (Technical Support Document For The Stack Height Regulations) (Revised)

(17) Environmental Protection Agency (2022) Air Quality Monitoring Report 2021 (& previous reports)

(18) EPRI (2020) Phase II Assessment of NO_2/NO_X Ratios at Fossil Fuel Power plants

(19) https://www.epa.gov/scram/nitrogen-dioxidenitrogen-oxide-stack-ratio-isr-database

(20) UK DEFRA (2018) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. TG(16)

(21) USEPA (2011) Additional Clarification Regarding Application of Appendix W Modelling Guidance for the 1-Hour National Ambient Air Quality Standard

(22) UK Environment Agency (2016) Air Quality Modelling and Assessment Unit – Diesel Generator Short Term NO_2 Impact Assessment

(23) UK Environment Agency (2019) Emissions from specified generators - Guidance on dispersion modelling for oxides of nitrogen assessment from specified generators

APPENDIX I

Description of the AERMOD Model

The AERMOD dispersion model has been developed in part by the U.S. Environmental Protection Agency (USEPA)[1,4]. The model is a steady-state Gaussian model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement on the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources.

Improvements over the ISCST3 model include the treatment of the vertical distribution of concentration within the plume. ISCST3 assumes a Gaussian distribution in both the horizontal and vertical direction under all weather conditions. AERMOD with PRIME, however, treats the vertical distribution as non-Gaussian under convective (unstable) conditions while maintaining a Gaussian distribution in both the horizontal and vertical direction during stable conditions. This treatment reflects the fact that the plume is skewed upwards under convective conditions due to the greater intensity of turbulence above the plume than below. The result is a more accurate portrayal of actual conditions using the AERMOD model. AERMOD also enhances the turbulence of night-time urban boundary layers thus simulating the influence of the urban heat island.

In contrast to ISCST3, AERMOD is widely applicable in all types of terrain. Differentiation of the simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions. In the dividing-streamline concept, flow below this height remains horizontal, and flow above this height tends to rise up and over terrain. Extensive validation studies have found that AERMOD (precursor to AERMOD with PRIME) performs better than ISCST3 for many applications and as well or better than CTDMPLUS for several complex terrain data sets[8].

Due to the proximity to surrounding buildings, the PRIME (Plume Rise Model Enhancements) building downwash algorithm has been incorporated into the model to determine the influence (wake effects) of these buildings on dispersion in each direction considered. The PRIME algorithm takes into account the position of the stack relative to the building in calculating building downwash. In the absence of the building, the plume from the stack will rise due to momentum and/or buoyancy forces. Wind streamlines act on the plume leads to the bending over of the plume as it disperses. However, due to the presence of the building, wind streamlines are disrupted leading to a lowering of the plume centreline.

When there are multiple buildings, the building tier leading to the largest cavity height is used to determine building downwash. The cavity height calculation is an empirical formula based on building height, the length scale (which is a factor of building height & width) and the cavity length (which is based on building width, length and height). As the direction of the wind will lead to the identification of differing dominant tiers, calculations are carried out in intervals of 10 degrees.

In PRIME, the nature of the wind streamline disruption as it passes over the dominant building tier is a function of the exact dimensions of the building and the angle at which the wind approaches the building. Once the streamline encounters the zone of influence of the building, two forces act on the plume. Firstly, the disruption caused by the building leads to increased turbulence and enhances horizontal and vertical dispersion. Secondly, the streamline descends in the lee of the building due to the reduced pressure and drags the plume (or part of) nearer to the ground, leading to higher ground level concentrations. The model calculates the descent of the plume as a function of the building shape and, using a numerical plume rise model, calculates the change in the plume centreline location with distance downwind.

The immediate zone in the lee of the building is termed the cavity or near wake and is characterised by high intensity turbulence and an area of uniform low pressure. Plume mass captured by the cavity region is re-emitted to the far wake as a ground-level volume source. The volume source is located at the base of the lee wall of the building, but is only evaluated near the end of the near wake and beyond. In this region, the disruption caused by the building downwash gradually fades with distance to ambient values downwind of the building.

AERMOD has made substantial improvements in the area of plume growth rates in comparison to ISCST3[3,5]. ISCST3 approximates turbulence using six Pasquill-Gifford-Turner Stability Classes and bases the resulting dispersion curves upon surface release experiments. This treatment, however, cannot explicitly account for turbulence in the formulation. AERMOD is based on the more realistic modern planetary boundary layer (PBL) theory which allows turbulence to vary with height. This use of turbulence-based plume growth with height leads to a substantial advancement over the ISCST3 treatment.

Improvements have also been made in relation to mixing height[1,3]. The treatment of mixing height by ISCST3 is based on a single morning upper air sounding each day. AERMOD, however, calculates mixing height on an hourly basis based on the morning upper air sounding and the surface energy balance, accounting for the solar radiation, cloud cover, reflectivity of the ground and the latent heat due to evaporation from the ground cover. This more advanced formulation provides a more realistic sequence of the diurnal mixing height changes.

AERMOD also has the capability of modelling both unstable (convective) conditions and stable (inversion) conditions. The stability of the atmosphere is defined by the sign of the sensible heat flux. Where the sensible heat flux is positive, the atmosphere is unstable whereas when the sensible heat flux is negative the atmosphere is defined as stable. The sensible heat flux is dependent on the net radiation and the available surface moisture (Bowen Ratio). Under stable (inversion) conditions, AERMOD has specific algorithms to account for plume rise under stable conditions, mechanical mixing heights under stable conditions and vertical and lateral dispersion in the stable boundary layer.

AERMOD also contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold.

APPENDIX II

Meteorological Data - AERMET

AERMOD incorporates a meteorological pre-processor AERMET (version 21112)[12]. AERMET allows AERMOD to account for changes in the plume behaviour with height. AERMET calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, convective (CBL) and stable boundary layer (SBL) height and surface heat flux. AERMOD uses this information to calculate concentrations in a manner that accounts for changes in dispersion rate with height, allows for a non-Gaussian plume in convective conditions, and accounts for a dispersion rate that is a continuous function of meteorology.

The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. A morning sounding from a representative upper air station, latitude, longitude, time zone, and wind speed threshold are also required.

Two files are produced by AERMET for input to the AERMOD dispersion model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower, if available, or the one-level observations taken from other representative data, one record level per hour.

From the surface characteristics (i.e. surface roughness, albedo and amount of moisture available (Bowen Ratio)) AERMET calculates several boundary layer parameters that are important in the evolution of the boundary layer, which, in turn, influences the dispersion of pollutants. These parameters include the surface friction velocity, which is a measure of the vertical transport of horizontal momentum; the sensible heat flux, which is the vertical transport of heat to/from the surface; the Monin-Obukhov length which is a stability parameter relating the surface friction velocity to the sensible heat flux; the daytime mixed layer height; the nocturnal surface layer height and the convective velocity scale which combines the daytime mixed layer height and the sensible heat flux. These parameters all depend on the underlying surface.

The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use types was carried out in line with USEPA recommendations[4] and using the detailed methodology outlined by the Alaska Department of Environmental Conservation[14]. AERMET has also been updated to allow for an adjustment of the surface friction velocity (u*) for low wind speed stable conditions based on the work of Qian and Venkatram (BLM, 2011). Previously, the model had a tendency to over-predict concentrations produced by near-ground sources in stable conditions.

<u>Surface roughness</u>

Surface roughness length is the height above the ground at which the wind speed goes to zero. Surface roughness length is defined by the individual elements on the landscape such as trees and buildings. In order to determine surface roughness length, the USEPA recommends that a representative length be defined for each sector, based on geometric mean of the inverse distance area-weighted land use within the sector, by using the eight land use categories outlined by the USEPA. The area-weighted surface roughness length derived from the land use classification within a radius of 1km from Casement Aerodrome is shown in Table A1.

Table A1 Surface Roughness based on an inverse distance area-weighted average of the land use within a 1km radius of Casement Aerodrome.

Sector	Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter Note 1
0-360	100% Grassland	0.050	0.100	0.010	0.010

Note 1 Winter defined as periods when surfaces covered permanently by snow whereas autumn is defined as periods when freezing conditions are common, deciduous trees are leafless and no snow is present (Iqbal (1983)). Thus for the current location autumn more accurately defines "winter" conditions at the facility.

Albedo

Noon-time Albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Albedo is used in calculating the hourly net heat balance at the surface for calculating hourly values of Monin-Obuklov length. The area-weighted arithmetic mean albedo derived from the land use classification over a 10km x 10km area centred on Casement Aerodrome is shown in Table A2.

Table A2 Albedo based on an area-weighted arithmetic mean of the land use over a 10km x 10km area centred on Casement Aerodrome.

Area Weighted Land Use Classification	Spring	Summer	Autumn	WinterNote 1
0.5% Water, 30% Urban, 0.5% Coniferous Forest 38% Grassland, 19% Cultivated Land	0.155	0.180	0.187	0.187

Note 1 For the current location autumn more accurately defines "winter" conditions at the facility.

Bowen Ratio

The Bowen ratio is a measure of the amount of moisture at the surface of the earth. The presence of moisture affects the heat balance resulting from evaporative cooling which, in turn, affects the Monin-Obukhov length which is used in the formulation of the boundary layer. The area-weighted geometric mean Bowen ratio derived from the land use classification over a 10km x 10km area centred on Casement Aerodrome is shown in Table A3.

Table A3 Bowen Ratio based on an area-weighted geometric mean of the land use over a 10km x 10km area centred on Casement Aerodrome.

Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter Note 1
0.5% Water, 30% Urban, 0.5% Coniferous Forest 38% Grassland, 19% Cultivated Land	0.549	1.06	1.202	1.202

Note 1 For the current location autumn more accurately defines "winter" conditions at the facility.