12 AIR QUALITY AND CLIMATE

12.1 INTRODUCTION

AWN Consulting Ltd. has been commissioned to carry out an air quality and climate impact assessment including an air dispersion modelling study of odour, air and climate emissions from the existing facility, the licensed waste management activities and proposed development at Drehid Waste Management Facility (WMF) at the townlands of Timahoe West, Coolcarrigan, Killinagh Upper, Killinagh Lower, Drummond, Kilkeaskin, Loughnacush, and Parsonstown, County Kildare based on the design details. The proposed development provides for additional landfill infrastructure, a new Municipal Solid Waste (MSW) processing and composting facility, a new soil & stones and C&D Waste (rubble) Processing Facility (hereafter referred to as Soils Processing Facility) and increased throughput of waste to the existing compost facility including a new odour abatement system. This assessment is prepared in line with the Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2022a);

This chapter was completed Dr. Avril Challoner. She is a Principal Consultant in the Air Quality section of AWN Consulting. She holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin. She is a Chartered Scientist (CSci), Chartered Environmentalist (CEnv), Member of the Institute of Environmental Management and Assessment, Member of the Institute of Air Quality Management and specialises in the fields of air quality, EIA, air dispersion modelling and climate.

The existing Drehid WMF comprises an engineered landfill and a Composting Facility and is licensed by the EPA (IED Licence number W0201-03). The engineered landfill is currently permitted to accept a maximum of 120,000 TPA of non-hazardous waste for disposal. The Composting Facility is permitted to accept 25,000 TPA of suitable organic wastes.

In respect of this air quality and climate assessment, the existing Drehid WMF includes the following relevant infrastructure;

- Landfill facility;
- Gas Utilisation Plant;
- Flares; and
- Composting Facility.

The key elements of the proposed development are summarised as follows and are set out in more detail in Chapter 2:

- Changes to the duration and volume of waste acceptance at the landfill facility;
- Development of additional landfill capacity to provide for the landfilling of non-hazardous waste for a period of 25 years;
- Development of new processing facilities for certain waste types prior to use within the facility boundary for engineering purposes, landfilling or export from the Drehid WMF for further processing off-site;
- Increase in acceptance of waste at the existing Composting Facility and removal of the restriction on the operating life of the Composting Facility contained in Condition 2(2) of ABP Ref. No. PL.09.212059; and
- Development of associated buildings, plant, infrastructure and landscaping.

The following is a list of the main non-hazardous waste types that will be disposed of to landfill at the facility along with the estimated quantities of each waste type:

- C&D fines and C&D rubble – c. 109,000 TPA
- Non-hazardous soils and stones – c. 50,000 TPA
- Residual municipal solid waste (rMSW) – c. 85,000 TPA
- Other non-MSW – c. 1,000 TPA
- Incinerator bottom ash (IBA) – c. 5,000 TPA
- Biostabilised waste (generated at Drehid WMF) – c. 40,000 TPA
- Recovered inert waste for engineering purposes – c. 50,000 TPA

In accordance with the EIA Directive, an assessment aim is to identify, describe and present an assessment of the likely significant effects. This assessment is to determine whether the air and odour emissions from the facility will lead to ambient concentrations which are in compliance with the relevant ambient air quality standards and guidelines for odour, NO_2 & PM_{10}/$PM_{2.5}$ and if any significant effect will occur. The assessment was conducted using the methodology outlined in *"Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)"* (EPA, 2020). This assessment describes the outcome of this study. The study of the current and ongoing emission scenarios consists of the following components;

- Review of emission data and other relevant information needed for the modelling study;
- Desktop study of baseline pollutant concentrations;
- Dispersion modelling of released substances (including odour, NOx and Particulates) under current and ongoing emission scenario;
- Presentation of predicted ground level concentrations of released substances;
- Evaluation of the significance of these predicted concentrations, including consideration of whether these ground level concentrations are likely to exceed the relevant ambient air quality and odour limit values and guideline values; and
- Impact of traffic related to ongoing activities for pollutants of concern in the vicinity of the facility.

Information supporting the conclusions has been detailed in the following sections. The assessment methodology and study inputs are presented below in Section 12.2. The dispersion modelling results, and assessment summaries are presented in Section 12.4. The model formulation is detailed in Appendix 12-1.

12.2 ASSESSMENT METHODOLOGOGY

12.2.1 Standards and Guidance for Odour

The exposure of the population to a particular odour consists of two factors; the concentration and the length of time that the population may perceive the odour. By definition, 1 OU_E/m^3 is the detection threshold of 50% of a qualified panel of observers working in an odour-free laboratory using odour-free air as the zero reference.

The EPA (EPA 2001) has issued guidance specific to intensive agriculture which has outlined the following standards:

- Target value for new pig-production units of 1.5 OUE/m^3 as a 98^{th}%ile of one hour averaging periods;
- Limit value for new pig-production units of 3.0 OUE/m^3 as a 98^{th}%ile of one hour averaging periods;

- Limit value for existing pig-production units of 6.0 OUE/m^3 as a 98th%ile of one hour averaging periods.

DEFRA (Environment Agency 2002, 2003) in the UK has published detailed guidance on appropriate odour threshold levels based in part on the offensiveness of the odour. As shown in Table 12.1, a landfill facility is included in the list with a UK ranking of 20. Green waste composting is also included and is similarly ranked with moderately odorous industries such as fish smoking and sugar production.

Guidance from the UK (UK EA 2011), and adapted for Irish EPA use, recommends that odour standards should vary from 1.5 – 6.0 OU_E/m^3 as a 98th%ile of one hour averaging periods at the worst-case sensitive receptor based on the offensiveness of the odour and with adjustments for local factors such as population density. A summary of the indicative criterion is given below in Table 12.2 which is taken from EPA Guidance document AG9 (EPA 2019).

The relevant exposure criteria for non-green waste composting is 3.0 OU_E/m^3 which should be expressed as a 98th%ile and based on one hour means over a one-year period in the absence of any local factors.

Table 12.1 – Ranking Table For Various Industrial Sources (Environment Agency, 2002)

Environmental Odour	Ranking	Ranking	Ranking
Industrial Source	UK Median	UK Mean	Dutch Mean
Bread Factory	1	2.5	1.7
Coffee Roaster	2	3.9	4.6
Chocolate Factory	3	4.6	5.1
Beer Brewery	6	7.7	8.1
Fragrance & Flavour Factory	8	8.5	9.8
Charcoal Production	8	9.2	9.4
Green Fraction composting	**9**	**10.3**	**14**
Fish smoking	9	10.5	9.8
Frozen Chips production	10	11	9.6
Sugar Factory	11	11.3	9.8
Car Paint Shop	12	11.7	9.8
Livestock odours	12	12.6	12.8
Asphalt	13	12.7	11.2
Livestock Feed Factory	15	14.2	13.2
Oil Refinery	14	14.3	13.2
Car Park Bldg	15	14.4	8.3
Wastewater Treatment	17	16.1	12.9
Fat & Grease Processing	18	17.3	15.7
Creamery/milk products	10	17.7	-
Pet Food Manufacture	19	17.7	-
Brickworks (burning rubber)	18	17.8	-

Environmental Odour	Ranking	Ranking	Ranking
Industrial Source	UK Median	UK Mean	Dutch Mean
Slaughter House	19	18.3	17.0
Landfill	**20**	**18.5**	**14.1**

Table 12.2 – Indicative Odour Standards Based on Offensiveness Of Odour and Adapted for Irish EPA (EPA 2019)

Industrial Sectors	Relative Offensiveness of Odour	Indicative Criterion
Rendering Fish Processing Oil Refining Creamery WWTP Fat & Grease Processing	High	1.5 OU_E/m^3 as a 98^{th}%ile of hourly averages at the worst-case sensitive receptor
Intensive Livestock Rearing Food Processing (Fat Frying) Paint-spraying Operations Asphalt Manufacture	Medium	3.0 OU_E/m^3 as a 98^{th}%ile of hourly averages at the worst-case sensitive receptor
Brewery Coffee Roasting Bakery Chocolate Manufacturing Fragrance & Flavouring	Low	6.0 OU_E/m^3 as a 98^{th}%ile of hourly averages at the worst-case sensitive receptor

Note 1 *Professional judgement should be applied in the determination of where the worst-case sensitive receptor is located.*

12.2.2 Standards and Guidance for 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. The applicable legal standards in Ireland are outlined in the Air Quality Regulations 2022 (S.I. No. 739/2022), which incorporate the CAFE Directive. The Air Quality Regulations set limit values for the pollutants nitrogen dioxide (NO_2) and nitrogen oxides (NO_X), particulate matter (PM) with an aerodynamic diameter of less than 10 microns (PM_{10}), PM with an aerodynamic diameter of less than 2.5 microns ($PM_{2.5}$), lead (Pb), sulphur dioxide (SO_2), benzene and carbon monoxide (CO) (see Table 12.3). These limit values are set for the protection of human health. NO_x limit values are set for the protection of ecosystems.

There are no statutory limits on dust deposition and the focus is on the prevention of nuisance and minimising air borne dust emissions where practicable. Although coarse dust is not regarded as a threat to health, it can create a nuisance by depositing on surfaces. No statutory or official air quality criterion for dust annoyance has been set in Ireland, UK, Europe or at World Health Organisation (WHO) level.

The most commonly applied guideline is the German TA Luft (German VDI, 2002) guideline of 350 mg/(m^{2}*day) as measured using Bergerhoff type dust deposit gauges as per the German

Standard Method for determination of dust deposition rate (VDI 2119). This is commonly applied to ensure that no nuisance effects will result from specified industrial activities. Below these thresholds dust problems are considered less likely. Dust deposition is normally measured by gravimetrically determining the mass of particulates and dust deposited over a specified surface area over a period of one month (30 days +/- 2 days).

Recommendations outlined by the Department of the Environment, Heritage & Local Government (2004), apply the Bergerhoff limit of 350 mg/(m^2*day) to the land ownership boundary of quarries. This standard can be applied to the proposed development in regard to dust deposition.

Table 12.3 – Air Quality Regulations (based on the CAFE Directive) and TA Luft

Pollutant	Regulation*	Limit Type	Value
NO_2	S.I.No. 739/2022	Hourly limit for protection of human health - not to be exceeded more than 18 times / year	200µg/m^3 NO_2
		Annual limit for protection of human health	40µg/m^3 NO_2
Nitrogen Oxides (NO + NO_2)		Critical limit for the protection of vegetation and natural ecosystems	30µg/m^3 NO + NO_2
Lead	S.I.No. 739/2022	Annual limit for protection of human health	0.5µg/m^3
SO_2	S.I.No. 739/2022	Hourly limit for protection of human health - not to be exceeded more than 24 times / year	350µg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times / year	125µg/m^3
		Critical limit for the protection of vegetation and natural ecosystems (calendar year and winter)	20µg/m^3
PM (as PM_{10})	S.I.No. 739/2022	24-hour limit for protection of human health - not to be exceeded more than 35 times / year	50µg/m^3
		Annual limit for protection of human health	40µg/m^3
PM (as $PM_{2.5}$)	S.I.No. 739/2022	Annual limit for protection of human health	25µg/m^3
Benzene	S.I.No. 739/2022	Annual limit for protection of human health	5µg/m^3
CO	S.I.No. 739/2022	8-hour limit (on a rolling basis) for protection of human health	10µg/m^3
Dust deposition (non-hazardous dust)	TA Luft (German VDI 2002)	Average daily dust deposition at the boundary of the site	350 mg/(m^2*day) Total Dust

Note 1 *CAFE Directive replaces the previous Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management and daughter directives, Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen,*

particulate matter and lead in ambient air and Directive 2000/69/EC of the European Parliament and of the Council of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air. S.I. No. 739/2022 revokes S.I. No. 180 of 2011.

12.2.3 Standards and Guidance for Climate

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (UNFCCC 2007). The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions. The Sharm el-Sheikh Implementation Plan was drafted at COP27 in November 2022. This plan included a new funding arrangement for "loss and damage" for vulnerable countries hit hard by climate disasters. No significant agreements were made regarding the phasing out of fossil fuels or limiting global heating to 1.5°C above pre-industrial levels, however the plan resolves to pursue further efforts to limit the rise to 1.5°.

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

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) (Government of Ireland, 2015) was enacted (the 2015 Act). The purpose of the 2015 Act was to enable Ireland '*to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050*' (section 3(1) of the 2015 Act). This is referred to in the 2015 Act as the '*national transition objective*'. The 2015 Act made provision for, *inter alia*, a national adaptation framework. In addition, the 2015 Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations. The 2015 Act was amended by the Climate Action and Low Carbon Development (Amendment) Act 2021 (the 2015 Act as amended).

A duty imposed on planning authorities by section 15 of the Climate Action and Low Carbon Development Act 2015 (as amended) is:

"1) A relevant body [e.g., a planning authority] shall, in so far as practicable, perform its functions in a manner consistent with —

(a) the most recent approved climate action plan,

(b) the most recent approved national long term climate action strategy,

(c) the most recent approved national adaptation framework and approved sectoral adaptation plans,

(d) the furtherance of the national climate objective, and

(e) the objective of mitigating greenhouse gas emissions and adapting to the effects of climate change in the State."

The first Climate Action Plan (CAP) was published by the Irish Government in June 2019 (Government of Ireland, 2019a). The Climate Action Plan 2019 (2019 CAP) outlined the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlined the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The 2019 CAP also detailed the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The Government published the second Climate Action Plan in November 2021 (Government of Ireland, 2021a). The plan contains similar elements as the 2019 CAP and aims to set out how Ireland can reduce our greenhouse gas emissions by 51% by 2030 (compared to 2018 levels) which is in line with the EU ambitions, and a longer-term goal of to achieving net-zero emissions no later than 2050. The 2021 CAP outlines that emissions from the Built Environment sector must be reduced to 4 – 5 $MtCO_2e$ by 2030 in order to meet our climate targets. This will require further measures in addition to those committed to in the 2019 CAP. This will include phasing out the use of fossil fuels for the space and water heating of buildings, improving the fabric and energy of our buildings, and promoting the use of lower carbon alternatives in construction.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 in December 2019 (Government of Ireland 2019b) followed by the publication of the Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021) (hereafter referred to as the 2021 Climate Act) in July 2021 (Government of Ireland, 2021b). The 2021 Climate Act was prepared for the purposes of giving statutory effect to the core objectives stated within the CAP.

The purpose of the 2021 Climate Act is to provide for the approval of plans '*for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050*'. The 2021 Climate Act will also '*provide for carbon budgets and a decarbonisation target range for certain sectors of the economy*'. The 2021 Climate Act defines the carbon budget as '*the total amount of greenhouse gas emissions that are permitted during the budget period*'. The 2021 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister shall request each local authority to make a '*local authority climate action plan*' lasting five years and to specify the mitigation measures and the adaptation measures to be adopted by the local authority.

In relation to carbon budgets, the 2021 Climate Action and Low Carbon Development (Amendment) Act states '*A carbon budget, consistent with furthering the achievement of the national climate objective, shall be proposed by the Climate Change Advisory Council, finalised by the Minister and approved by the Government for the period of 5 years commencing on the*

1 January 2021 and ending on 31 December 2025 and for each subsequent period of 5 years (in this Act referred to as a 'budget period'). The carbon budget is to be produced for 3 sequential budget periods, as shown in Table 12.4. The carbon budget can be revised where new obligations are imposed under the law of the European Union or international agreements or where there are significant developments in scientific knowledge in relation to climate change. In relation to the sectoral emissions ceiling, the Minister for the Environment, Climate and Communications (the Minister for the Environment) shall prepare and submit to government the maximum amount of GHG emissions that are permitted in different sectors of the economy during a budget period and different ceilings may apply to different sectors. The sectorial emission ceilings for 2030 were published in July 2022 and are shown in Table 12.5. Waste falls under the "other" sector emission target which has a 50% reduction requirement between 2018 and 2030.

In December 2022, CAP23 was published (Government of Ireland, 2022). This is the first CAP since the publication of the carbon budgets and sectoral emissions ceilings, and it aims to implement the required changes to achieve a 51% reduction in carbon emissions by 2030. The CAP has six vital high impact sectors where the biggest savings can be made: renewable energy, energy efficiency of buildings, transport, sustainable farming, sustainable business and change of land-use. CAP23 states that the decarbonisation of Irelands manufacturing industry is key for Ireland's economy and future competitiveness. There is a target to reduce the embodied carbon in construction materials by 10% for materials produced and used in Ireland by 2025 and by at least 30% for materials produced and used in Ireland by 2030. CAP23 states that these reductions can be brought about by product substitution for construction materials and reduction of clinker content in cement. Cement and other high embodied carbon construction elements can be reduced by the adoption of the methods set out in the Construction Industry Federation 2021 report Modern Methods of Construction. In order to ensure economic growth can continue alongside a reduction in emissions, the IDA Ireland will also seek to attract businesses to invest in decarbonisation technologies.

Table 12.4 – 5-Year Carbon Budgets 2021-2025, 2026-2030 and 2031-2025

Sector	Reduction Required	2018 Emissions ($MtCO_2e$)
2021-2025	295 Mt CO_2eq	Reduction in emissions of 4.8% per annum for the first budget period.
2026-2030	200 Mt CO_2eq	Reduction in emissions of 8.3% per annum for the second budget period.
2031-2035	151 Mt CO_2eq	Reduction in emissions of 3.5% per annum for the third provisional budget.

Table 12.5 – Sectoral Emission Ceilings 2030

Sector	Reduction Required	2018 Emissions ($MtCO_2e$)	2030 Emission Ceiling ($MtCO_2e$)
Electricity	75%	10.5	3
Transport	50%	12	6
Buildings (Commercial and Public)	45%	2	1
Buildings (Residential)	40%	7	4
Industry	35%	7	4
Agriculture	25%	23	17.25

Other (F-Gases, Waste & Petroleum refining)	50%	2	1

12.2.4 Odour Assessment Methodology

12.2.4.1 Characteristics of Odour

Odour Intensity and Threshold

Odour intensity is a measure of the strength of the odour sensation and is related to the odour concentration. The odour threshold refers to the minimum concentration of an odorant that produces an olfactory response or sensation. This threshold is normally determined by an odour panel consisting of a specified number of people, and the numerical result is typically expressed as occurring when 50% of the panel correctly detect the odour. This odour threshold is given a value of one odour unit and is expressed as 1 OU_E/m^3. The odour threshold is not a precisely determined value but depends on the sensitivity of the odour panellists and the method of presenting the odour stimulus to the panellists. An odour detection threshold relates to the minimum odorant concentration required to perceive the existence of the stimulus, whereas an odour recognition threshold relates to the minimum odorant concentration required to recognise the character of the stimulus. Typically, the recognition threshold exceeds the detection threshold by a factor of 2 to 10 (Water Environment Federation 1995) (AEA Technology 1994).

Odour Character

The character of an odour distinguishes it from another odour of equal intensity. Odours are characterised on the basis of odour descriptor terms (e.g. putrid, fishy, fruity etc.). Odour character is evaluated by comparison with other odours, either directly or through the use of descriptor words.

Hedonic Tone

The hedonic tone of an odour relates to its pleasantness or unpleasantness. When an odour is evaluated in the laboratory for its hedonic tone in the neutral context of an olfactometric presentation, the panellist is exposed to a stimulus of controlled intensity and duration. The degree of pleasantness or unpleasantness is determined by each panellist's experience and emotional associations. The responses among panellists may vary depending on odour character; an odour pleasant to many may be declared highly unpleasant by some.

Adaptation

Adaptation, or Olfactory Fatigue, is a phenomenon that occurs when people with a normal sense of smell experience a decrease in perceived intensity of an odour if the stimulus is received continually. Adaptation to a specific odorant typically does not interfere with the ability of a person to detect other odours. Another phenomenon known as habituation or occupational anosmia occurs when a worker in an industrial situation experiences a long-term exposure and develops a higher threshold tolerance to the odour.

12.2.4.2 Odour Dispersion Modelling 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) (USEPA 2022a) and following guidance issued by the EPA (EPA 2020a, 2022). The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources and has replaced ISCST3 (USEPA 1995) as the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain (USEPA 2017). The model has more advanced algorithms and gives better agreement with monitoring data in extensive validation studies (USEPA 1999, Schulman et al. 2000). An overview of the AERMOD dispersion model is outlined in Appendix 12-1.

The odour 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, as per EPA Guidance (EPA 2020a). 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.

The modelling incorporated the following features:

- 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 sources and draw plumes down towards the ground (termed building downwash). Building downwash was incorporated into the modelling.
- Detailed terrain has been mapped into the model using SRTM data with 30 m resolution. The site is located in gentle terrain. This takes account of all significant features of the terrain. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP (USEPA 2018).
- 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 12.1).

The source and emission data, including stack dimensions, volume flows and emission temperatures have been incorporated into the model.

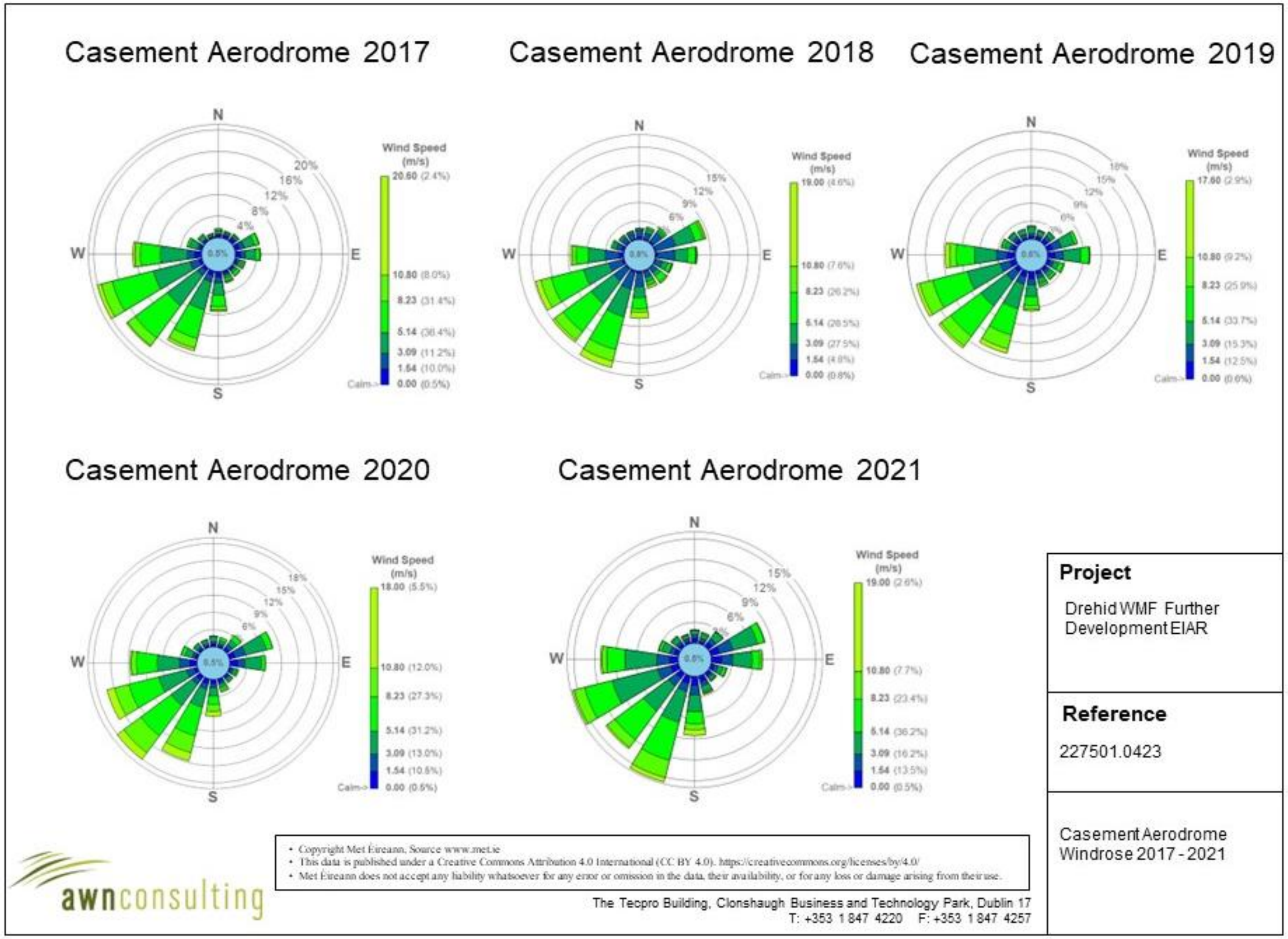

Figure 12.1 – Casement Aerodrome Windrose 2017-2021

12.2.4.2.1 Terrain

The AERMOD air dispersion model has a terrain pre-processor AERMAP (USEPA 2022a) 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 (USEPA 2022a) 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" (USEPA 2022a). The terrain surrounding the facility is detailed in Figure 12.3.

12.2.4.2.2 Meteorological Data

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA (USEPA 2017). 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 27 km east 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 station provide an indication of the prevailing wind conditions for the region (see Section 12.3.2). Results indicate that the prevailing wind direction is south-westerly in direction over the period 2017 - 2021.

12.2.4.2.3 Odour Emission Rates

The existing Drehid WMF is currently licensed by the EPA (IED Licence number W0201-03), including the operation of a gas utilisation plant and 3 flares. There are no significant odour emissions from either of these processes however they are included in the odour model.

The existing permission for the disposal of municipal solid waste has a permitted lifespan to 2028. Ongoing activities at the existing facility consist of the landfilling of municipal solid waste materials in a landfill at a maximum rate of 120,000 TPA for disposal, inert waste that is recovered for engineering purposes in the magnitude of approximately 300,000 TPA and acceptance of suitable waste for composting in a Composting Facility at a maximum rate of 25,000 TPA. Permission is sought for the landfilling of the above waste materials in the new landfill for a period of 25 years. Based on a blended density of the above (Section 12.1) waste types of c. 1.19 tonnes/m^3, it is envisaged that there will be a requirement for 285,000 m^3 landfilling capacity for each of the 25 years. This equates to c. 7,150,000 m^3 over the 25-year operational lifetime of the new landfill. Based on the indicative waste types to be disposed of in the landfill, the MSW and biostabilised organic waste quantity is predicted to be less than 50% of the total waste quantity within the landfill (refer to Chapter 2). Due to its nature, odour emissions from biostabilised waste are predicted to be at least 50% lower than raw MSW. In addition, wastes such as IBA, crushed glass, soil & stones, C&D waste including rubble and fines will also have significantly lower odour emissions. Odour emission rates from the landfill have not been reduced to reflect this in order to keep the emission calculations conservative.

The current Composting Facility is permitted to accept up to 25,000 TPA and has two biofilters which treat air prior to being vented from the building. The proposed development includes increasing the quantity of waste accepted at the existing Composting Facility from the currently permitted 25,000 TPA to 35,000 TPA. In addition, by way of an extension to the existing Composting Facility, the existing biofilters will be upgraded with a new biofilter system complete with two new biofilter stacks as described in Chapter 2. Waste accepted at the existing compost facility comprises organic fines and source separated organic waste from municipal and industrial sources. The same waste types will continue to be accepted at the facility under this current proposal. There is also the addition of a new MSW processing and composting facility as part of the proposed development, this will be situated as an extension to existing the composting facility building, bringing the combined total capacity of the building to 90,000 TPA. Table 12.6 and Table 12.7 provide details on the odour emission sources included in the model.

Further details on the proposed development are available in Chapter 2.

Table 12.6 – Drehid Facility, County Kildare. Landfill Odour Emission Source Details

Activity Type	Municipal Solid Waste (ou m^{-2} s^{-1}) Note 1
Capped	0.10
Temp cap	0.67
Interim Cap	1.69
Active	6.17

Note 1: *Odour emission rates (ou m^{-2} s^{-1}) taken from the 2012, 2017, 2018 Drehid EIS/EIAR's.*

Table 12.7 – Drehid Facility, County Kildare. Composting Odour Emission Source Details

Stack Reference	Stack Height	Exit Diameter (m)	Temp (K)	Exit Velocity (m/sec)	Odour Conc. (OU_E/Nm^3) Note 1	Odour Mass Emission (g/s)
Composting Facility existing facility x 2	17	1.18	293.15	13.6	1000	13,889
MSW Processing & Composting Facility – new facility x 2	17	1.08	293.15	19.5	1000	16,667
Flare 1	8	2.3	1323	24.6	-	983
Flare 2	8	2.3	1338	21.2	-	983
Flare 3	10	1.5	1273	49.7	-	983

Note 1: *Odour emission rates are based on upper limit of actual working detection for existing Composting Facility*

12.2.5 Air Quality Assessment Methodology

This assessment has been prepared based on the following TII Air Quality guidance:

- PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects; (TII 2022a);
- PE-ENV-01107: Air Quality Assessment Standard for Proposed National Roads (TII 2022b); and
- TII Roads Emissions Model (REM) and Model Development Report (GE-ENV-01107) (TII 2022b).

These guidance documents were issued in December 2022 and supersede the 2011 Transport Infrastructure Ireland 'Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes', or TII Air Quality Guidelines (TII 2011). The primary aspects of the assessment relate to the existing ambient air quality, proximity of sensitive locations and a review of the overall significance of potential changes in air quality.

Section 1.9 of PE-ENV-01107 (Air Quality Assessment Standard for Proposed National Roads):

'where projects requiring approval under Section 51, Section 177AE or Part 8 have, at the date of publication of this SD, commenced planning and design, and in particular, where technical advisor contracts have been executed, this SD should be:

- *treated as advice and guidance;*
- *employed to the greatest extent reasonably practicable; and*
- *applied in a proportionate manner, having regard to the characteristics and location of the project/maintenance works and the type and characteristics of potential impacts.'*

This document was drafted and legally reviewed prior to the guidance being issued. At the date of publication of the updated guidance climate assessments this document was progressed and legally reviewed prior to the guidance being issued. As per Section 1.9 of PE-ENV-01107 given above, it is considered reasonably practicable to employ the updated guidance to a reasonably practicable extent.

12.2.5.1Construction Phase

The Institute of Air Quality Management document *'Guidance on the Assessment of Dust from Demolition and Construction'* (IAQM, 2016) states that site traffic and plant is unlikely to make a significant impact on local air quality, dust being the exception to this. The distance between sensitive receptors and the emission locations for onsite traffic and plant is greater than the study area for emissions to impact sensitive receptors (200 m) as per TII Guidance (TII 2022a). Material handling activities, including excavation and backfill, on site may typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1- 75 µm). Deposition typically occurs in close proximity to each site and potential impacts generally occur within 350 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

The potential for dust to be emitted will depend on the type of activity being carried out (demolition, earthworks, construction and the trackout of dust to public roads) in conjunction with environmental factors including levels of rainfall, wind speed and wind direction. For further details on the proposed works, see Chapter 2.

There are no sensitive human within 350 m or designated ecological receptors within 50 m of the works areas, these areas of potential impact are in line with IAQM Guidance (IAQM 2016). While trackout can occur for up to 500 m from the site exit, it is not predicted to have any impact on public roads due to the length of the private driveway from the works areas (<4 km). As there are no sensitive receptors within the bands of potential impact provided by IAQM (IAQM 2016) to the active works areas and landfill there is no potential for impacts as a result of construction dust emissions therefore, the construction stage dust assessment has been scoped out from any further assessment.

12.2.5.2Operational Phase Traffic Assessment

The potential impact due to operational traffic is assessed with respect to the impact on nearby (within 200 m) sensitive receptors (i.e., residential properties, schools, hospitals, sensitive ecology) by an 'affected' road link as per TII Guidance (TII 2022a). The TII Guidance (TII 2022a), states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment.

- Annual Average Daily Traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV) (vehicles greater than 3.5 tonnes, including buses and coaches) flows will change by 200 AADT or more;
- Peak hour speed will change by 20 kph or more;
- Daily average speed change by 10 kph or more; or
- A change in carriageway alignment by 5 m or greater.

The change in traffic due to the proposed operational stage traffic, with a maximum increase in 2024 on a public road link of 214 AADT or 156 HGVs daily (See table 14-16 in Traffic Chapter 14 for further details), does not meet the above scoping criteria as there are no impacts within 200 m of a sensitive receptor and the changes in traffic are below the scoping criteria. Note, these numbers are based on a baseline without the current operational waste facility, whereas the proposed numbers are akin to a continuation of the current traffic generation on site. Therefore, traffic impacts have been scoped out from any further assessment as there is no potential for significant impacts to air quality.

12.2.5.3Operational Phase Air Quality Dispersion Modelling Methodology

Emissions from the site have been modelled using the AERMOD dispersion model (Version 22112) which has been developed by the U.S Environmental Protection Agency (USEPA) and the American Meteorological Society (AMS). The model is recommended as an appropriate model for assessing the impact of air emissions from industrial facilities in the EPA Guidance document "*Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (2020)*" (EPA 2020a).

The model is a "new-generation" steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement of the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources. Details of the model are given in Appendix 12-1. Fundamentally, the model has made significant advances in simulating the dispersion process in the boundary layer. This will lead to a more accurate reflection of real-world processes and thus considerably enhance the reliability and accuracy of the model particularly under those scenarios which give rise to the highest ambient concentrations.

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

The modelling incorporated the following features in line with EPA Guidance (EPA 2020a):

- Two receptor grids were created at which concentrations would be modelled. Receptors were mapped with sufficient resolution to ensure all localised "hot-spots" were identified without adding unduly to processing time. The receptor grids were based on Cartesian grids with the site at the centre. An outer grid extended to 10,000 m^2 with the site at the centre and with concentrations calculated at 100 m intervals. A smaller denser grid extended to 4,500 m2 from the site with concentrations calculated at 50 m intervals. Boundary receptor locations were also placed along the boundary of the site, at 25 m intervals, giving over 18,400 calculation points for the model as shown in Figure 12.2.
- 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 30 m resolution across the receptor grid, as detailed in Section 12.2.4.2.1. The site is located in gentle terrain. This takes account of all significant features of the terrain. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP (USEPA 2018) as shown in Figure 12.3.
- 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 12.1).
- The source and emission data, including stack dimensions, gas volumes and emission temperatures have been incorporated into the model.

Figure 12.2 – AERMOD 2-Tier Receptor Grid

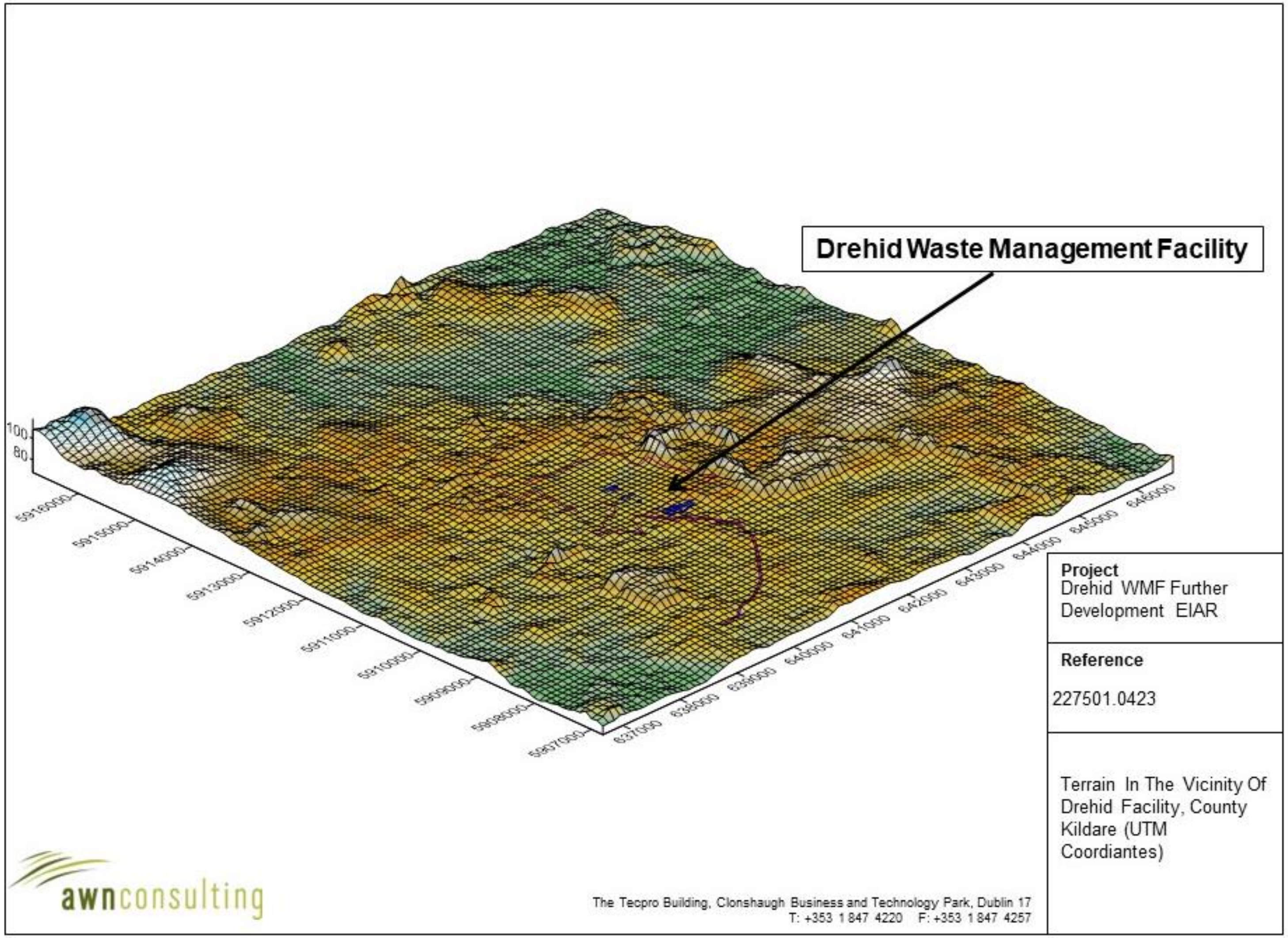

Figure 12.3 – Terrain in the Vicinity of Drehid Facility (UTM Coordinates)

12.2.5.3.1 Geophysical Considerations

AERMOD simulates the dispersion process using planetary boundary layer (PBL) scaling theory (USEPA 2022a). 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 (USEPA 2022b) to enable the calculation of the appropriate parameters. The AERMET meteorological pre-processor requires the input of surface characteristics, including surface roughness (z0), 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 10 km from the meteorological station for Bowen Ratio and albedo and to a distance of 1 km for surface roughness in line with USEPA recommendations (USEPA 2008, 2022b) as outlined in Appendix 12-2.

In relation to AERMOD, detailed guidance has been published (Alaska Department of Environmental Conservation 2008) for calculating the relevant surface parameters. The most pertinent features are the following;

- The surface characteristics should be those of the meteorological site (Casement Airport) rather than the installation;
- Surface roughness should use a default 1 km 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 30°; and
- Bowen ratio and albedo should be based on a 10 km 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 (USEPA 2008), 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 (Alaska Department of Environmental Conservation 2008). This approach has been applied to the current site with full details provided in Appendix 12-2.

12.2.5.3.2 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 800 m).

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 (USEPA 1985).

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.

The Plume Rise Model Enhancements (PRIME) (Paine, R & Lew, F. 2010, Schulman, L.L et al 2000) plume rise and building downwash algorithms, calculate the impact of buildings on plume rise and dispersion, and have been incorporated into AERMOD. The building input processor BPIP-PRIME produces the parameters which are required in order to run PRIME. The model takes into account the position of each stack relative to each relevant building and the projected shape of each building for 36 wind directions (at 10° intervals). The model determines the change in plume centreline location with downwind distance based on the slope of the mean streamlines and coupled to a numerical plume rise model (Paine, R & Lew, F. 2010).

Given that most stacks onsite 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 may change as the wind direction changes for each of the 36 wind directions. The dominant building for each relevant stack will vary as a function of wind direction and relative building heights.

12.2.5.3.3 Operational Phase Dust

The greatest potential impact on air quality during the occasional construction works aimed at increasing the landfill capacity is from construction dust emissions and the potential for nuisance dust and PM_{10}/$PM_{2.5}$ emissions. While construction dust tends to be deposited within 350 m of a construction site, the majority of the deposition occurs within the first 50 m (IAQM 2014). The large site and long entrance drive ensure that there are no sensitive residential receptors within 350 m of the construction area.

12.2.5.3.4 Air Quality Process Emissions

The Drehid facility is currently licensed (IED Licence numbers W0201-03) including the operation of a gas utilisation plant and flares. The site has three flares (one of which functions as a backup) which are assumed to run continuously, two of which are associated with the gas utilisation plant. Flare monitoring reports from 2019, 2020, 2021 and 2022 indicate that the flares are below the licensed limit under W0201-03, which sets a limit value for NO_x of 150 mg/m^3. The flares have been modelled as being in continuous operation as a worst-case scenario; however, this is unlikely to be the case.

On site there is also the capture and utilisation of the landfill gas for the generation of electricity for supply to the national grid. As part of the utilisation plant there are four gas engines. These engines are licensed to discharge NO_x and particulates under W0201-03, see Table 12.8 for details.

The Ozone Limiting Method (OLM) was used to model NO_2 concentrations. The OLM is a regulatory option in AERMOD which calculates ambient NO_2 concentrations by applying a background ozone concentration and an in-stack NO_2/NOx ratio to predicted NOx concentrations. An in-stack NO_2/NOx ratio of 0.1 and a background ozone concentration of 55 µg/m^3 were used for modelling.

These emissions are part of the currently operational facility.

Table 12.8 – Drehid Facility, County Kildare. Landfill NO_x and PM_{10} Emission Source Details

Emission Source Reference	Exit Diameter (m)	Temp (K)	Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual, wet)	NO_2		PM_{10}	
					Concentration (mg/Nm^3)	Mass Emission (g/s)	Concentration (mg/Nm^3)	Mass Emission (g/s)
Gas Utilisation Plant 1	0.4	733	5,216	28.1	500	0.724	130	0.19
Gas Utilisation Plant 2	0.4	744	5,204	27.0	500	0.723	130	0.19
Gas Utilisation Plant 3	0.4	738	5,127	28.1	500	0.712	130	0.19
Gas Utilisation Plant 4	0.4	733	5,122	28.3	500	0.711	130	0.18
Flare 1	2.3	1296	36,350	17.8	150	1.51	N/A	N/A
Flare 2	2.3	1287	36,350	17.7	150	1.51	N/A	N/A
Flare 3	1.5	1273	36,350	49.7	150	1.21	N/A	N/A

The TII *Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document PE-ENV-01106 (TII 2022a)* details the methodology for determining air quality impact significance criteria that are consistent with the Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2022a). The degree of impact is determined based on both the absolute and relative impact. The TII significance criteria have been adopted for the existing facility and are detailed in Table 12.9. The significance criteria are based on $PM_{2.5}$, PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40 µg/m^3).

Table 12.9 – Definition of Impact Descriptors for Changes in Ambient Pollutant Concentrations

Long term average Concentration at receptor in assessment year (µg/m^3)	% Change in concentration relative to Air Quality Standard Value (AQLV)			
	1-2%	2-5%	5-10%	>10%
75% of less of AQLV	Neutral	Neutral	Slight	Moderate
76-94% of AQLV	Neutral	Slight	Moderate	Moderate
95-102% OF AQLV	Slight	Moderate	Moderate	Substantial
103-109% of AQLV	Moderate	Moderate	Substantial	Substantial
110% or more of AQLV	Moderate	Substantial	Substantial	Substantial

Source: Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document (TII 2022a)

AQLV = Air Quality Limit Value

12.2.5.4 Operational Phase Air Quality Impact on Ecological Sites

For impacted roads which pass within 2 km of a designated area of conservation (either Irish or European designation) require identification by the Air Quality Specialist However, in practice the potential for impact on an ecological site is highest within 200 m of the proposed development and therefore only designated habitats impacted roads within 200 m when significant changes in AADT (see Section 12.2.5.2) occur require assessment (TII 2022a). The TII Air Quality Guidelines (TII 2022a) state that designated habitats that are sensitive to nitrogen require consideration within the air quality assessment, designated habitats include:

- Ramsar Sites;
- Special Protected Areas (SPA) and proposed sites (pSPA);
- Special Areas of Conservation (SAC) and proposed sites (pSAC);
- Nature Heritage Areas (NHA) and proposed Natural Heritage Areas (pNHA);
- Ancient woodland;
- Veteran trees;
- Nature Reserves;
- National Parks;
- Refuge for Fauna and Flora;
- Wildfowl Sanctuaries;
- Biogenetic Reserves; and
- UNESCO Biosphere Reserves.

Predictions of NOx concentrations, ammonia (NH_3) concentrations, N deposition and acid deposition should be conducted. NO_x concentrations are predicted using the TII REM (TII 2022c) and ammonia is predicted using Calculator for Road Emissions of Ammonia (CREAM) Tool developed by Air Quality Consultants (Air Quality Consultants 2020). Habitats that have been designated as a geological feature or a water course do not require inclusion within the assessment. Information to EPA's research papers '*Research 323: Critical Loads and Soil-Vegetation Modelling*' (EPA 2020b) and '*Research 390: Nitrogen-Sulphur Critical Loads: Assessment of the Impacts of Air Pollution on Habitats*' (EPA 2021a) provide information regarding background concentrations and critical loads. Total NH_3 concentrations should then be compared to the critical levels of 1 µg/m^3 for lichens and bryophytes and 3 µg/m^3 for everything else (IAQM, 2020). Background concentrations for NH_3, NO_x, N deposition and acid deposition are included in Section 12.3.3.

At sensitive designated habitats, where significant effects are determined, site survey information from the project ecologist will be required to determine if the sensitive habitat of relevance is present in the affected area and to inform on any potential mitigation measures that may be required. Further guidance can also be found in the IAQM document A Guide to The Assessment of Air Quality Impacts on Designated Nature Conservation Sites (IAQM 2020) and in LA105 Air Quality (Highways England 2019), both of which describe NO_X emissions as the most likely source of significant impacts from road traffic.

The closest designated ecological site to the area of operation is Hodgestown Bog NHA which is approximately 3.5 km from the site boundary. There are no designated areas within 200 m of road links directly impacted by the proposed development for the construction or operational phases. As such an assessment of the impact with regards to air quality impacts on sensitive ecology was screened out as there is no likely potential for significant impacts.

Potential Impacts on NHA from the gas utilisation plant and flares, discussed in Section 12.2.5.3.4, will be considered as part of the impact assessment in Section 12.4.2.

12.2.6 Climate Assessment Methodology

The climate assessment has been prepared based on the following TII Climate guidance:

- PE-ENV-01104: Climate Guidance for National Rods, Light Rail and Rural Cycleways (offline & Greenways) – Overarching Technical Document (TII 2022d), and
- PE-ENV-01105: Climate Assessment of Proposed National Roads – Standard (TII 2022e);
- GE-ENV-01106: TII Carbon Assessment Tool for Road and Light Rail Projects and User Guidance Document (TII 2022f).

These guidance documents were issued in December 2022 and supersedes the 2011 Transport Infrastructure Ireland '*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*', or TII Air Quality Guidelines (TII 2011) which also included information on the climate assessment. The climate assessment is split into two aspects, the greenhouse gas assessment (i.e. the impact of the project on climate change) and the climate change risk assessment (i.e. the impact of climate change on the project).

Section of 1.5 of PE-ENV-01105 (Climate Assessment Standard for Proposed National Roads) (TII 2022e) states that:

'where projects requiring approval under Section 51, Section 177AE or Part 8 have, at the date of publication of this SD, commenced planning and design, and in particular, where technical advisor contracts have been executed, this SD should be:

- *treated as advice and guidance;*
- *employed to the greatest extent reasonably practicable; and*
- *applied in a proportionate manner, having regard to the characteristics and location of the project/maintenance works and the type and characteristics of potential impacts.'*

This document was drafted and legally reviewed prior to the guidance being issued. At the date of publication of the updated guidance climate assessments this document was progressed and legally reviewed prior to the guidance being issued. As per Section of 1.5 of PE-ENV-01105 given above, it is considered reasonably practicable to employee to the updated guidance to a reasonably practicable extent.

As per PE-ENV-01104 (TII 2022d) the climate assessment is broken into two main headings:

- Greenhouse Gas Emissions Assessment (GHGA) – Quantifies the GHG emissions from a project over its lifetime. The assessment compares these emissions to relevant carbon budgets, targets and policy to contextualise magnitude.
- Climate Change Risk assessment (CCRA) – Identifies the impact of a changing climate on a project and receiving environment. The assessment considers a projects vulnerability to climate change and identifies adaptation measures to increase project resilience.

In addition to assessing the impacts of the proposed development on climate change in the form of a Greenhouse Gas Assessment (GHGA), the impact of climate change on the proposed development must be considered. This is completed by a climate change risk assessment (CCRA). A CCRA considers a project's vulnerability to climate change and identifies adaptation measures.

The climate vulnerability and risk assessment helps identify the significant climate risks. It is the basis for identifying, appraising and implementing targeted adaptation measures. This will help reduce the residual risk to an acceptable level.

12.2.6.1 Greenhouse Gas Assessment (GHGA)

The assessment set out in PE-ENV-01104 (TII 2022d) aims to quantify the difference in GHG emissions between the Proposed Scheme and the baseline scenario (the alternative project/solution in place of the Proposed Scheme). The assessment process is guided by the following documents:

- Publicly Available Specification (PAS) 2080:2016 on Carbon Management in Infrastructure (BSI 2016): this provides a framework that allows all parties involved in the development of an infrastructure project to work together to quantify the project's overall carbon impact.
- The Institute of Environmental Management and Assessment Assessing Greenhouse Gas Emissions and Evaluating their significance (2nd Edition) (IEMA 2022): lays out the process of assessing GHG emissions to understand their significance in the context of an EIA.

The IEMA EIA guidance (IEMA 2022) does not recommend a particular approach for this due to variations of situations but instead it sets out advice for the key common components necessary for undertaking a GHG emissions assessment. During the assessment IEMA recommend use of a reasonable worst-case scenario rather than an absolute worst-case scenario. The TII GHGA (TII 2022d) should incorporate the following steps into any climate assessment, these steps have been utilised when developing the methodology for this assessment:

- Evaluate early opportunities to reduce GHG emissions;
- Set the scope and boundaries of the GHG assessment;
- Data collection;
- Develop the baseline and Do-Minimum Scenario;
- Calculate/determine the GHG emissions from the proposed development;
- Identify mitigation measures;
- Access Significance; and
- Access cumulative impacts.

TII Guidance PE-ENV-01104 (TII 2022d) states that: *"activities that account for less than 5% of the total energy usage and/or 5% of the mass balance can be excluded from the assessment scope. e.g., if electricity for operating signage is less than 5% of total electricity used of the project infrastructure, it can be excluded from the assessment scope."*

With respect to the requirement for a cumulative assessment PE-ENV-01104 (TII 2022d) states that *"for GHG Assessment is the global climate and impacts on the receptor from a project are not geographically constrained, the normal approach for cumulative assessment in EIA is not considered applicable."*

However, by presenting the GHG impact of a project in the context of its alignment to Ireland's trajectory of net zero and any sectoral carbon budgets, this assessment will demonstrate the potential for the project to affect Ireland's ability to meet its national carbon reduction target. Therefore, the assessment approach is considered to be inherently cumulative.

PE-ENV-01104 (TII 2022d) outlines the recommended sources of input data and the appraisal methodology for the assessment of impacts for both the Construction Phase and Operational Phase as outlined in Table 12.10 (reproduced from Table 6.2 of PE-ENV-01104). A detailed discussion of the input data and appraisal methodology for both the Construction and Operational Phases is detailed in Section 12.2.6.1. The assessment is broken down into stages (construction and operational) and individual assessment techniques for each of these stages which are conducted in the same manner for a highways project, rail project, housing project or commercial development.

The GHG systems boundary for assessment and life cycle stages scoped in include preconstruction, products utilised in construction, the construction activities, maintenance of materials during the lifespan of the Proposed Scheme and the use or operational phase.

To define the boundary of the assessment consideration should be given to the system boundary and to the temporal boundary. The system boundary includes the emission sources of the project and the lifecycle stage in which they arise, Table 12.10 shows an overview of such sources. The temporal boundary is the time period which the assessment covers, in this case a design life of 25 years is considered.

Embodied Construction Emissions

GE-ENV-01106: TII Carbon Assessment Tool for Road and Light Rail Projects and User Guidance Document (TII 2022f) provides guidance on the use of the TII Carbon Tool for assessing lifecycle carbon emissions for National Road and light rail infrastructure projects in

Ireland. Tool aligns with Section 7 of PAS 2080, which was published by the British Standards Institution (BSI), the Construction Leadership Council and the Green Construction Board in 2016.

The embodied construction emissions for the Proposed Scheme were calculated using the online TII Carbon Assessment Tool (TII 2022f). The TII Online Carbon Tool (TII 2022f) uses emission factors from recognized sources including the Civil Engineering Standard Method of Measurement (CESSM) Carbon and Price Book database (CESSM, 2013), UK National Highways Carbon Tool v2.4 and UK Government 2021 Greenhouse Gas Reporting Conversion Factors. The carbon emissions are calculated by multiplying the emission factor by the quantity of the material that will be used over the entire construction / maintenance phase. The TII Online Carbon Tool (TII 2022f) has been commissioned by TII to assess GHG emissions associated with infrastructure projects using Ireland-specific emission factors and data. The goal of the tool is to assist project development as a decision-making tool that drives lower carbon infrastructure and to facilitate the integration of environmental issues into infrastructure planning, construction and operation. While this project is not a TII related project, the emissions factors remain the same for the materials.

The Construction Phase of the Proposed Scheme will result in GHG emissions from various sources, as outlined in Table 12.10. Embodied carbon refers to GHGs emitted during the manufacture, transport and use of building materials, together with end-of-life emissions. As part of the Proposed Scheme, Construction Phase embodied GHG emissions are categorised under the following headings:

- Land clearance activities;
- Manufacture of materials and transport to site;
- Construction works (including excavations, construction, water usage, electrical power/fuel usage, personnel travel and project size); and
- Construction waste products (including transport off-site).

Detailed project information including volumes of materials required for construction and generated during the construction phase were obtained from Tobin Consulting. The landfilling element of the proposed development is expected to have an operational lifespan of 25 years. The predicted embodied emissions can be averaged over the full construction phase and the lifespan of the proposed development to give the predicted annual emissions to allow for direct comparison with annual emissions and targets. Emissions have been compared to the transport sector carbon budget (Department of the Taoiseach 2022) which has a ceiling of 6,000ktCO_2eq in 2030 and compared against the Ireland's non-ETS 2030 target of 33,381.3 Kt CO_{2eq} (as set out in Commission Implementing Decision (EU) 2020/2126 of 16 December 2020 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council).

The assessment commences with the preliminary design of the proposed development, through the pre-construction or site clearance period, followed by the assessment of the embodied carbon associated with all materials used in the construction of the Proposed Scheme, the emissions during the construction phase and additionally emissions related to waste generated during the Construction Phase. The TII Carbon Tool also assesses on-going maintenance associated with the default 60-year lifetime of the Proposed Scheme however the landfilling element of the proposed project will have a project lifespan of 25 years.

An emission factor is a coefficient which allows one to convert activity data into GHG emissions. The carbon emissions are calculated by multiplying the emission factor by the quantity of the material that will be used over the entire construction / maintenance phase. The tool aligns with the specification (PAS) 2080: 2016 Carbon Management in Infrastructure.

Standard maintenance, as indicated through the TII Online Carbon Tool (TII 2022f), required over the Operational Phase has also been considered as part of the embodied construction emissions including consideration of the maintenance cycles for embodied carbon for road pavements. Given the extent of the Operational Phase, PE-ENV-01104 (TII 2022d) states that decommissioning can be scoped from the boundary of the climate assessment.

Table 12.10 – Sources and Life Cycle Stages for a Project's GHG Emissions (reproduced from Table 6.2 PE-ENV-01104 (TII 2022d))

Lifecyle stage	Reporting Category	Description	Primary emissions sources
Before use	Embodied carbon	Raw material extraction, transportation (within the supply chain up to the point of final factory gate) and manufacturing of products required for the proposed development.	• Embodied carbon (GHG emissions) within the construction materials. Fuel consumed for material and plant transportation to construction site. •Clearance / demolition activities (including the area of land to be cleared, vegetation/sequestration loss and water use). •All advanced works for example archaeological works, fencing etc., should be included. •All ground works including earthworks material, laying and compaction etc.
	Transport	Transportation of products/materials and construction equipment from point of production/storage to construction site. • Transport to works site.	•GHG emissions from the excavation of material.
	Construction processes	Temporary works, ground works, and landscaping. •Excavation •On site energy use •On site water use.	•Grid electricity to power auxiliary facilities. Fuel consumed by construction vehicles and plant. •GHG emissions from the provision of water and treatment of wastewater.
	Material use	• Waste production, transportation, and waste management. • Carbon emitted or sequestered directly from the fabric of products and materials once they have been installed as part of infrastructure and it is in normal use.	•GHG emissions from the treatment of waste. • GHG emissions savings arising from planting of different vegetation types and/or rehabilitation activities e.g. peat restoration. For maturing vegetation such as trees, sequestration should be accounted for as the vegetation matures (e.g., <30 years) and once matured (e.g., >30 years).
Use	Maintenance	Maintenance and repair activities.	GHG emissions from energy and fuel use, maintenance vehicles, provision of water and treatment of wastewater during maintenance. • Embodied emissions associated with maintenance and repair e.g. rail/steel replacement and resurfacing materials.

Lifecyle stage	Reporting Category	Description	Primary emissions sources
	Operation	•Operational energy (B6) •Operational water (B7) •Other operational processes (B8)	GHG emissions resulting from the consumption of energy and fuel use for infrastructure operation e.g. lighting, signage. •GHG emissions resulting from the consumption of water. •Other could include GHG emissions as a result of management of operational waste.
	User emissions	User's utilisation of infrastructure.	•GHG emissions from vehicles and fuel use for generators on site. •GHG emissions from the fuel consumed for worker(s) commuting to and from the site. •Activities associated with treatment and processing for recovery, reuse and recycling of waste materials arising from infrastructure.
End of Life	Deconstruction	Onsite activities involved in deconstructing, dismantling, and demolishing the infrastructure.	GHG emissions resulting from final disposal of demolition materials.
	Transport (C2)	Transport to and from disposal.	
	Waste processing for recovery and disposal (C4)	Reuse, recycling, and recovery of materials Disposal of materials.	
Supplementary information beyond the infrastructure lifecycle	Lifecycle benefits and loads beyond the system boundary	GHG emissions potential of reuse and recycling, Benefits and loads of additional infrastructure functions.	Offsetting carbon emissions of a scheme through credible offsite renewable, planting, rehabilitation, and regenerative schemes.

Land Use Change

The land use change associated with the Construction Phase of the Proposed Scheme has also been quantified using the approach outlined in Table 12.10. Trees and peat are a natural carbon sink and absorb carbon dioxide (CO_2) from the atmosphere helping in the reduction of climate change; any felling of trees has the potential to result in a loss of this carbon sink thus increasing the levels of CO_2 in the atmosphere. In contrast, increased planting of trees on suitable lands or rewetting of peat, will over time, help to increase the carbon sink potential of the land and benefit climate. The change in land use associated with the Proposed Scheme has been calculated using the methodology outlined in the Intergovernmental Panel on Climate Change (IPCC) 'Guidelines on National GHG Inventories – Chapter 4: Forest Land' (IPCC 2006).

Consideration is also given to the 2010 European Commissions Guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive EU 2009/28/EC (European Union 2010). Operational land use change is also appropriately assessed.

Traffic Related Emissions

Emissions related to the transportation of products/materials and construction equipment from point of production/storage to construction site are included within the online carbon tool as per PE-ENV-01104 (TII 2022d).

PE-ENV-01104 (TII 2022d) states that road traffic related emissions information should be obtained from an Air Quality Practitioner to show future user emissions during operation without the project in place. The Air Quality Practitioner calculated the traffic related emissions through the use of the TII REM tool (TII 2022c) which includes detailed fleet predictions for age, fuel technology, engine size and weight based on available national forecasts. However, Section 12.2.5.2 scoped out operational phase impacts due to traffic on the basis of no roads being classed as affected.

Operational Phase Waste Emissions

The breakdown of organic material that occurs in landfills releases a combination of methane and carbon dioxide, a process that occurs on a timescale of 100 or more years. CH_4 emissions can be 'flared' to convert the CH_4 to CO_2 before being released into the atmosphere, this is done as CO_2 has a lower global warming potential than methane. The IPCC AR5 Synthesis Report: Climate Change 2014 of the Fifth Assessment Report (AR5) (IPCC 2015) sets out the global warming potential for a 100-year time period (GWP100) for CO_2 as the basic unit (GWP = 1) whereas CH_4 has a global warming potential equivalent to 28 units of CO_2 and N_2O has a GWP100 of 265. This approach is also maintained in the draft IPCC AR6 Technical Summary (IPCC 2021). Up to 50% of the organic biogenic carbon in the waste is sequestered (Eunomia 2020). Hence, landfills act as an 'carbon capture and storage' facility as some CH_4 remains sequestered within it.

Detailed guidelines have been published for the calculation of GHG emissions (IPCC 2006a; USEPA 2002) from solid waste disposal sites (SWDSs) including municipal waste landfills. The main GHG emission from SWDSs is methane (CH_4). Even though the source of carbon is primarily biogenic, CH_4 would not be emitted were it not for the human activity of landfilling waste, which creates anaerobic conditions conducive to CH_4 formation. Although CO_2 is also produced in substantial amounts from landfills, the primary source of CO_2 is from the decomposition of organic material derived from biomass sources (crops, forests) and which are re-grown on an annual basis. Hence, these CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology (IPCC 2006a). The IPCC Waste Model (IPCC 2006b) has been utilised to calculated emissions due to MSW from the landfill.

The proposed development has some beneficial potential with respect to climate by diverting waste from direct landfill and directing suitable waste to the Composting Facility (BEIS 2021). An emission rate based on biostabilised waste which has been landfilled has been derived from literature studies (European Communities 2001). An average value has been taken between the two quoted studies, The first study is based on a highly stabilised compost which is landfilled with all methane oxidised prior to escape and a second study where a less completely stabilised compost is landfilled and 25% of the methane formed escapes with the remaining oxidised. An average rate of 134 $kgCO_2e$/tonne is derived based on these studies.

Incinerator bottom ash (IBA) is not considered to be a significant as the material is considered to be inert (Eunomia 2010).

12.2.6.2 Climate Change Risk Assessment (CCRA)

PE-ENV-01104 (TII 2022d) states that the CCRA is guided by the principles set out in the overarching best practice guidance documents:

- EU (2021) Technical guidance on the climate proofing of Infrastructure in the Period 2021-2027 (European Commission, 2021); and
- The Institute of Environmental Management and Assessment, Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (2nd Edition) (IEMA, 2020).

The baseline environment information provided in Section 12.3.4, future climate change modelling and input from other experts working on the Proposed Scheme (i.e. hydrologists) should be used in order to assess the likelihood of a climate hazard. A risk register is generated in order to document the risk assessment process (Appendix 12-4).

The initial stage of an assessment is to establish a scope and boundary for the assessment taking into account the following criteria:

- Spatial boundary: As per PE-ENV-01104 (TII 2022d), the study area with respect to the GHGA is Ireland's Climate budget. The study area with respect to the CCRA can be considered the project boundary and its assets that are considered within the methodology set out in Section 12.2.6.2. The study area will be influenced by current and future baselines (Section 12.3.4). This study area is influenced by the input of other experts within the EIAR team;
- Climate hazards: The outcomes of the climate screening i.e. vulnerability assessment and baseline assessment; and
- Project receptors: TII state that the project receptors are the asset categories considered in the climate screening. In addition, any critical connecting infrastructure and significant parts of the surrounding environment e.g. water bodies that should be considered as a part of the indirect, cumulative and in combination impact assessment should also be considered project receptors. (Section 12.3.1).

Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021a) outlines an approach for undertaking a climate change risk assessment where there is a potentially significant impact on the proposed development due to climate change. The risk assessment assesses the likelihood and consequence of the impact occurring, leading to the evaluation of the significance of the impact. The role of the climate consultant in assessing the likelihood and impact is often to facilitate the climate change risk assessment process with input from the design team or specific specialists such as hydrology.

Examples of climate hazards which are considered in the risk assessment include:

- Flooding (coastal) – including sea level rise and storm surge.
- Flooding (pluvial);
- Flooding (fluvial);
- Extreme heat – including extreme heat events and increasing temperatures overtime;
- Extreme cold – including frost and snow;
- Wildfire;
- Drought;

- Extreme wind;
- Lightning and hail;
- Landslides; and
- Fog.

The climate screening risk assessment comprises of a sensitivity analysis which is intended to evaluate the project's vulnerability to climate change. This is completed by combining a sensitivity (Table 12.11) and exposure (Table 12.12) analysis. The sensitivity analysis identifies the climate hazards relevant to the specific project type irrespective of its location (example: Sea level rise will affect seaport projects regardless of location). Sensitivity ratings are classed as:

- High Sensitivity: the climate hazard may have a significant impact on assets and processes, inputs, outputs and transport links. This is a sensitivity score of 3;
- Medium Sensitivity: the climate hazard may have a slight impact on assets and processes, inputs, outputs and transport links. This is a sensitivity score of 2; and
- Low Sensitivity: the climate hazard has no (or insignificant) impact. This is a sensitivity score of 1.

The European Commission assessment states that there are four themes to sensitivity analysis. Transport links may be outside the direct control of the project but still should be considered. TII (TII 2022a) set out the following as potential sensitive receptors: drainage, structures, earthworks, geotechnical, utilities, landscaping, signs, light posts and fences and buildings, these can be considered the on-site assets for road projects.

Table 12.11 – Screening Assessment: Likelihood Categories

Sensitive Receptors	Sensitivity to Climate Hazards (No consideration of site location)								
	Flood (Fluvial/ Pluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Pavements									
Drainage									
Structures									
Earthworks									
Utilities									
Landscaping									
Signs, light posts and fences									
Buildings									
Composting/MSW/Inert Facility									
Landfill									
Access/ Transportation									
Integrated Constructed Wetland (ICW)									

The exposure analysis identifies the climate hazards relevant to the planned project location irrespective of the project type for example: flooding could be a risk if the project location is next to a river in a floodplain. Exposure may be classed as high, medium or low:

- High exposure: It is almost certain or likely this climate hazard will occur at the project location i.e. might arise once to several times per year. This is an exposure score of 3;
- Medium exposure: It is possible this climate hazard will occur at the project location i.e. might arise a number of times in a decade. This is an exposure score of 2; and
- Low exposure: It is unlikely or rare this climate hazard will occur at the project location i.e. might arise a number of times in a generation or in a lifetime. This is an exposure score of 1.

Table 12.12 -Screening Assessment: Exposure Assessment

Climate Exposure	Exposure Risk to Climate Variable (Consider the site location)								
	Flood pluvial	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Without exposure at project location									

Once sensitivity and exposure are categorised, a vulnerability analysis is conducted using Table 12.13. If the project scores a high or medium vulnerability, the project should proceed to add further mitigation measures including management for vulnerabilities that cannot be fully mitigated.

Table 12.13 – Screening Assessment: Vulnerability Analysis

		Exposure (current + future climate)		
		High	Medium	Low
Sensitivity (highest across the four themes)	High	High	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Low

12.2.6.3 Climate Significance Criteria

12.2.6.3.1 Significance Criteria for GHGA

PE-ENV-01104 (TII 2022d) outlines a recommended approach for determining the significance of both the Construction and Operational Phases. The approach is based on comparing the 'Do Something' scenario and the net project GHG emissions (i.e. Do Something – Do Minimum) to the relevant carbon budgets (Department of the Taoiseach, 2022). With the publication of the Climate Action Act in 2021, sectoral carbon budgets have been published for comparison with the Net CO_2 project GHG emissions from the Proposed Scheme. The waste sector emitted approximately 2 MtCO2eq in 2018 and has a ceiling of 1 MtCO2eq in 2030 which is a 50% reduction over this period. The comparison of impacts with the relevant budget has been completed in Section 12.4.3.

PE-ENV-01104 (TII 2022d) states that significance of GHG effects is based on IEMA guidance (IEMA, 2022) which is consistent with the terminology contained within Figure 3.4 of the EPA's (2022) *'Guidelines on the information to be contained in Environmental Impact Assessment Reports'.*

The 2022 Guidance (IEMA 2022), a guidance which PE-ENV-01104 (TII 2022d) takes a lead from, sets out the following principles for significance:

- When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative or negligible;
- Where GHG emissions cannot be avoided, the goal of the EIA process should be to reduce the project's residual emissions at all stages; and
- Where GHG emissions remain significant, but cannot be further reduced, approaches to compensate the project's remaining emissions should be considered.

TII (TII 2022d) states that professional judgement must be taken into account when contextualising and assessing the significance of a project's GHG impact. In line with IEMA Guidance (IEMA, 2022), TII state that the crux of assessing significance is *"not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050"*.

Significance is determined using Table 12.14 (derived from Table 6.7 of PE-ENV-01104 (TII 2022d)) along with a with consideration of the following two factors:

- The extent to which the trajectory of GHG emissions from the project aligns with Ireland's GHG trajectory to net zero by 2050; and
- The level of mitigation taking place.

Table 12.14 – GHGA Significance Matrix

Effects	Significance level Description	Description
Significant adverse	Major adverse	The project's GHG impacts are not mitigated.
		The project has not complied with do-minimum standards set through regulation, nor provide reductions required by local or national policies; and
		No meaningful absolute contribution to Ireland's trajectory towards net zero.
	Moderate adverse	The project's GHG impacts are partially mitigated.
		The project has partially complied with do-minimum standards set through regulation, and have not fully complied with local or national policies; and
		Falls short of full contribution to Ireland's trajectory towards net zero.
Not significant	Minor adverse	The project's GHG impacts are mitigated through 'good practice' measures.
		The project has complied with existing and emerging policy requirements; and
		Fully in line to achieve Ireland's trajectory towards net zero.
	Negligible	The project's GHG impacts are mitigated beyond design standards.
		The project has gone well beyond existing and emerging policy requirements; and
		Well 'ahead of the curve' for Ireland's trajectory towards net zero.
Beneficial	Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmosphere GHG concentration.
		The project has gone well beyond existing and emerging policy requirements; and
		Well 'ahead of the curve' for Ireland's trajectory towards net zero, provides a positive climate impact.

12.2.6.3.2 Significance Criteria for CCRA

The significance rating for the CCRA in Table 12.15 is provided on the basis that all adaptation/mitigation measures have been implemented. Consultation with TII has been carried out regarding residual risk to confirm the consequence of the identified risk. Any risks that remain significant (i.e. a high or extreme risk) should be prioritised in the monitoring and reviews to the risk assessment.

Table 12.15 – Risk profile comparison

Risk Rating	Number of Risks	
	Initial risk rating	Residual risk rating
Low Risk	No. of low risk	No. of low risk
Medium Risk	No. of medium risk	No. of medium risk
High Risk	No. of high risk	No. of high risk
Extreme Risk	No. of extreme risk	No. of extreme risk

12.3 RECEIVING ENVIRONMENT

12.3.1 Sensitive Receptors

Air and Odour Receptors

The Bord na Móna property is located within the County Kildare townlands of Drehid, Ballynamullagh, Kilmurry, Mulgeeth, Mucklon, Timahoe East, Timahoe West, Coolcarrigan, Corduff, Coolearagh West, Allenwood North, Killinagh Upper, Killinagh Lower, Ballynakill Upper, Ballynakill Lower, Drummond, Kilkeaskin, Loughnacush, and Parsonstown. This landholding has a total area of 2,544 ha.

The nearest sensitive human receptor consists of a dwelling and is situated over 1,000 m from the proposed works area. A sensitive receptor is within 140 m to the southwest of the site boundary close to the facilities main gate from the public road, however no development is proposed in this area and therefore it is unlikely to be significantly impacted. Figure 12.4 shows the location of the proposed development and the existing facility.

There are no designated ecology areas within 200 m of road links impacted by the proposed development for the construction or operational phases. In addition, there is no designated ecology within 350 m of any dust generating activities during the construction phase. The closest designated site to the area of operation is Hodgestown Bog NHA which is 3.5 km from the site boundary. Impacts from the gas utilisation plant and flares will be considered at this and other designated ecological areas.

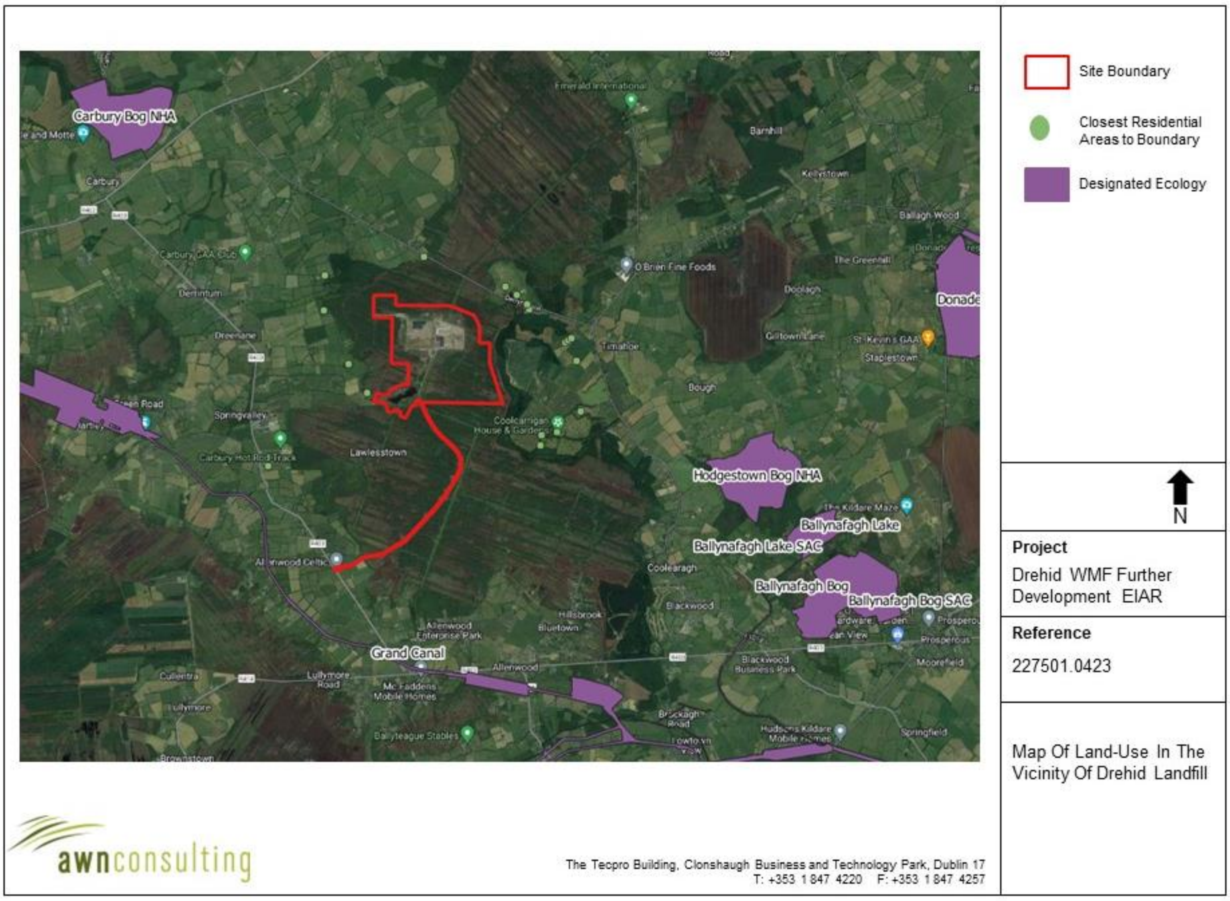

Figure 12.4 – Map of Land-Use in The Vicinity of Drehid Landfill

Climate Receptors - GHGA

PE-ENV-01104 (TII 2022a) and IEMA states (IEMA 2022) that GHG emissions are not geographically limited due to the global nature of impacts rather than directly affecting any specific local receptor.

As Ireland declared a climate and biodiversity emergency in May 2019 and it is currently failing to meet its EU binding targets under Regulation (European Union 2018) the sensitivity of the environment can be considered high. The declaration of the biodiversity emergency results in changes in GHG emissions either beneficial or adverse are of more significance than previously considered prior to these declarations. This ties in with the IEMA Guidance (IEMA 2022) which states that the sensitive receptor for GHG emissions is the global atmosphere. The receptor has a high sensitivity, given the severe consequences of global climate change and the cumulative contributions of all GHG emission sources.

Climate Receptors - CCRA

TII state in PE-ENV-01104 (TII 2022a) that the following sensitive receptors should be considered for any TII projects:

- Pavements – e.g. road pavement, shoulders, and footpaths;
- Drainage –e.g. culverts, drains, pipes;
- Structures – e.g. bridges, retaining walls, crash barriers;

- Earthworks, geotechnical assets – e.g. foundations, pavement subgrades, embankments;
- Utilities – e.g. cabling;
- Landscaping – e.g. vegetated median strips or embankments;
- Signs, light posts and fences – e. g street lighting, road signs, gantries, boundary fences;
- Composting/MSW/Inert Facility;
- Landfill;
- Access/Transportation;
- Integrated Constructed Wetland (ICW); and
- Buildings – e.g. offices, warehouses etc.

12.3.2 Meteorological Data

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA (USEPA, 2022b). A primary requirement is that the data used should have a data capture of greater than 90% for all parameters.

A key factor in assessing temporal and spatial variations in the air quality assessment is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (e.g. traffic levels) (WHO, 2021).

Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

Casement Aerodrome meteorological station, which is located approximately 27 km east of the site, collects data in the correct format and has data capture collection of greater than 90% for the required parameters. Long-term hourly observations at Casement Aerodrome meteorological station provide an indication of the prevailing wind conditions for the region (see Figure 12.1). 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 4.7 m/s over the 30-year historical period 1980 - 2010. Calm conditions account for only a small fraction of the time in any one year peaking at 70 hours in 2021 (0.8% of the time). There are also no missing hours over the period 2017 – 2021.

12.3.3 Background Concentrations of Pollutants

Air quality monitoring programs have been undertaken in recent years by the EPA. The most recent annual report on air quality in Ireland is "*Air Quality In Ireland 2021*" (EPA 2022b). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA 2022b).

As part of the implementation of the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011), as amended, four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA 2022b). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In terms of air monitoring and assessment, the proposed development site is within Zone D (EPA 2022c). The long-term monitoring data has been used to determine background concentrations in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

Long-term NO_2 monitoring was carried out at the Zone D locations of Castlebar, Emo and Kilkitt for the period 2017 - 2021 (EPA 2022b). Long term average concentrations are significantly below the annual average limit of 40 µg/m^3; average results range from 4 – 7 µg/m^3 (Table 12.16) over the five-year period, with a maximum monitored annual mean concentration of 8 µg/m^3. Based on the above information an estimate of the current background NO_2 concentration for the region of the proposed development is 8 µg/m^3. In relation to the annual average background for modelling of NO_2, the ambient background concentration was added directly to the process concentration with the short-term peaks assumed to have an ambient background concentration of twice the annual mean background concentration.

Table 12.16 – Trends in Zone D Air Quality – NO_2

Station	Averaging Period Notes 1, 2	Year				
		2017	2018	2019	2020	2021
Castlebar	Annual Mean NO_2 (µg/m^3)	7	8	8	6	6
	99.8th %ile 1-hr NO_2 (µg/m^3)	60	60	59	54	48
Kilkitt	Annual Mean NO_2 (µg/m^3)	2	3	5	2	2
	99.8th %ile 1-hr NO_2 (µg/m^3)	17	22	42	13	11
Emo	Annual Mean NO_2 (µg/m^3)	3	3	4	4	4
	99.8th %ile 1-hr NO_2 (µg/m^3)	28	42	28	23	28

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. 739 of 2022).*

Continuous PM_{10} monitoring was carried out at the Zone D locations of Castlebar, Claremorris and Kilkitt for 2017 - 2021. Levels range from 8 – 12 µg/m^3 over the five-year period (Table 12.17). In addition, the 24-hour limit value of 50 µg/m^3 (as a 90.4th percentile) was complied with at all sites (EPA, 2022b). Based on the EPA data, an estimate of the current background PM_{10} concentration in the region of the proposed development is 13 µg/m^3.

Table 12.17 – Trends in Zone D Air Quality – PM_{10}

Station	Averaging Period Notes 1, 2	Year				
		2017	2018	2019	2020	2021
Castlebar	Annual Mean PM_{10} (μg/m^3)	11	11	16	14	10
	90th %ile 24-hr PM_{10} (μg/m^3)	19	20	24	22	22
Killkitt	Annual Mean PM_{10} (μg/m^3)	8	9	7	8	8
	90th %ile 24-hr PM_{10} (μg/m^3)	14	15	13	14	13
Claremorris	Annual Mean PM_{10} (μg/m^3)	11	12	11	10	10
	90th %ile 24-hr PM_{10} (μg/m^3)	17	20	20	16	13

Note 1 Annual average limit value of 40 μg/m^3 and 24-hour limit value of 50 μg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).

Monitoring of both PM_{10} and $PM_{2.5}$ takes place at the station in Claremorris which allows for the $PM_{2.5}/PM_{10}$ ratio to be calculated. Average $PM_{2.5}$ levels in Claremorris over the period 2017 - 2021 ranged from 4 - 8 μg/m^3, with a $PM_{2.5}/PM_{10}$ ratio ranging from 0.36 – 0.86 (EPA, 2022b). Based on this information, a ratio of 0.7 was used to generate an existing $PM_{2.5}$ concentration in the region of the development of 9.1 μg/m^3.

Ecological receptors are impacted by N deposition, NH_3 and NO_x concentrations. The EPA monitors NOx but does not have monitoring for N deposition or NH_3. TII Guidance (TII 2022a) states that background concentrations for these pollutants should be sources from the UK Air Pollution Information System (APIS) (APIS 2022). Given the source location, the background concentrations at the Drehid location for N deposition and NH_3 are considered to be 0 Kg N/ha/year and 0 μg m^3 respectively.

NO_x monitoring (EPA, 2022b) was conducted in the rural background stations of Emo and Kilkitt for the period 2015 - 2019 (EPA, 2022b). Long term average concentrations are significantly below the annual average limit of 30 μg/m^3; average results range from 2.5 – 7.6 μg/m^3. Based on the above information an estimate of the current background NO_x concentration for the region of the proposed development is 8 μg/m^3.

12.3.4 Climate Baseline

PE-ENV-01104 (TII 2022d) states that a baseline climate scenario should identify, consistent with the study area for the project, GHG emissions without the project for both the current and future baseline (Do-Minimum scenarios).

Ireland declared a climate and biodiversity emergency in May 2019 and in November 2019 European Parliament approval of a resolution declaring a climate and environment emergency in Europe, in addition to Ireland's current failure to meet its EU binding targets under Regulation (European Union 2018). This results in changes in GHG emissions either beneficial or adverse are of more significance than previously considered prior to these declarations.

Data published in 2022 (EPA 2022b) predicts that Ireland exceeded (without the use of flexibilities) its 2021 annual limit set under EU's Effort Sharing Decision (ESD) (EU 2018/842) by 2.71million tonnes CO_2 equivalent (Mt CO_{2eq}) as shown in Table 12.26. The sector with the highest emissions in 2021 is agriculture at 35.3% of the total, followed by transport at 20.3%. Ireland's greenhouse gas emissions increased by 4.7% in 2021 compared to 2020. For 2021

(EPA 2022b), total national emissions were estimated to be 59.87 Mt CO_{2eq} as shown in Table 12.18. Waste accounted for 1.4% of Ireland's 2021 emissions, with 707 kt CO_2eq of the total 937 kt CO_2eq generated from landfills. Biological treatment of solid waste accounted for 50 kt CO_2eq.

The future baseline with respect to the GHGA can be considered the future targets which the significance criteria will be compared against. In line with TII (TII 2022d) and IEMA Guidance (IEMA, 2022) the future baseline is a trajectory towards net zero by 2050 "*whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050*".

The future baseline will be determined by Ireland meeting its targets set out in the CAP23, and future CAPs, alongside binding 2030 EU targets. In order to meet the commitments under the Paris Agreement, the European Union (EU) enacted 'Regulation (EU) 2018/842 on binding annual GHG emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013' (hereafter referred to as the Regulation) (European Union 2018). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. The ETS is an EU-wide scheme which regulates the GHG emissions of larger industrial emitters including electricity generation, cement manufacturing and heavy industry. The non-ETS sector includes all domestic GHG emitters which do not fall under the ETS scheme and thus includes GHG emissions from transport, residential and commercial buildings and agriculture.

CAP23 identifies the links between waste generation and atmospheric emissions and describes a key metric to deliver a reduction in emissions as the reduction in the amount of municipal waste landfilled to 10% by 2035, as required under the *EU Landfill Directive (1999/31/EC as amended)*.

Table 12.18 – Total National GHG Emissions In 2021

Category	2021 Kilotonnes CO_{2eq}	% of Total GHG emissions
Waste	937	1.5%
Energy Industries	10,272	16.7%
Residential	7,040	11.4%
Manufacturing Combustion	4,593	7.5%
Commercial Services	817	1.3%
Public Services	663	1.1%
Transport	10,912	17.7%
Industrial Processes	2,460	4.0%
F-gases	738	1.2%
Agriculture	23,097	37.5%
Total	61,528	100%

KCC (KCC 2019) discuss the climate baseline in Section 5 of the Climate Change Adaptation Strategy 2019-2024. Events that have occurred since 1986 include heavy rainfall, flooding, strong winds, periods of extreme heat, and extreme cold, frost conditions and heavy snowfall.

January 2016 was the wettest January on record and severe flooding has been recorded in County Kildare in November 1993, November 2000, November 2002, August 2008, November 2009 with a 1 in 100-year flood event occurring in October 2011. Storms such as Storm Ali in September 2018, Ophelia in October 2017 and Darwin in February 2014 are considered notable events. February and March 2018 saw a notable cold weather event bringing severe snowfall and Storm Emma occur. Droughts have also occurred including in 2018, which resulted in hosepipe bans to protect the water supply.

Impacts as a result of climate change will evolve with a changing future baseline, changes have the potential to include increases in global temperatures and increases in the number of rainfall days per year. Therefore, it is expected that the baseline climate will evolve over time and consideration is needed with respect to this within the detailed design of the Proposed Scheme as per the European Commission Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021a) and PE-ENV-01104 (TII 2022d) should the Proposed Scheme proceed.

TII's Guidance document PE-ENV-01104 (TII 2022a) states that for future climate change a moderate to high Representative Concentration Pathways (RCP) should be adopted. RPC4.5 is considered moderate while RPC8.5 is considered high. Representative Concentration Pathways (RCPs) describe different 21st century pathways of GHG emissions depending on the level of climate mitigation action undertaken.

Ireland has seen increases in the annual rainfall in the north and west of the country, with small increases or decreases in the south and east including in the region where the Proposed Scheme will be located (EPA 2021b). The EPA have compiled a list of potential adverse impacts (EPA 2021b) as a result of climate change including the following which may be of relevance to the Proposed Scheme:

- More intense storms and rainfall events;
- Increased likelihood and magnitude of river and coastal flooding;
- Water shortages in summer in the east;
- Adverse impacts on water quality; and
- Changes in distribution of plant and animal species.

EPA's State of the Irish Environment Report (Chapter 2: Climate Change) (EPA 2020c) notes that projections show that full implementation of additional policies and measures, outlined in the 2019 Climate Action Plan, will result in a reduction in Ireland's total GHG emissions by up to 25 per cent by 2030 compared with 2020 levels. Climate change is not only a future issue in Ireland, as a warming of approximately 0.8°C since 1900 has already occurred. The EPA state that it is critically important for the public sector to show leadership and decarbonise all public transport across bus and rail networks to the lowest carbon alternatives. The report (EPA 2020c) underlines that the next decade needs to be one of major developments and advances in relation to Ireland's response to climate change in order to achieve these targets and that Ireland must accelerate the rate at which it implements GHG emission reductions. The report states that mid-century mean annual temperatures in Ireland are projected to increase by between 1.0°C and 1.6°C (subject to the emissions trajectory). In addition, heat events are expected to increase by mid-century (EPA 2020c). While individual storms are predicted to have more severe winds, the average wind speed has the potential to decrease (EPA 2020c).

Future climate predictions undertaken by the EPA have been published in 'Research 339: High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (EPA 2020d).

The future climate was simulated under both Representative Concentration Pathway 4.5 (RCP4.5) (medium-low) and RCP8.5 (high) scenarios. This study indicates that by the middle of this century (2041–2060). Mid-century mean annual temperatures are projected to increase by 1 to 1.2°C and 1.3 to 1.6°C for the RCP4.5 and RCP8.5 scenarios, respectively, with the largest increases in the east. Warming will be enhanced at the extremes (i.e., hot days and cold nights), with summer daytime and winter night-time temperatures projected to increase by 1 to 2.4°C. There will be a substantial decrease of approximately 50% which is projected for the number of frost and ice days. Summer heatwave events are expected to occur more frequently, with the largest increases in the south. In addition, precipitation is expected to become more variable, with substantial projected increases in the occurrence of both dry periods and heavy precipitation events. Climate change also has the potential to impact future energy supply which will rely on renewables such as wind and hydroelectric. Wind turbines need a specific range of wind speeds to operate within and droughts or low ground water levels may impact hydroelectric energy generating sites. More frequent storms have the potential to damage the communication networks requiring additional investment to create resilience within the network.

The EPA's *Critical Infrastructure Vulnerability to Climate Change report* (EPA 2021b) assesses the future performance of Irelands critical infrastructure when climate is considered. With respect to road infrastructure, which is required to maintain access to Drehid, fluvial flooding and coastal inundation/coastal flooding are considered the key climate change risks with snowstorm and landslides being medium risks. Extreme winds and heatwaves/droughts are considered low risk to road infrastructure. One of the key outputs of the research was a framework that will provide quantitative risk-based decision support for climate change impacts and climate change adaptation analysis for infrastructure.

12.4 LIKELY SIGNIFICANT EFFECTS

The key elements of the proposed development are summarised in Section 12.1 and are set out in more detail in Chapter 2.

12.4.1 Odour Emissions

Details of the 98th%ile of 1-hour mean odour concentrations at the worst-case receptor are given in Table 12.19 over a five-year period (2017-2021) based on the USEPA approved AERMOD model (version 22112) as per the methodology follows AG4 guidance as detailed in Section 12.2.4.2

Table 12.20 shows the maximum results at the closest sensitive receptors to the site. The worst-case receptor (in this case a residential property) is the receptor which experiences the highest concentration of odour. The maximum 1-hour 98th%ile odour concentration at the worst-case sensitive receptor is 2.14 OU_E/m^3. This is equivalent to 71% of the relevant odour criterion of 3.0 OU_E/m^3 measured as a 98th%ile of mean hourly odour concentrations at the worst-case receptor. There is no set rating for significance with respect to odour however as the worst-case odour impact remains significantly below (71%) of the guidance value the impact is describes as at worst, slight. In accordance with EPA Guidance can be classed as a slight, long term, reversible and localised impact at the worst-case location.

It should be noted that concentrations less than 3.0 Ou_E/m^3 are not shown on Figure 12.5 because it was not considered necessary as they are below the ambient odour criterion of 3.0 Ou_E/m^3.

Table 12.19 – Predicted Odour Concentration At Worst-Case Offsite Receptor (OU_E/m^3)

Model Scenario / Meteorological Year	Averaging Period	Predicted Odour Concentration (OU_E/m^3)	Guideline (OU_E/m^3) EPA AG9 (2019)
Ambient Odour Concentration / 2017	Maximum 1-Hour (as a 98th%ile)	1.98	3.0
Ambient Odour Concentration / 2018		1.69	
Ambient Odour Concentration / 2019		2.14	
Ambient Odour Concentration / 2020		1.79	
Ambient Odour Concentration / 2021		2.05	

Table 12.20 – Predicted Odour Concentration At Closest Sensitive Receptors (OU_E/m^3)

Sensitive Receptor Grid Co-ordinates UTM (Zone 29 N)		Maximum 1-Hour 98th%ile Predicted Odour Conc. (OU_E/m^3)				
		2017	2018	2019	2020	2021
642601	5911907	1.98	1.56	2.14	1.79	2.05
642189	5912274	1.57	1.43	1.84	1.46	1.87
642374	5912133	1.84	1.69	1.92	1.61	1.91
642562	5911993	1.86	1.55	2.05	1.72	1.95

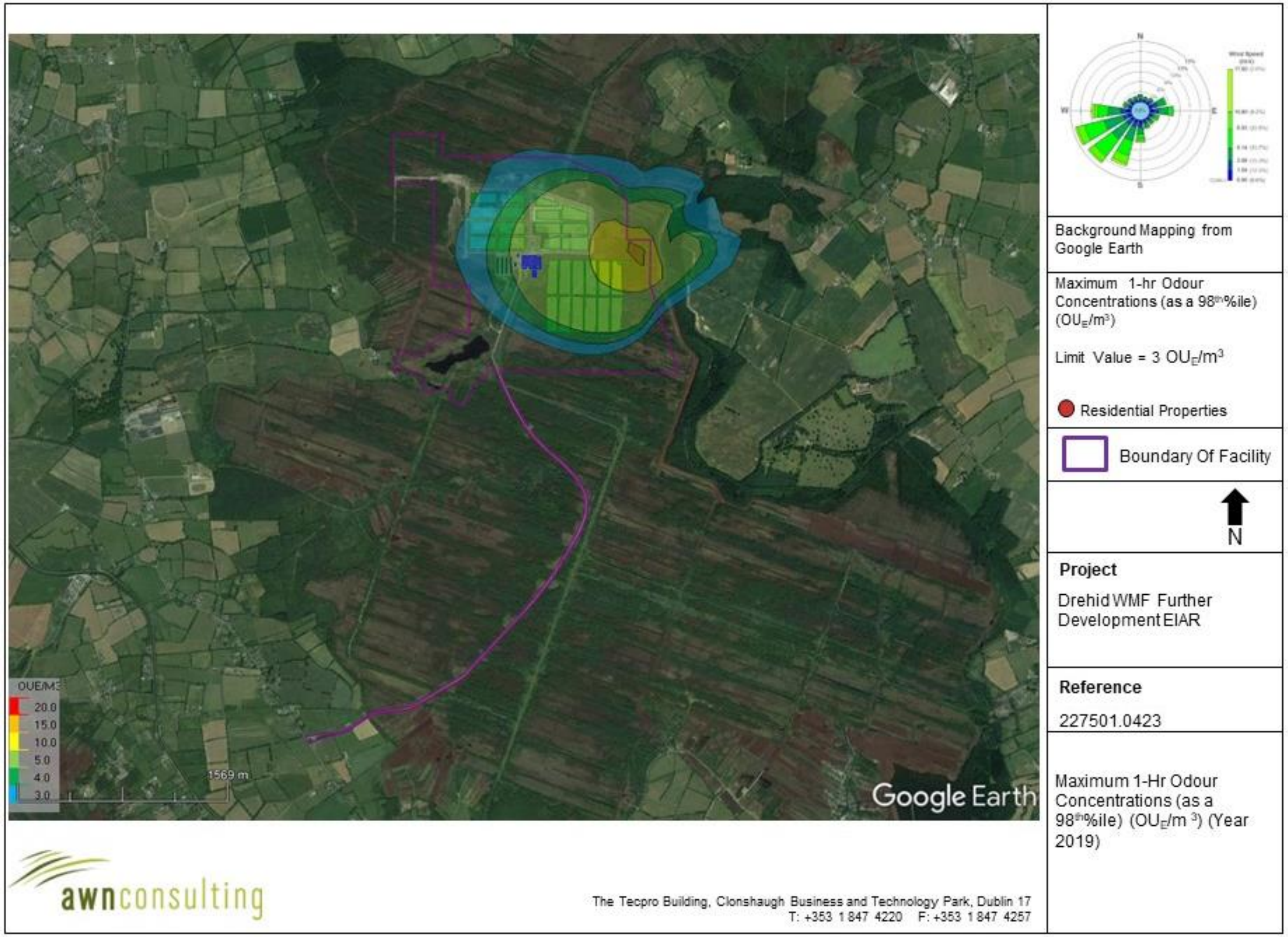

Figure 12.5 – 98th % of 1-Hour Odour Concentrations (OU_E/m^3) (Year 2019)

12.4.2 NOx and Particulate Matter Dispersion Modelling

12.4.2.1NOx

The NO_2 modelling results are detailed in Table 12.21. The results indicate that the ambient ground level concentrations at the worst-case ground level location are significantly below the relevant air quality standards for NO_2. Cumulative emissions from the gas utilisation plant and flares lead to an ambient NO_2 concentration (including background) which is 79% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 31% of the annual limit value at the worst-case off-site location (see Table 12.21). At the worst-case receptor this ambient NO_2 concentration (including background) which is 20% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 23% of the annual limit value.

With respect to ecological habitats, the closest designated site to the area of operation is Hodgestown Bog NHA which is 3.5 km from the site boundary. NO_x concentrations due to the gas utilisation plant and flares at this and other designated sites is considered negligible. Process contributions within the NHA are less than 0.1 µg/Nm^3 or 0.3% of the 30 µg/m^3 limit value for NO_x with respect to the projection of sensitive habitats.

There are no additional emissions of particulars as a result of the further development at Drehid. The emissions modelled for the assessment related to emissions which are currently operational.

Table 12.21 – Dispersion Model Results– NO_2

Pollutant/ Meteorological year	Background (µg/m^3)	Averaging Period	NO_2 Process Contribution (µg/m^3)	NO_2 Predicted Environmental Concentration (PEC) (µg/Nm^3)	% of Standard (µg/Nm^3)	Standard (µg/Nm^3) *Note 1*
NO_2 / 2017	16	99.8th%ile of 1-hr means	132.8	148.8	74%	200
	8	Annual Mean	4.3	12.3	31%	40
NO_2 / 2018	16	99.8th%ile of 1-hr means	142.2	158.2	79%	200
	8	Annual Mean	3.8	11.8	29%	40
NO_2 / 2019	16	99.8th%ile of 1-hr means	138.8	154.8	77%	200
	8	Annual Mean	3.9	11.9	30%	40
NO_2 / 2020	16	99.8th%ile of 1-hr means	139.9	155.9	78%	200
	8	Annual Mean	4.4	12.4	31%	40
NO_2 / 2021	16	99.8th%ile of 1-hr means	141.1	157.1	79%	200
	8	Annual Mean	3.6	11.6	29%	40

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

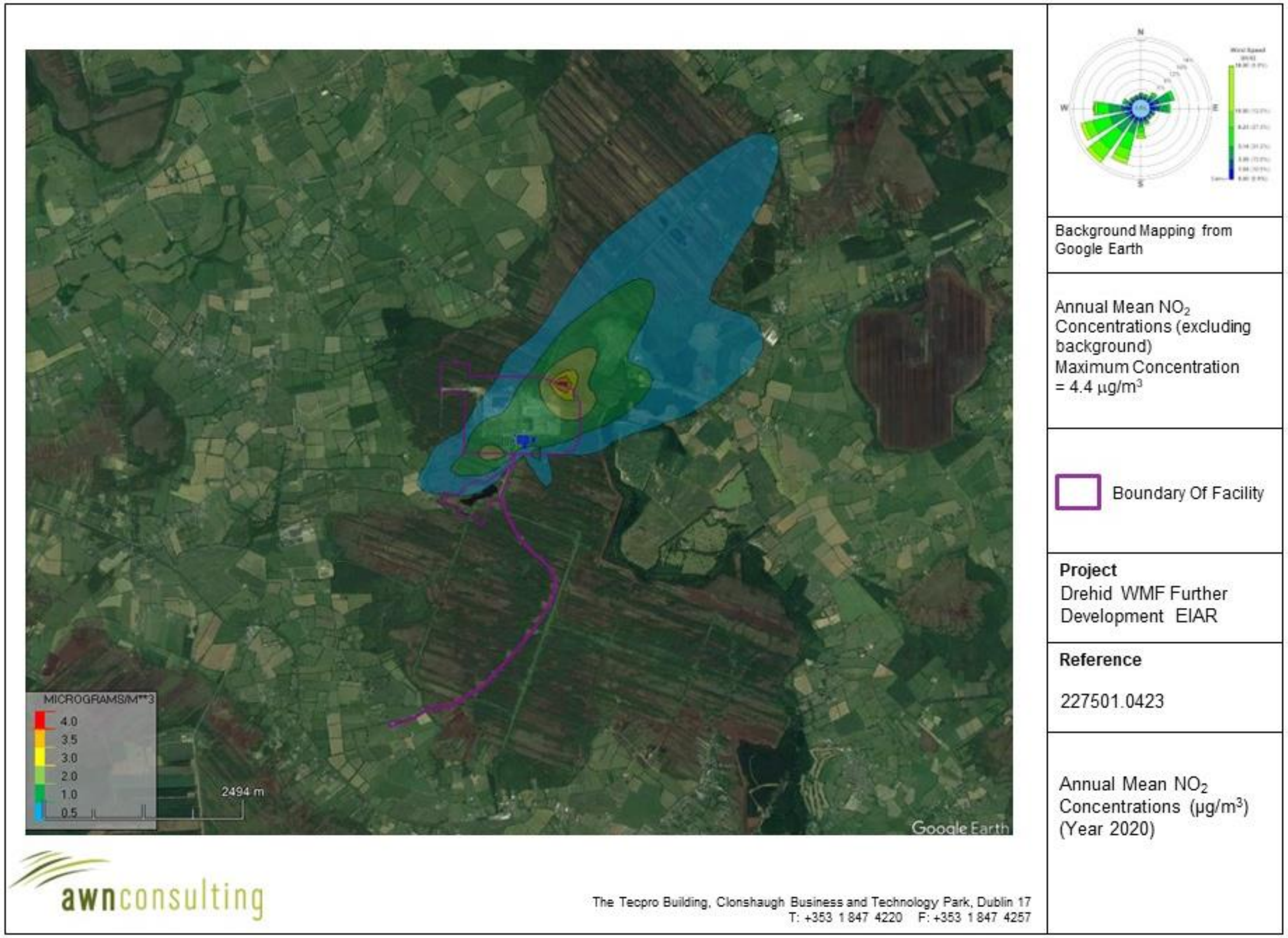

Figure 12.6 – Annual Mean NO_2 Concentrations (µg/m³ (Year 2020)

12.4.2.2 Particulate Matter

The PM_{10} / $PM_{2.5}$ modelling results are detailed in Table 12.16 and Table 12.17. The results indicate that the ambient ground level concentration is below the relevant air quality standard for PM_{10} / $PM_{2.5}$. Cumulative emissions from the gas utilisation plant dust filter lead to an ambient PM_{10} concentration (including background) which is 59% of the maximum ambient 24-hour limit value at the worst-case off site location (see Table 12.22 and Figure 12.7). In relation to the annual mean concentration, ambient PM_{10} concentration (including background) are at most 36% of the annual mean limit values at the worst-case off-site location (see Table 12.22). At the worst-case off-site location only 3.5% of this is a contribution due to the Drehid WMF as per the process contributions shown in Table 12.22 .

Ambient $PM_{2.5}$ concentration (including background) are at most 42% of the annual mean limit values at the worst-case off-site location (see Table 12.23), only 5.5% of this is a contribution due to the Drehid WMF.

In accordance with Table 12.9 this is a moderate NO_2 impact and slight PM_{10} and $PM_{2.5}$ impact for the cumulative impact of the further development and current operations at the Drehid facility. However, there are no additional emissions of particulars as a result of the further development at Drehid. In accordance with Table 12.9 this is a negligible impact from the proposed development and the likely effect in accordance with EPA Guidance can be classed as a negligible, long term, reversible and localised impact at the worst-case location.

Table 12.22 – Dispersion Model Results – PM_{10}

Pollutant / Scenario	Background (µg/m³)	Averaging Period	Process Contribution (µg/m³)	Predicted Environmental Concentration (µg/Nm³)	% of Standard (µg/Nm³)	Standard (µg/Nm³) Note 1
PM_{10} / 2017	26	Maximum 24-hr mean (as a 90th%ile) Note 2	3.4	29.4	59%	50
	13	Annual mean	1.38	14.38	36%	40
PM_{10} / 2018	26	Maximum 24-hr mean (as a 90th%ile) Note 2	3.6	29.6	59%	50
	13	Annual mean	1.22	14.22	36%	40
PM_{10} / 2019	26	Maximum 24-hr mean (as a 90th%ile) Note 2	3.4	29.4	59%	50
	13	Annual mean	1.23	14.23	36%	40
PM_{10} / 2020	26	Maximum 24-hr mean (as a 90th%ile) Note 2	3.7	29.7	59%	50
	13	Annual mean	1.37	14.37	36%	40
PM_{10} / 2021	26	Maximum 24-hr mean (as a 90th%ile) Note 2	3.2	29.2	58%	50
	13	Annual mean	1.2	14.2	35%	40

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

Table 12.23 – Dispersion Model Results – $PM_{2.5}$

Pollutant / Scenario	Annual Mean Background (µg/m^3)	Averaging Period	Process Contribution (µg/m^3)	Predicted Environmental Concentration (µg/Nm^3)	% of Standard (□g/Nm^3)	Standard (µg/Nm^3) Note 1
$PM_{2.5}$ / 2017	9.1	Annual mean	1.38	10.48	42%	25
$PM_{2.5}$ / 2018	9.1	Annual mean	1.22	10.32	41%	25
$PM_{2.5}$ / 2019	9.1	Annual mean	1.23	10.33	41%	25
$PM_{2.5}$ / 2020	9.1	Annual mean	1.37	10.47	42%	25
$PM_{2.5}$ / 2021	9.1	Annual mean	1.16	10.26	41%	25

Note 1 Air Quality Standards 2011 (from EU Directive 2008/50/EC)

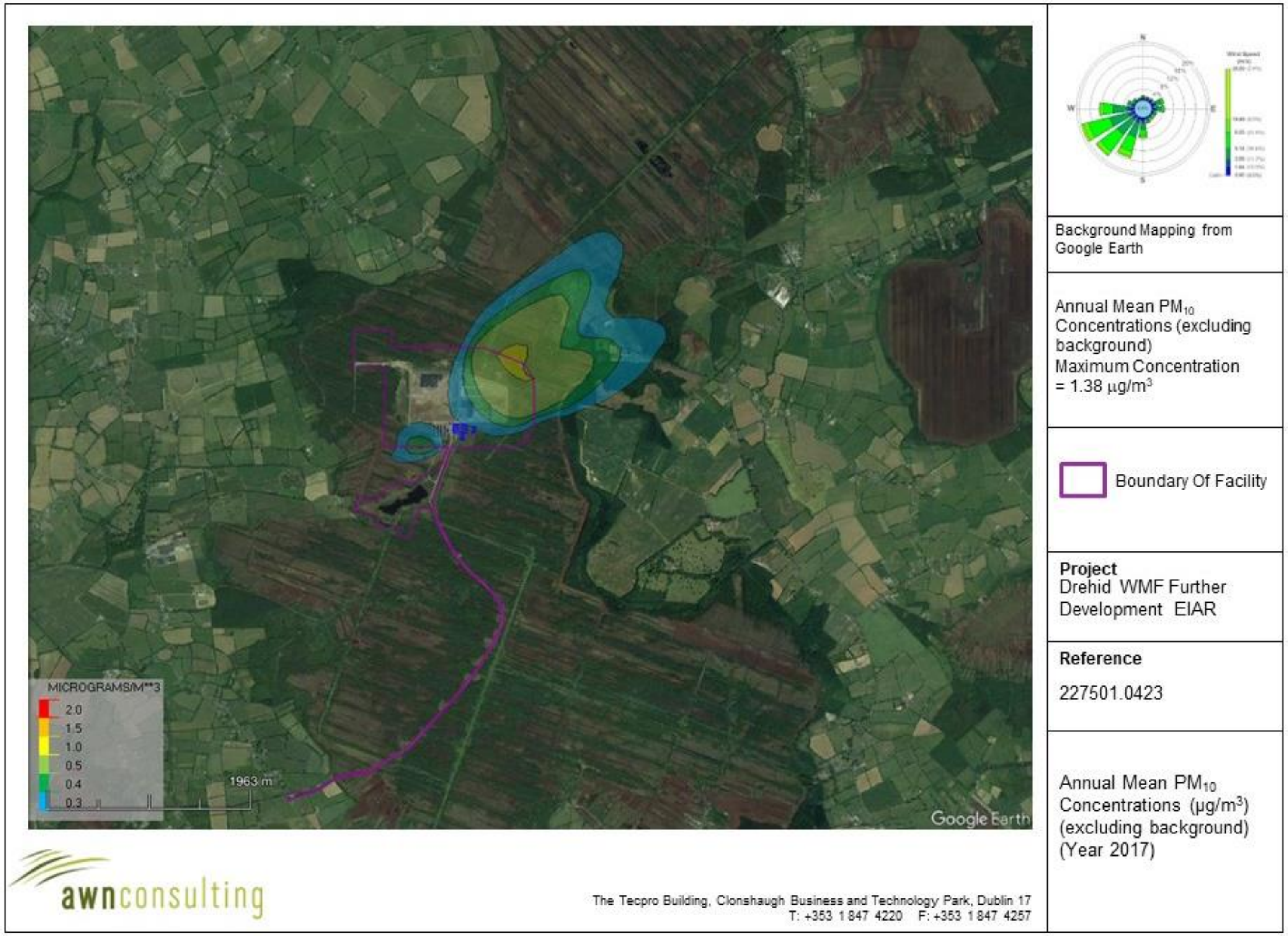

Figure 12.7 – Annual Mean PM_{10} Concentrations (µg /m^3) (excluding background) (Year 2017)

12.4.3 Climate Assessment

12.4.3.1 GHGA Construction Phase

Construction Embodied Carbon

The unmitigated embodied carbon within the construction materials has been calculated. This calculation was based on the updated TII Online Carbon Tool (TII 2022f) (See Table 12.24) with the breakdown of the activities between the different phases of the proposed development assessed. As shown in Table 12.24, the assessment indicates that the key sources of GHG emissions are associated with the embodied carbon of the construction materials (materials include liner materials, soil for coverage of the cells, drainage materials, bentonite materials) and the transport of these materials. As calculated using the TII Online Carbon Tool (TII 2022f) the proposed development will result in total Construction Phase GHG emissions of 77,569 tonnes CO_2eq over a 25-year period or 3,103 tonnes annually. This is equivalent to an annualised total of 0.009% of Ireland's non-ETS 2030 target or 0.31% of the "other" sectorial carbon budget which includes waste. Emissions related to peat loss from land use change are included within the calculations (pre-construction), 28.8% of construction emissions are related to this peat loss. These calculations assume the peat is currently in good condition and operating as a carbon sink, however this is conservative calculation as the peat on site is not fully wet. A rehabilitation plan, as per with CAP23, for areas of the bog outside the redline boundary are proposed however this is outside the scope of this assessment and therefore not included as a carbon sink. This includes drain blocking to encourage rewetting. Within the proposed development some gradual drain blocking will also encourage water levels to rise and rewet areas of the peat however no estimation of such future carbon sinks are included in the calculations.

65% of emissions are related to the materials required for the construction including geomembrane layers, pipework, granular material, sand and steel cladding.

Table 12.24 – Construction Stage GHG Emissions

Activity	Tonnes CO_2eq Over 25 Years
Pre-Construction	22,329
Embodied Carbon	53,122
Construction Activities	2,118
Total (Tonnes CO_2)	77,569
Total Annually (25 years) Tonnes CO_2	3,103
Annual Compared to EU ESD Targets 2030	0.009%
Annual Compared to 2030 "other" Carbon Budget (which includes waste)	0.310%

12.4.3.2 GHGA Operational Phase

Emissions from the Composting Facility are calculated based on the BEIS Factors Waste (BEIS 2021) for composting of 8.95 $kgCO_2e$ per tonne of waste. The new MSW Processing &

Composting Facility will have a maximum intake of 90,000 TPA. An estimate of 35,000 TPA will be compost waste and goes straight to composting tunnels. The other 55,000 TPA of MSW is dried initially and then screened to remove recyclables. It is estimated that 20,000 TPA of recyclables will be removed, leaving 35,000 TPA of material left. This 35,000 TPA will go into composting tunnels. The proposed new MSW Processing and Composting Facility will provide for a maximum intake of 90,000 TPA of suitable wastes as described in Chapter 2. From current market conditions, it is estimated that approximately 70,000 TPA of this waste intake will comprise material which will be composted onsite.

The proposed further development increases composting TPA from 25,000 to 70,000 TPA. This is an increase of 45,000 TPA or an increase of 403 tonnes CO_2e annually, as shown in Table 12.25.

Table 12.25 – $CO_{2}e$ Emissions from Composting

Waste Type	Projected TPA	Emission Factor (kg CO_2e per tonne)	Tonnes CO_2e
Current Composting	25,000	8.95	224
Proposed Composting	70,000	8.95	627
Totals			403
Total as a percentage of EU ESD Targets 2030			**0.0012%**
Total as a percentage of 2020 Waste Emissions Ireland			**0.0451%**
Total as a percentage of 2030 "Other" Sectorial Emission Limit			**0.0403%**

2021 weighbridge records are used to estimate the current scenario, as shown in Table 12.26. Based on the current waste breakdown CO_2e emissions from Drehid landfill equate to 0.10% in terms of Ireland's obligations under the EU 2030 Target or 3.32% of Irelands 2030 "Other" Sectorial Emission Limit ("other" includes waste emissions).

Table 12.26 – $CO_{2}e$ Emissions from Landfill at Current Tonnage (2021 Records)

Waste Type	TPA	Emission Factor (kg CO_2e per tonne)	Tonnes CO_2e
C&D fines and C&D rubble Note 1	950	1.2	1.2
Non-hazardous soils and stones Note 1	18,393	17.5	322
Municipal solid waste (MSW) Note 3	98,297	IPCC Spreadsheet	31,426
Incinerator bottom ash (IBA)	887	0.0	-
Biostabilised waste Note 2	10,753	134.0	1,441
Inert waste for engineering purposes	312,528	0.0	-
Totals	441,808		33,190
Total as a percentage of EU ESD Targets 2030			**0.10%**
Total as a percentage of 2020 Waste Emissions Ireland			**3.72%**
Total as a percentage of 2030 "Other" Sectorial Emission Limit			**3.32%**

Note 1: Emission factor source BEIS (2021)
Note 2: Emission factor source (European Communities 2001)
Note 3: Calculation completed using the IPCC Spreadsheet (IPCC 2006b)

Table 12.27 is a list of the landfill waste types that will be accepted at the facility along with the estimated quantities of each waste type and an emission factor taken for that source. Based on the projected waste breakdown CO_2e emissions from Drehid landfill this would equate to 0.13% in terms of Ireland's obligations under the EU 2030 Target or 4.31% of Irelands 2030 "Other" Sectorial Emission Limit ("other" includes waste emissions). Emissions from MSW are calculated using the IPCC Spreadsheet for Estimating Methane Emissions from Solid Waste Disposal Sites (IPCC Waste Model) (IPCC 2006b). This includes a contingency capacity of an additional 30,000 TPA MSW as described in Section 2.2.1.1 of Chapter 2 (note that the contingency capacity is not confined to MSW, however MSW is used here to reflect a worst-case scenario for CO_2e emissions).

There is an increase from the currently permitted scenario of 9,947 tonnes CO_2e annually or 0.03% in terms of Ireland's obligations under the EU 2030 Target or 1.26% of Irelands 2030 "Other" Sectorial Emission Limit ("other" includes waste emissions). If the contingency capacity of an additional 30,000 TPA MSW is not utilised the increase reduces to 356 Tonnes CO_2e.

Emissions from the biostabilised waste are lower than MSW as the majority of the biodegradable component of the waste has been broken down within the biostabilisation/composting process. If the Composting Facility did not first biostabilise the waste prior to disposal, the emissions would result in an estimated 9,284 additional tonnes CO_2e per annum.

Table 12.27 – CO_2e Emissions from Landfill at Proposed Tonnage

Waste Type	Projected TPA	Emission Factor (kg CO_2e per tonne)	Tonnes CO_2e
C&D fines and C&D rubble (and other non-MSW)	110,000	1.2	136
Non-hazardous soils and stones	50,000	17.5	875
Municipal solid waste (MSW)	85,000	IPCC Spreadsheet	27,175
Municipal solid waste (MSW) (Contingency Capacity)	30,000	IPCC Spreadsheet	9,591
Incinerator bottom ash (IBA)	5,000	-	-
Bio stabilised waste	40,000	134	5,360
Inert waste for engineering purposes	50,000	-	-
Totals	370,000	-	43,138
Total as a percentage of EU ESD Targets 2030			**0.13%**
Total as a percentage of 2020 Waste Emissions Ireland			**5.31%**
Total as a percentage of 2030 "Other" Sectorial Emission Limit			**4.31%**

Note 1: Emission factor source BEIS (2021)
Note 2: Emission factor source (European Communities 2001)
Note 3: Calculation completed using the IPCC Spreadsheet (IPCC 2006b)

Current operational data for 2021 indicates that 8301 GJ of diesel consumption is required for machines associated with operation. A conservative estimate that a 50% increase in fuel would be required for the further development. However future technology changes may result in better fuel economy or electric options being developed over the operational lifespan. Embodied emissions associated with operational energy are estimated to be 20,391 tonnes CO_2eq over a 25-year period or 815 tonnes CO_2eq annual.

The operational phase will also have carbon sinks in the form of approximately 13 ha of the 50 ha of peat being stripped being allowed to be vegetated in the environmental screening berms with an additional area of 59 ha being either allowed to revegetate naturally or being planted (Transitional Woodland Scrub factor used) based on the updated TII Online Carbon Tool (TII 2022f). As calculated using the TII Online Carbon Tool (TII 2022f) the proposed development will result in total operational Phase GHG emissions of 17,040 tonnes CO_2eq over a 25-year period or 762 tonnes annually. This is equivalent to an annualised total of 0.002% of Ireland's non-ETS 2030 target or 0.076% of the "other" sectorial carbon budget which includes waste.

The impact of the change in CO_2e emissions due to the proposed increased landfill and Composting Facility capacity is shown in Table 12.28.

In accordance with the significance criteria noted in Section 12.2.6.3 with consideration for compliance with the extent to which the trajectory of GHG emissions from the project aligns with Ireland's GHG trajectory to net zero by 2050 and the level of mitigation taking place is considered moderate adverse, national and long-term. The increase of the composting capacity does comply with Action: CE/23/6 from CAP23 to enhance food waste segregation, collection and treatment (anaerobic digestion and composting) and the requirements to divert biodegradable municipal waste from landfill under the Landfill Directive target by the use of waste segregation and composting. The development of the new MSW Processing and Composting Facility provides further infrastructure to screen out recyclable materials which can be diverted from the less preferred waste treatment options of energy recovery and disposal to landfill. The infrastructure will support the move away from landfilling of MSW by maximising the recovery of materials from the MSW stream. The reduced reliance on landfilling in Ireland is a welcome progression and the commitment to reduce MSW disposal to landfill to 10% by 2035 will support the reduction of carbon emissions as set out on the CAP23.

Table 12.28 – Summary CO_2e Emissions Impact

Type	Tonnes CO_2e
Annualised Embodied Energy - Construction Phase	3,103
Composting Facility (627-224 Tonnes CO_2e)	403
Landfill (43,138-33,190 Tonnes CO_2e)	9,947
Annualised Operational Phase Fuel Usage	762
Carbon Sink (Annualised)	-54
Totals	**14,160**
Total as a percentage of EU ESD Targets 2030	**0.04%**
Total as a percentage of 2020 Waste Emissions Ireland	**1.59%**
Total as a percentage of 2030 "Other" Sectorial Emission Limit	**1.42%**

12.4.4 Climate Change Risk Assessment

A risk assessment has been conducted for potentially significant impacts on the proposed development associated with climate change during the Operational Phase. The risk assessment assesses the likelihood and consequence of potential impacts occurring and then provides an evaluation of the significance of the impact using the framework set out in Section 12.2.6.2. Section 2.1.1 discusses Major Accidents and Natural Disasters and provides to sections within the EIAR which discuss potential issues. These include;

- Risk of contamination through spillages or leakages onsite is assessed in Chapter 9 (Water);
- Risk of fires, explosion and building collapse in terms of human health is assessed in Chapter 5 (Population & Human Health). An emergency response plan is included in the CEMP (Appendix 2-5).
- Risk of traffic accident is assessed in Chapter 14 (Traffic and Transportation);
- Risk of flooding is assessed within the Flood Risk Assessment, provided as Appendix 8-2 to this EIAR; and
- Risk of peat instability and landslide is assessed in Chapter 7 (Soils, Geology and Hydrogeology).

These take into account the risk arising from climate change due to severe meteorological events found potential for risks during the Operational Phase to be low when identified mitigation measures are applied.

Potential impacts are considered in accordance with the likelihood categories set out in Section 12.2.6.2 (Table 12.11) in combination with the exposure analysis (Table 12.12) in order to assess the significance conclusion (Table 12.13).

Examples of potential climate impacts during operation are included in Annex D (Climate proofing and environmental impact assessment) of the technical guidance on the climate proofing of infrastructure (European Commission 2021a). Potential impacts of climate change of the proposed development include:

- Flood Risk due to increased precipitation, and intense periods of rainfall. This includes fluvial and pluvial flooding;
- Increased temperatures potentially causing drought, wildfires and prolonged periods of hot weather;
- Reduced temperatures resulting in ice or snow;
- Geotechnical impacts; and
- Major Storm Damage – including wind damage.

Each of these potential risks are considered with respect to the operational phase of the proposed development. An initial scoping of the risk assessments has been conducted, in line with technical guidance on the climate proofing of infrastructure in the period 2021-2027 (European Commission 2021a) and PE-ENV-01104 (TII 2022d).

Table 12.29 – Sensitivity to Climate Hazards (with design mitigation in place)

Sensitive Receptors	Sensitivity to Climate Hazards (No consideration of site location)								
	Flood (Fluvial/Pluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Pavements	1	1	1	1	1	1	1	1	1
Drainage	1	1	1	1	1	1	1	1	1
Structures	1	1	1	1	1	1	1	1	1
Earthworks	1	1	1	1	1	1	1	1	1
Utilities	1	1	1	1	2	1	1	1	1
Landscaping	1	1	1	2	1	1	1	1	1
Signs, light posts and fences	1	1	1	1	1	1	1	1	1
Buildings	1	1	1	1	2	1	1	1	1
Composting/MSW/Inert Facility	1	2	1	1	1	1	1	1	1
Landfill	1	1	1	1	1	1	1	1	1
Access/Transportation	1	1	2	1	1	1	2	1	1
Integrated Constructed Wetland (ICW)	1	2	2	2	1	1	1	1	1

Table 12.30 – Exposure Risk to Climate Hazards

Climate Exposure	Exposure Risk to Climate Variable (Consider the site location)								
	Flood pluvial	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
Without exposure at project location	2	2	2	1	1	2	2	1	1

Table 12.31 – Vulnerability Analysis to Climate Hazards

Assets	Vulnerability Analysis								
	Flood (coastal, pluvial or fluvial)	Extreme Heat	Extreme Cold	Drought	Wind	Wildfire	Fog	Lightning & Hail	Landslides
	2 (Low Risk)	4 (Medium Risk)	4 (Medium Risk)	2 (Low Risk)	2 (Low Risk)	2 (Low Risk)	2 (Low Risk)	1 (Low Risk)	1 (Low Risk)

The most likely impact due to climate change on the existing facility is due to flooding. An assessment has been carried out in Chapter 8 – Water of this EIAR to ensure that the site has sufficient capacity in the system for adaption to future increased rainfall due to climate change.

Areas of pluvial flooding were noted on the OPW Preliminary Flood Risk Assessment PFRA mapping, but no records of fluvial flooding were noted on the OPW/CFRAM website for the site. Drainage improvement works have rectified the drainage on the site and reduced the potential for surface water ponding.

The existing facility site is not located in a flood prone area (Flood Zone A or B) based on the preliminary flood risk assessment (PFRA) maps. In line with a likely, or mid-range future scenario, an additional 20% increase in peak flood flows has been accounted for when consideration of flood mitigation on the site.

The network of drainage ditches effectively drain the site and surrounding area. Small areas of pluvial flooding occur to the north-west and west of the site; however improved drainage and water management has limited the potential for flooding in this area reducing the level of risk.

The composting facility and integrated constructed wetlands have the potential to be impacted by extreme heat. Temperature control of the composting facility is critical for its operational efficiency.

Design mitigation measures are also put in place including fire prevention systems within the landfill which will protect the infrastructure from wildfire. While fires have been known to occur in the area, it is unknown if the source of them are natural or human.

Wind has the potential to damage some utilities, such as overhead lines, and building on site and therefore they are considered more at risk to high wind associated with storms than other receptors.

Transport links have the potential to be impacted by ice or snow during severe cold weather events.

12.4.5 Major Accidents and Natural Disasters

Section 12.4.4 discusses the potential risk on future climate change and the potential natural disasters or accidents which may occur as a result.

With respect to air quality and odour, the most significant risk would relate to fires and explosion, the impact of these are discussed in terms of human health is assessed in Chapter 5 (Population & Human Health) and an emergency response plan is included in Appendix 2-8. The risk of fire will be reduced through site management and design mitigation measures including fire suppression/prevention systems within the landfill which will protect the infrastructure from wildfires and internal fires (refer to Appendix 2-7). The risk of explosion is reduced through design, as all landfill gas is flared and/or burned to produce electricity as it is generated. It is not stored on site or piped over long distances.

12.5 MITIGATION MEASURES

12.5.1 Construction Phase

The potential for impact during the construction phase of new landfill capacity from dust emissions has been scoped out due to the distance from sensitive receptors. However, dust mitigation should still be put in place in order to ensure good practice measures.

In order to minimise dust emissions during construction of new phases, a series of mitigation measures have been prepared in the form of a dust minimisation plan. The dust minimisation measures outlined in the Plan (see Appendix 12-3) and Construction Environmental Management Plan (CEMP) (Appendix 2-5) will be adhered to during the construction phase.

In summary the measures which will be implemented will include the following;

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic;
- Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions;
- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates;
- Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary;
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods; and
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

Monitoring of the embodied carbon in the construction and operational phases will be conducted. The aim of the monitoring will be to seek further ways to minimise climate impacts. Monitoring will include; embodied carbon of construction materials, water usage, power and fuel usage and waste generation (including reuse and recycling rates). Where monitoring shows the proposed development is not meeting its targets further mitigation will be put in place.

12.5.2 Operational Phase Odour

The Drehid facility (W0201-03) operates an odour mitigation and management plan which includes a range of practical odour abatement measures for the Composting Facility. All processes associated with the Composting Facility are internal within buildings under negative pressure, so air does not escape from the buildings.

An odour management plan will be in place for the proposed landfill facility. This plan includes management strategies for the prevention of emissions and a strict preventative maintenance and management program for ensuring that all odour mitigation techniques remain operational at optimal capacity throughout all operational scenarios. Good housekeeping practices (internally and externally) and a closed-door management strategy will also be maintained at all times.

If composting temperatures exceed approximately 65°C, odour emissions increase significantly, due to the changes in process biochemistry. Excessive increases in composting temperatures are especially relevant in the first stage of composting when, due to the fast degradation, a lot of energy is released. Temperature sensors are used to measure the temperature in the composting tunnels and subsequently in the maturation area. The SCADA control system ensures that the composting temperature does not exceed 65°C by adding more fresh process air to the composting mass. This reduces the odour load in the process air being transported to the odour abatement systems.

Critical and key odour abatement system performance parameters are continually monitored on the SCADA control system. Should any parameter deviate outside of its accepted range, an alarm will be immediately generated. Critical alarms will be texted to selected mobile phone numbers thereby ensuring the communication of critical alarms to responsible individuals on a 24-hour basis.

The biofilters are maintained to ensure optimum performance. Biofilters are compartmentalised to facilitate maintenance and replacement of media. Each biofilter comprises two sections such that treatment is provided by one of the sections while the other section is being maintained. Biofilters are covered and hence isolated from extreme weather conditions (e.g., intensive rainfall or intensive heat) thereby providing optimum control of biofilter efficacy.

12.5.3 Operational Phase Air Quality

There is no significant predicted operational phase impact with respect to air quality from traffic. However, some site-specific mitigation measures are required for the existing development, in particular the prevention of vehicles from having engines idling while waiting to be processed, even over short time periods.

The review of road traffic for impacts on human and ecological receptors has found no significant impacts that require mitigation measures with respect to the modelling of emissions. However, some mitigation measures can be put in place to minimise emissions:

- Implement a policy which prevents idling of vehicles both on and off-site including HGV holding sites;
- Traffic should be monitored to ensure vehicles are using the designated haul routes;
- Efficient scheduling of deliveries to minimise number of deliveries required, and in turn their emissions; and
- Construction vehicles should conform to the current EU emissions standards and where reasonably practicable, their emissions should meet upcoming standards prior to the legal requirement date for the new standard. This will ensure emissions on haul routes are minimised.

Mitigation measures are required for the control of dust with respect HGV moments onsite with the site and deliveries to/from the site:

- HGV traffic leaving site will pass through a wheel wash;
- Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary. If public roads are deemed to require additional cleaning where possible a suction device for road cleaning will be utilised can access spaces around cars and other street furniture more effectively; and
- During movement of materials both on and off-site, trucks will be stringently covered at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

12.5.4 Operational Phase Climate

Vehicles, generators etc., will give rise to some GHG emissions, however the proposed development's impact on climate due to traffic can be minimised through mitigation measures. The following mitigation measures will be put in place to minimise emissions:

- Implement a policy which prevents idling of vehicles both on and off-site including HGV holding sites;
- Construction Phase traffic should be monitored to ensure construction vehicles are using the designated haul routes;
- All plant and machinery will be maintained and serviced regularly;
- Efficient scheduling of deliveries will be undertaken to minimise emissions; and
- Construction vehicles should conform to the latest EU emissions standards and where reasonably practicable, their emissions should meet upcoming standards prior to the legal requirement date for the new standard. This will ensure emissions on haul routes are minimised.

Monitoring of carbon emissions will also include the ongoing management of adaptation and mitigation in order to measure their effectiveness, with consideration given to the vulnerabilities to extreme heat and cold noted in Section 12.4.4. Emissions from the composting and landfill process will be minimised through good practice measures and management however are vulnerable to extreme heat. If monitoring of adaptation measures and mitigation measures indicates the measures are not effectively minimising embodied carbon or climate is impacting on the construction of the proposed development, then they should be reviewed and updated.

The majority of mitigation measures with respect to the proposed development's vulnerability to climate change are set out through management plans, designing out potential issues. Operational Phase climate vulnerability should be reassessed on an annual basis in order to respond to new scientific data on potential climate change impacts.

The impact of the landfill emissions are mitigated by the collection of the landfill gases emitted (as per Section Table 12.27) to produce electricity. A landfill gas collection system will be installed to safely collect and divert this gas from the new landfill to the existing landfill gas management compound which includes landfill gas flares and landfill gas utilisation plant (LGUP) which generates electricity. The amount generated will vary throughout the lifespan of the landfill as the waste decomposes. Landfill gas generation rates will vary considerably over the lifetime of the facility and is discussed in more detail in Section 2.3.4 of the EIAR.

Development of the new MSW Processing and Composting Facility will allow for the extraction of recyclable and organic materials from incoming MSW and minimise the residual waste quantity requiring further treatment. Recyclables will be extracted from the MSW and sent off-site for future reuse. This will divert the material from landfill and maintain suitable materials in the circular economy for as long as possible. Organic fines screened from the MSW will be composted in a controlled environment within the new building to reduce their organic content. The biostabilised output will be disposed of in the new landfill but has a reduced emission factor compared with unprocessed MSW.

The operational phase will also have carbon sinks in the form of approximately 72 ha of the site being allowed to be vegetated (Transitional Woodland Scrub factor used) based on the updated TII Online Carbon Tool (TII 2022f). As calculated using the TII Online Carbon Tool (TII 2022f) the proposed development will result in total operational Phase GHG emissions of 17,040 tonnes CO_2eq over a 25-year period or 762 tonnes annually. Further areas of revegetation will be created where possible. In addition, in areas where it is practical gradual drain blocking will also encourage water levels to rise resulting in the rewetting of peat which is currently dried out. A bog rehabilitation plan is being conducted for areas outside the project redline boundary which includes drain blocking to encourage rewetting.

12.6 WORST CASE IMPACT

In order to protect nearby sensitive receptors, construction and operational phase impacts have been assumed to be a reasonable worst case for odour, air and climate emissions throughout the assessment.

Potential construction phase impacts have been taken to be worst case for any occasional construction activities associated with development of additional landfill capacity and therefore strict mitigation measures have been outlined in a dust minimisation plan (Appendix 12-3) and any construction works associated with the development of additional landfill capacity is carried out in accordance with the construction stage CEMP which is agreed in advance with Bord na Móna. The mitigation measures for dust are designed with a number of layers of protocol, therefore if one fails in the short-term it should be eliminated by the next. Construction dust monitoring occurs as part of the IED Licence (W0201-03) which will be in place to ensure that, should mitigation measures fail and construction dust impacts occur, they will be at worst slight, localised and short term in nature.

12.7 DIFFICULTIES ENCOUNTERED

In late December, at the date of publication of the new TII guidance documents, the chapter was complete and had undergone a legal review. As per Section 1.9 of PE-ENV-01107 and Section of 1.5 of PE-ENV-01105 given above, it is therefore considered reasonably practicable to retain the use of previous guidance.

12.8 DO-NOTHING

The Do-Nothing assessment assumes that the proposed infrastructure is not built, and existing infrastructure carries on until licences run out or capacity is no longer available. In this scenario the odour, air quality and climate emissions will remain as per to the current baseline in the short-term.

In the do-nothing scenario odour impacts will reduce in concentration as the landfill is filled and capped with final capping. Odour emissions from a capped landfill are significantly lower than an active phase and in the do-nothing scenario the landfill will reach its fully capped status sooner than in the proposed scenario. In addition, odour concentrations will be lower as there will be no additional contribution from the composting and MSW sorting facility which are associated with the proposed development.

While there is no immediate impact on air quality for the do-nothing scenario, air quality emissions of NO_2 and particulates will decrease sooner in the do-nothing scenario as no additional landfill capacity is added. Due to this the timespan over which gas utilisation plant and flares, the source of NO_2 and particulate emissions, will be required to be run is shorter than with the proposed development in place.

Climate impacts of the current operations, which is the do-nothing scenario, are calculated in Table 12.26. These emissions are lower than the proposed development. However, no account is made for the opportunity cost of the loss of increased capacity with respect to climate. The waste may be sent to an alternative waste disposal location which results in lower or high carbon emissions depending on its treatment.

12.9 RESIDUAL EFFECTS

The scenarios modelled lead to odour concentrations which are in compliance with the relevant odour criterion of 3.0 OU_E/m^3 measured as a 98^{th}%ile of mean hourly odour concentrations at the worst-case receptor. The maximum 1-hour 98^{th}%ile odour concentration at the worst-case sensitive receptors is 2.14 OU_E/m^3. This is equivalent to 71% of the relevant odour criterion of 3.0 OU_E/m^3 measured as a 98^{th}%ile of mean hourly odour concentrations at the worst-case receptor. There is no set rating for significance with respect to odour however as the worst-case odour impact remains significantly below (71%) of the guidance value the impact is describes as at worst, slight. In accordance with EPA Guidance this can be classed as a slight, long term, reversible and localised impact at the worst-case location.

With regard to NO_2, the modelled scenario will lead to ambient NO_2 concentrations (including background) which are in compliance with the relevant limit values, reaching at most 79% of the 1-hour limit value (measured as a 99.8^{th}%ile) and 31% of the annual limit value at the worst-case off-site location. In accordance with Table 12.9 this is a moderate NO_2 impact for the cumulative impact of the further development and current operations at the Drehid facility. However, there are no additional emissions of particulars as a result of the further development at Drehid. In accordance with Table 12.9 this is a negligible impact from the proposed development and the likely effect in accordance with EPA Guidance can be classed as a negligible, long term, reversible and localised impact at the worst-case location.

With regard to PM_{10} / $PM_{2.5}$, emissions from the facility will lead to ambient PM_{10} / $PM_{2.5}$ levels (including background) which are in compliance with the relevant limit values, with levels reaching at most 59% of the relevant limit values at the worst-case off-site location including background however the contribution due to process emissions from Drehid are only 5.5% of the relevant limit values. In accordance with Table 12.9 this is a slight PM_{10} and $PM_{2.5}$ impact for the cumulative impact of the further development and current operations at the Drehid facility. However, there are no additional emissions of particulars as a result of the further development at Drehid. In accordance with Table 12.9 this is a negligible impact from the proposed development and the likely effect in accordance with EPA Guidance can be classed as a negligible, long term, reversible and localised impact at the worst-case location.

The impact of the increased CO_2e emissions due to the increased landfill and Composting Facility capacity is 0.04% of Irelands EU ESD Targets 2030 or 1.59% of Irelands "other" sectorial emission value. With consideration the significance criteria set out in Section 12.2.6.3.1 which states that impact should consider the extent to which the trajectory of GHG emissions from the project aligns with Ireland's GHG trajectory to net zero by 2050 and the level of mitigation taking place, the impact is considered moderate.

12.10 CUMULATIVE EFFECTS

Details of potential cumulative projects which are assessed are discussed in Section 4.3 of the EIAR including the North Timahoe solar farm, the Ballydermot Wind Farm, and another recent solar farm application (KCC Pl. Ref. – 22/1203).

The current waste management activities within the existing Drehid Waste Management Facility have been included within air quality, climate and odour modelling and assessment throughout the EIAR. This ensures that cumulative effects due to the current operations of the facility with respect to air quality, odour or climate do not result in a significant impact.

The EIAR scoped out the potential for dust impacts from the proposed development due to the distance to sensitive receptors. Currently the potential for cumulative effects therefore is negligible. However, in order to ensure that no cumulative impacts occur with respect to dust nuisance, human health or ecological receptors, a series of mitigation measures as per IAQM Guidance (IAQM 2014) as per Appendix 12-3, will be put in place should any cumulative projects occur within 350m of the proposed development. Therefore, it is assumed that no significant cumulative impacts will arise.

No significant cumulative effects are predicted with respect to odour, air quality or climate.

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