KNOCKHARLEY LANDFILL LTD.

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED DEVELOPMENT AT KNOCKHARLEY LANDFILL

VOLUME 2 – MAIN EIAR

CHAPTER 7 – AIR QUALITY & CLIMATE

NOVEMBER 2018

Knockharley Landfill Ltd.
Kentstown, Navan,Co.Meath

FEHILY TIMONEY & COMPANY

TABLE OF CONTENTS

Page

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

7 AIR QUALITY AND CLIMATE

This chapter was prepared by Dr Andrew Meacham and Mr Paul Ottley of Odournet UK Ltd, and Mr Adam Dawson (formerly of Odournet UK Ltd). Mr Nick Jones of Odournet UK Ltd co-authored Appendix, 7.1 the odour impact appraisal which informs the odour aspects of this Chapter.

Nick Jones is Managing Director of Odournet UK Ltd. He has over twenty-six years of experience in odour and air quality related issues. He has worked exclusively as an odour specialist for Odournet UK Ltd since 1998. He holds an Honours Bachelor of Science degree from the University College of North Wales: Bangor, in Marine Biology and Oceanography. He is a qualified Environmental Auditor and his professional memberships include the International Water Association (IWA) and the Institute of Directors (IoD).

Dr Andrew Meacham is a principal consultant and holds a BSc and PhD in chemistry. Andrew has been employed at Odournet as a specialist environmental odour consultant for 12 years.

Mr Paul Ottley is also a principal consultant and holds a BSc in Environmental Science. Paul is a member of the Institute of Air Quality Management and has been employed at Odournet as a specialist environmental odour consultant for 14 years.

Mr Adam Dawson was a consultant at Odournet for approximately 2 years, and prior to that was employed by the Environment Agency's Air Quality Modelling and Assessment Unit. Adam holds a bachelor's degree in Meteorology and Atmospheric Science and an MSc in Applied Meteorology and Climatology.

There was input to this chapter from Ms Tanya Ruddy and Ms Donna O' Halloran of Fehily Timoney and Company. Ms Tanya Ruddy is a Principal Scientist and holds a BA Mod in Environmental Science and an MSc in Environmental Management. She is a Chartered Scientist and has been employed by FT as a waste consultant for 17 years. She Ms. Donna O' Halloran is a Project Scientist. Ms Donna O' Halloran has a BSc in Agricultural Science and a MSc in Environmental Resource Management and a MSc in Ecological Assessment. She has been employed at FT for 3 years where she has carried out air and climate impact appraisals for EIS and EIAR.

Odournet UK Ltd. carried out the air quality assessment with input from Fehily Timoney and Company on the dust impact assessment and preparation of the landfill gas prediction model. Fehily Timoney and Company carried out the climate impact assessment.

7.1 Introduction

This chapter of the EIAR examines the potential effects of the proposed development on air quality and climate. It considers the potential impacts that may arise on the environment at and near the site of the proposed development and the measures proposed to mitigate such potential effects. Consideration is given to both the construction and operational phases of the proposed development. The main issues examined with respect to the potential impacts from the proposed development on air quality and climate are:

- vehicle emissions
- dust/particulate emissions
- landfill gas utilisation emissions
- process emissions
- odour emissions

An appraisal has been made with regards to the operation of the existing facility and the proposed development elements comprising the intensification of the rate of waste acceptance, storage of incinerator bottom ash (IBA), biological processing of residual municipal solid waste (MSW) fines and the storage and treatment of leachate.

The following have been considered in the preparation of this EIAR:

- Environmental Impact Assessment of Projects, Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU), (EC, 2017)
- Guidelines on the information to be contained in Environmental Impact Assessment Reports, Draft, (EPA, 2017)
- Guidance on the assessment of odour for planning, Version 1.1, (IAQM, 2018)
- Odour Impact Assessment Guidance for EPA Licensed Sites AG5, (EPA, 2010)
- Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes, (NRA, 2011)
- Guidance on the assessment of dust from demolition and construction, (IAQM, 2014)
- Design Manual for Roads and Bridges (DMRB, 2007)

7.1.1 Consultation

The scope for this assessment has been informed by pre-application consultation with An Bord Pleanála, Meath County Council, prescribed bodies and other interested parties as summarised in Chapter 5 of Volume 2 of the EIAR.

This chapter considers the responses received from the consultation relating to air and climate issues.

The comments expressed in particular by Meath County Council, the Health Service Executive (HSE), and An Táisce in written consultations received from as part of the process leading up to the preparation of this EIAR were considered in the preparation of this chapter.

7.2 Existing environment

From the perspective of air quality pollutants, the site is located in a Zone D area as defined within AG4 guidance (rural Ireland, including towns with a population of less than 15,000). The nearest EPA air quality monitoring station within a comparably rural location is located at Monaghan (Kilkitt) and this measures a range of air quality parameters. Review of the monitoring data collected at this station over the last 3 years indicates that the measured background concentrations of relevant pollutants are substantially below their applicable limit values and Air Quality Standards.

Under the existing IE licence conditions, there is a requirement to monitor dust deposition, PM_{10}, landfill gas, emissions from the landfill gas flares and utilisation plant, as well as volatile organic compounds (VOC) from the surface of the landfill. A monitoring location map illustrating the location of each of these existing monitoring points is provided in Volume 4 of this EIAR. Figure 7.1 shows the dust and PM_{10} monitoring location points.

There are 8 no. dust monitoring points. Dust deposition results for the facility from 2013- Quarter 3 2018 have been within the EPA limit value of 350 mg/m^2/day throughout 2013-Quarter 3 2018 except for two results in Quarter 2, 2014 and one result in Quarter 4 2015 where algal growth in the dust pots (as opposed to landfill operations) resulted in levels recorded above the licence limit. The elevated levels were not attributable to site activities.

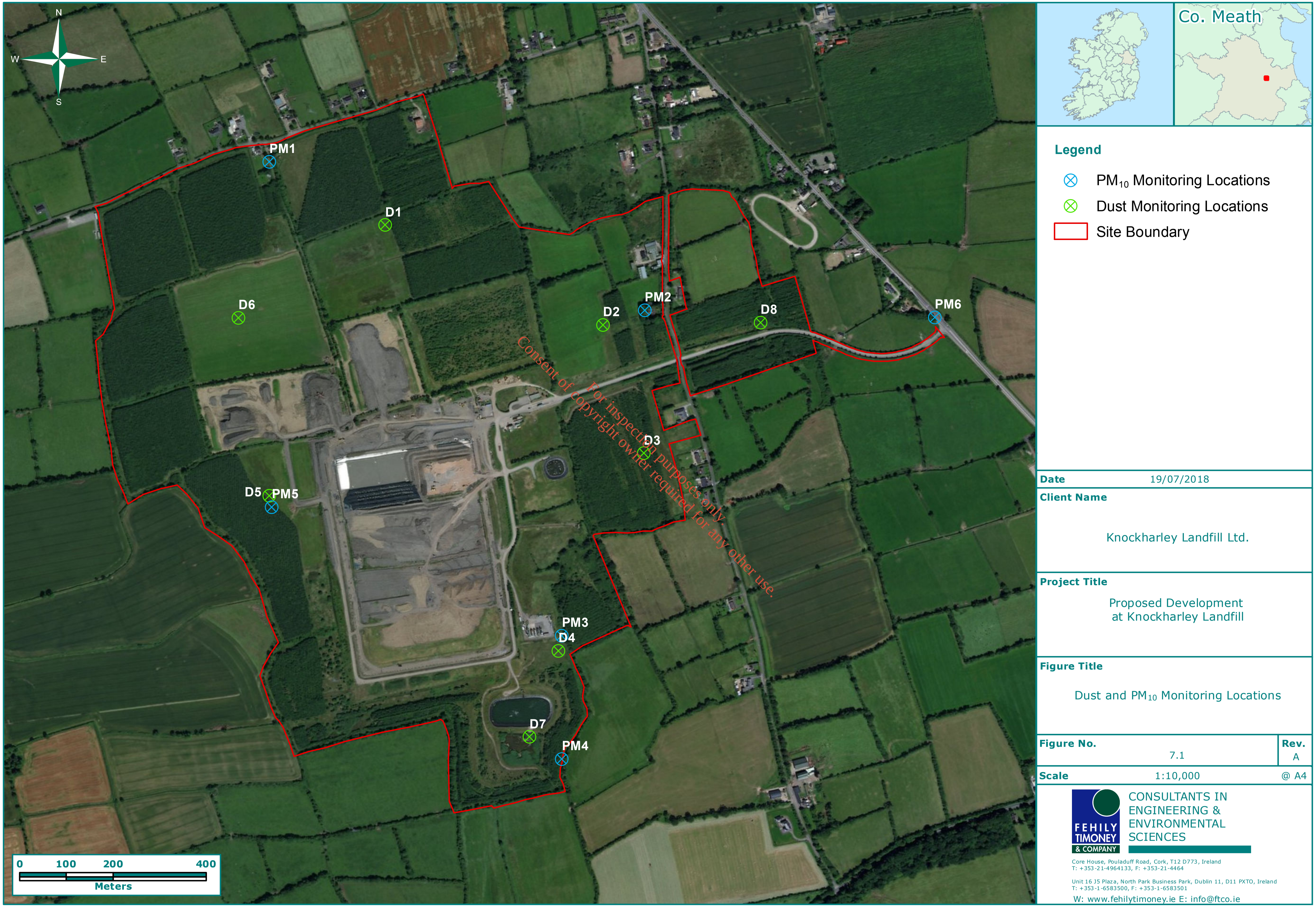
PM_{10} (i.e. particulate matter less than 10 microns) monitoring is undertaken annually at six monitoring locations (PM1- PM6) at the facility. Monitored results are compared with the limit values for the protection of human health in SI No 180 of 2011 which sets a PM_{10} 24-hour limit value of 50 µg/m^3 for protection of human health. This limit value is not to be exceeded more than 35 times per year. There were no exceedances of the 50 µg/m^3 at Knockharley in the 5 year 2014-2018, all results were <10 µg/m^3.

Flare and engine stack monitoring is undertaken annually on site in accordance with Condition 6.3.2 and 6.3.3 and Schedule D of the licence. Stack testing results are available online on the EPA website. The results for the past 5 years (2014-2018) were within the Emission Limit Values (ELVs) set by the licence.

In accordance with the licence and the Odour Management Plan, odour assessments are carried out by the licensee. The landfill staff are trained to carry out odour impact assessment in accordance with AG5[1]. If odour nuisance is detected, or in response to an odour compliant, the potential source of odour is investigated and mitigated.

[1] Odour Impact Assessment Guidance for EPA Licensed Sites (AG5), EPA 2010.

Map: R:\Map Production\2014\LW14\821\01\Workspace\MXD\EIS\LW14-821-01_Fig7-1_DustAndPM10MonitoringLocations_A4.mxd



Legend

- PM$_{10}$ Monitoring Locations
- Dust Monitoring Locations
- Site Boundary

Date	19/07/2018	
Client Name	Knockharley Landfill Ltd.	
Project Title	Proposed Development at Knockharley Landfill	
Figure Title	Dust and PM$_{10}$ Monitoring Locations	
Figure No.	7.1	**Rev.** A
Scale	1:10,000	@ A4

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7.3 Assessment Methodology

This appraisal methodology involved the review and assessment of the proposed technology and infrastructure comprised in the proposed development in order to identify potential impacts on air and climate. The methodologies used to examine the potential impacts on air and climate arising in both the construction and operation phases are outlined below.

7.3.1 Assessment of Construction Impacts

As part of the proposed development, it is proposed to construct a new incinerator bottom ash (IBA) facility including a building, leachate management facility comprising tanks and lagoons, screening berms, two ESB sub-stations and a biological treatment facility. The existing landfill will continue to operate including construction of permitted landfill cells. Felling of existing commercial forestry is required to facilitate construction of the screening berms which will be re-planted. The principal potential impacts on local air quality are the emissions of dust and PM_{10} (particles with a diameter of 10 microns or less, released into the air via direct emissions from wind-blown soil, combustion engines) from soil movement and construction vehicles during construction itself and emissions of NO_x, CO and Benzene as a result of additional traffic from construction vehicles.

The closest receptors to the site are residential developments and are listed in Table 7.5.

7.3.1.1 Construction dust

During the construction phase of this project, dust emissions are likely to arise due to particulate matter becoming airborne. This airborne dust is then available to be carried downwind from the source.

The amount of dust generated and emitted from the proposed development at the Knockharley landfill facility and the potential impact on surrounding areas will vary according to the following:

- the type and quantity of material and working method
- distance between site activities and sensitive receptors
- climate/local meteorology and topography

Potential dust particles generated from construction and site operations within the site will primarily comprise of larger dust particulates (i.e. above 30 μm) which will deposit over short distances. Likely nuisance effects from this dust are deposition on buildings and vegetation surrounding the site of the construction activities. In the absence of specific Irish guidance on the matter, the appraisal comprised in this section of the EIAR has been carried out in accordance with guidance produced by the UK Institute of Air Quality Management (IAQM)[2]. The IAQM methodology considers the effects on both residential and ecological receptors from dust and PM_{10} and an assessment is undertaken for four separate construction related activities:

- Demolition
- Trackout
- Construction
- Earthworks

The terms are defined by the IAQM guidance as:

Demolition - Any activity involved with the removal of an existing structure (or structures). This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time.

[2] IAQM.2014. Guidance on the assessment of dust from demolition and construction version 1.1.www.IAQM.co.uk

Trackout - The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

This arises when heavy duty vehicles (HDVs) leave the construction / demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site.

Construction - Any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc.

Earthworks - Covers the processes of soil-stripping, ground-levelling, excavation and landscaping

The IAQM methodology suggests a four-step approach as detailed below:

- Step 1: screens the requirement for more detailed assessment
- Step 2: assesses the risk, considering the scale of the works and the sensitivity of the area
- Step 3: determines site-specific mitigation for the activities carried out
- Step 4: determines residual effects and whether or not they are significant

Following the IAQM guidance a dust assessment is recommended to be undertaken where there are human sensitive receptors:

- within 350 m of the Site boundary; and/or
- within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the Site entrance(s).

or ecological receptors:

- within 50 m of the Site boundary; and/or
- within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the Site entrance(s).

As there are sensitive human receptors within 350 m of the site boundary and within 50 m of the route(s) used by construction vehicles on the public highway, a full dust risk assessment has been undertaken. There are no sensitive habitat sites (i.e. Natural Heritage Areas (NHAs), proposed NHAs or European sites/Natura 2000 sites) within 50 m of the site boundary or of the route(s) used by construction vehicles on the public highway so there was no consideration of ecological receptors with regards to dust. The closest NHA/proposed NHA (pNHA) is Balrath Woods pNHA located circa 620 m from the site boundary and the closest European site is River Boyne and River Blackwater candidate Special Area of Conservation (cSAC) located approximately 4.3 km from the site boundary.

7.3.1.2 Construction Vehicle Emissions

During the construction phase of this project, traffic emissions are likely to arise due to the increase in construction vehicles required for the construction phase. These traffic emissions are airborne from the source (i.e. local road network used by construction vehicles) before dissipating.

The amount of traffic emissions generated and emitted from the proposed development at Knockharley landfill and the potential impact on surrounding areas will vary according to the following:

- the quantity and type of construction vehicles
- distance between routes used by construction traffic (local road network) and sensitive receptors
- climate/local meteorology

Potential traffic emissions from construction vehicles are comprised of a number of different polluting gases; the most notable are particulates (PM_{10}), nitrous oxides (NOx) and carbon dioxide (CO_2). These gases will be discharged into the local environment.

Particulates are known to negatively impact human health whilst NOx and CO_2 are greenhouse gases which when released can cumulatively impact on climate in the local and greater environment. The appraisal comprised in this section of the EIAR has been carried out in accordance with guidance produced by the National Road Authority[3] (NRA); now called Transport Infrastructure Ireland. This was considered the most appropriate guidance. The NRA methodology considers the potential effects on both residential and ecological receptors. The following approach was taken:

- Attain baseline air quality levels: Annual background pollutant concentrations were sourced from the EPA's three most recent ambient air quality reports (2015 - 2013) ((EPA, 2015[4]), (EPA, 2014[5]) & (EPA, 2013[6])). No values for 1,3-butadiene were available within the EPAs reports and values for benzene were not available for Zone D[7]; and will not be considered in calculations.
- Attain baseline local traffic flows: sourced from 2015 and 2016 surveys carried out by Abacus Transportation Surveys Ltd for the National road N2 and Regional road R150.
- Attain predicted construction phase traffic information: predicted traffic flows, vehicle composition (i.e. percentage cars and percentage heavy vehicles), average speed on routes being assessed.
- Determine the closest sensitive receptor to National road N2 and Regional road R150: This was done via a desktop survey of buildings and satellite imagery. The NRA (2011) defines a sensitive receptor as *"locations include: residential housing, schools, hospitals, places of worship, sports centres and shopping areas, i.e. locations where members of the public are likely to be regularly present."* Also, 'designated habitats' can also potentially be sensitive receptors i.e. Natural Heritage Areas (NHAs), proposed NHAs or European sites/Natura 2000 sites).
- Use the UK Highways Agency's DMRB[8] screening model as recommended in the NRA (2011) guidance to predict existing traffic emissions and predicted traffic emissions. The DMRB model predicts vehicle emissions for SO_2, NO_2 and NO_x, PM_{10}, 1,3-butadiene, benzene and CO.
- Compare predicted emissions with air quality standards: Findings were compared with the Irish ambient air quality standard - S.I. No. 180 of 2011 – Air Quality Standards Regulations, 2011. These regulations set limit values and averaging periods, which are used to assess the impact of emissions on human health, vegetation and ecosystems.
- Determine the impact magnitude: The increase in predicted traffic emissions findings, between existing and construction phase were assessed according to the NRA's (2011) guidelines:
  - *Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations* (see Table 7.1)
  - *Details of the descriptors for changes in annual mean nitrogen dioxide, PM_{10} and $PM_{2.5}$ at receptors* (see Table 7.2).
- If the screening model assessment predicts concentrations that exceed 90% of the air quality standards/limit values, then detailed dispersion modelling is required.
- Identify any mitigation measures to be implemented during both the construction and operational phases.

[3] NRA, 2011. Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes. Revision 1, 8TH May 2011.

[4] Air Quality in Ireland 2015, Key Indicators of Ambient Air Quality. Environmental Protection Agency, 2015

[5] Air Quality in Ireland 2014, Key Indicators of Ambient Air Quality. Environmental Protection Agency, 2014.

[6] Air Quality in Ireland 2013, Key Indicators of Ambient Air Quality. Environmental Protection Agency, 2013.

[7] Under the Air Quality Framework Directive (1996/62/EC), Ireland has been divided into four air management areas. Dublin is Zone A and Cork is defined as Zone B. Zone C consists of 16 towns with a population of greater than 15,000, while Zone D covers the remainder of the country (all towns with a population of less than 15,000 and all rural areas).

[8] Design Manual for Roads and Bridges (DMRB) (Volume 11, Section 3 Air Quality, May 2007), UK Highways Agency.

Table 7-1: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations (NRA[2])

Magnitude of Change	Annual Mean NO_2/PM_{10}	No. Days with PM_{10} conc. >50 µg/m^3	Annual Mean PM_{10}
Large	Increase/Decrease ≥4 µg/m^3	Increase/Decrease > 4 days	Increase/Decrease ≥2.5 µg/m^3
Medium	Increase/Decrease 2-< 4 µg/m^3	Increase/Decrease 3 or 4 days	Increase/Decrease 1.25 - <2.5 µg/m^3
Small	Increase/Decrease 0.4 - <2 µg/m^3	Increase/Decrease 1 or 2 days	Increase/Decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase/Decrease <0.4 µg/m^3	Increase/Decrease <1 day	Increase/Decrease <0.25 µg/m^3

Table 7-2: Descriptors for changes in Annual Mean Nitrogen Dioxide, PM_{10} and $PM_{2.5}$ at Receptors (NRA[2])

Absolute Concentration In relation to Objective/Limit Value	Change in Concentration		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value with Scheme (≥40 µg/m^3 of NO_2 or MP_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Substantial adverse
Just below objective/limit value with scheme (36- <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Moderate adverse
Below objective/limit value with scheme (30- <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - < 22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight adverse	Slight adverse
Well below objective/limit value (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight adverse
Decrease with Scheme			
Above objective/limit value without scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Substantial beneficial
Just below objective / limit value without scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Moderate beneficial
Below objective/limit value without scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight beneficial	Slight beneficial
Well below objective/limit value without scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight beneficial

7.3.1.3 Assessment of Climate Impacts

A desktop assessment of the potential impacts on climate was carried out. This chapter includes an assessment of the likely impacts on climate change.

A flood risk assessment was carried out to determine the risks associated with increased rainfall as a consequence of climate change. This is included in Chapter 12 of this EIAR.

7.3.2 Assessment of Operational Impacts

An assessment of the site operations has been undertaken to determine the impact of emissions to air as a result of operating under the proposed development. The operation of the proposed facility could result in potential emissions to air from the gas utilisation plant, dust, vehicle emissions from transferring waste to site, odour emissions from deposition or handling of waste and from the biological treatment plant. To assess the extent of the emissions from the proposed development the following scenarios will be considered:

- Impact on nearby residential and ecological receptors from operation of the landfill gas utilisation plant.
- Impact to human health on nearby residential receptors from road traffic due to operation of the landfill.
- Impact on human receptors in relation to odour exposure relating to operation of the landfill and the associated landfill gas utilisation plant and biological treatment plant.

During derivation of emission rates and modelling parameters, conservative assumptions have been assumed with details presented in the following sections. Considering the potential impacts stated above, the emission limits in the following sections have been deemed to be applicable.

7.3.2.1 Assessment of landfill gas utilisation emissions

To fully assess the operational impact of the landfill gas utilisation plant upon both residential and ecological receptors consideration was given to the following pollutants:

- Nitrogen dioxide (NO_2);
- Sulphur dioxide (SO_2);
- Total dust (as PM_{10});
- Carbon monoxide (CO);
- Hydrogen chloride (HCL);
- Hydrogen fluoride (HF);
- Total non-methane volatile organic compounds (TNMVOC)
- Nitrous oxides (NOx)

To assess the potential impact of the emissions from the landfill gas utilisation plant, an air dispersion modelling study was undertaken in accordance with the EPA guidance [9]. In accordance with this standard the results of the modelling study were compared to the EU Ambient Air Quality Directive (EU 2008/50/EC) as shown in Table 7.3.

[9]Air Dispersion Modelling from Industrial Installations Guidance Note (AG4), (EPA, 2010).

Relevant Standards

The European air quality objectives presented below have been transposed into Irish legislation by the *Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011)* with the EU 4th Daughter Directive passed into the *Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009* (S.I. No. 58 of 2009). In the absence of EU ambient air quality limit values for hydrogen chloride (HCl) and hydrogen fluoride (HF), Environmental Assessment Levels (EALs) from the UK were examined for limit values for these parameters and are shown in Table 7.4.

Table 7-3: European Union Limit and target values as outlined in Directives 2008/50/EC and 2004/107/EC

Pollutant	Obligation	Time Period	Legal Nature	Allowable Exceedances
Nitrogen Dioxide	200 µg/m³	1 hour	Limit Value	18 (99.79 %ile)
	40 µg/m³	Annual	Limit Value	n/a
Sulphur Dioxide	350 µg/m³	1 hour	Limit Value	24 (99.79 %ile)
	125 µg/m³	24 hours	Limit Value	3 (99.18 %ile)
PM_{10}	50 µg/m³	24 hours	Limit Value	35 (90.41 %ile)
	40 µg/m³	Annual	Limit Value	n/a
$PM_{2.5}$	25 µg/m³	Annual	Target Value	n/a
Carbon Monoxide	10 mg/m³	Maximum daily 8 hour mean	Limit Value	n/a
Benzene	5 µg/m³	Annual	Limit Value	n/a
Lead	0.5 µg/m³	Annual	Limit Value	n/a
Ozone	120 µg/m³	Maximum daily 8 hour mean	Target Value	25 (Over three years)
Arsenic	6 ng/m³	Annual	Target Value	n/a
Cadmium	5 ng/m³	Annual	Target Value	n/a
Nickel	20 ng/m³	Annual	Target Value	n/a
Polycyclic Aromatic Hydrocarbons (As B_aP)	1 ng/m³	Annual	Target Value	n/a
NO_x (Annual critical level for the protection of vegetation & natural ecosystems)	30 µg/m³	Annual	Limit Value	n/a

In order to ensure a robust and conservative assessment, as a precaution, all TNMVOC will be assumed to be benzene and compared against the European limit value of 5 µg/m³.

Table 7-4: Hydrogen Chloride and Hydrogen Fluoride EALs as per Environment Agency air emissions risk assessment[10]

Pollutant	Obligation	Time Period	Allowable Exceedances
Hydrogen Fluoride	160 μg/m^3	1 hour	None (100th percentile)
	16 μg/m^3	Annual	Annual
Hydrogen chloride	750 μg/m^3	1 hour	None (100th percentile)

An assessment was also made against the Annual critical level for the protection of vegetation and natural ecosystems as required by AG4. There are no specific screening distances stated by AG4, so a screening distance of 15 km (which exceeds the Environment Agency's Air emissions risk assessment[9] guidance screening distance of 10 km) for all designated European sites (special protection areas, candidate special areas of conservation or Ramsar sites) was used. This therefore requires assessment of the potential air quality and climate impacts arising on the following:

- River Boyne and River Blackwater cSAC (site code 002299)
- Boyne Estuary SPA (site code 004080)
- River Boyne and River Blackwater SPA (site code 004232)

In addition, the River Nanny Estuary and Shore SPA (site code 004158) which is located greater than 15 km, but is ecologically connected via the River Nanny, is also considered.

Predicted concentrations at these locations will be compared against the NO_x Annual critical level of 30 μg/m^3.

Model Selection

AERMOD is an advanced air model which increases the reliability and accuracy of the predictions and allows the calculation of emission concentration percentiles for the comparison to ambient air quality regulations. Based on guidance issued by the EPA (AG4), it is considered that AERMOD is appropriate for the assessment of impacts of pollutant emissions from this facility. The AERMOD regulatory option for multiple pollutant modelling was used in this assessment.

This model is appropriate for this assessment as in the region of the site there are no complex terrain features which would significantly alter meteorological conditions. Also, due to the low source stack heights in this assessment, pollutant concentrations over long distances are not considered significant.

Receptors

A receptor is a location at which the model will calculate a specific ground level concentration. The height of the receptor is set at 1.5 m which represents the breathing level of humans.

The model was set up to assess the impact of emissions on discrete receptors which were placed on 25 of the sensitive residential receptors in the vicinity of the site. A complete list of the residential receptors that were considered is presented below with their locations presented in Figure 7.2.

[10] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

Table 7-5: List of Sensitive Residential Receptors considered within the Model

Receptor ID	Receptor	UTM Easting (m)	UTM Northing (m)
1	Residential	663914	5947101
2	Residential	663964	5946962
3	Residential	663964	5946923
4	Residential	664022	5946690
5	Residential	664058	5946521
6	Residential	664179	5946270
7	Residential	663986	5945868
8	Residential	663732	5945583
9	Residential	663227	5945341
10	Residential	662604	5945704
11	Residential	661972	5946400
12	Residential	661868	5947142
13	Residential	661960	5947375
14	Residential	662181	5947349
15	Residential	662566	5947552
16	Residential	662829	5947662
17	Residential	662958	5947709
28	Residential	663191	5947772
19	Residential	663421	5947848
20	Residential	663537	5947794
21	Residential	663600	5947901
22	Residential	663805	5947914
23	Residential	663824	5947794
24	Residential	663838	5947673
25	Residential	663909	5947366

Figure 7-2: Location of sensitive receptors included within the dispersion model as blue dots with the planning boundary of Knockharley Landfill shown in red

Building Downwash

Good engineering practice is to select a stack height which is sufficiently high to avoid structural or building wake-effect induced downwash. Downwash brings pollutants closer to ground level at a shorter downwind distance giving the worst-case scenario for a particular site.

Relevant building dimensions were inputted into the model. The model software Building Profile Input Parameters (BPIPRPIME) was run to calculate the potential for building downwash on each emission source in each of the 36 wind direction sectors (10° width/sector). This model also calculates GEP heights where the effect of building downwash is eliminated. This data is then used in AERMOD to calculate plume downwash (i.e. adjusted plume centreline due to building wake affects). The effect of building downwash is only considered for point sources.

Meteorological Data

The meteorological data used by the model to simulate the dispersion and dilution effects generated by the atmosphere has been selected with reference to the AERMOD Implementation Guide[11], which advises that the most representative meteorological dataset should be utilised. This will be influenced by both proximity to the study site and the representativeness of the surface characteristics of the meteorological station in comparison to the study site.

[11] AERMOD Implementation Guide, Published by the US EPA, Last Revised: August 2015

Sequential hourly average meteorological data from Dublin Airport was utilised for the years 2012 – 2016[12]. This complies with Irish EPA AG4 guidance that states that the last year of meteorological data used must be within 10 years of the assessment year. Dublin Airport is located approximately 30 km to the south-east of the site and the estimated annual mean windspeed at the site is between 4-6 m/s from the Met Éireann website. The annual wind speed of the data between 2012-2016 from Dublin airport is 5.6 m/s therefore is within the expected range for this area of Ireland. The meteorological data was adjusted to reflect the surface characteristics of the study site in accordance with the guidelines in the AERMOD User Guide issued by the US EPA[5].

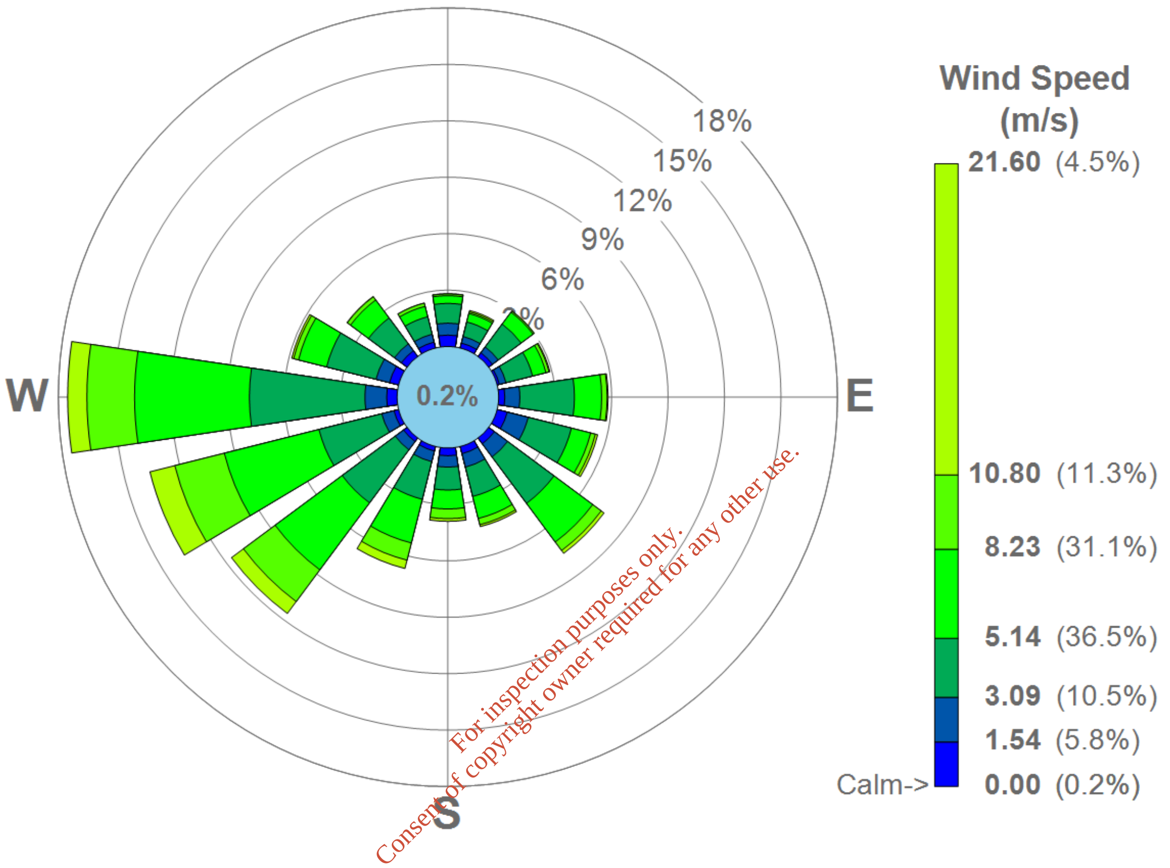


Figure 7-3: Windrose for Dublin airport (2012-2016)

Nitric Oxide to Nitrogen dioxide conversion

In line with AG4 guidance, the PVMRM NO_2/NO_X conversion method was used in AERMOD to take into account the portion of NOx converted to NO_2 in the atmosphere. This conversion assumes that 90% of the released emissions are nitric oxide and that there is an ambient ozone concentration of 57 $\mu g/m^3$. This is based on data collected by the EPA[13] at Macehead Galway in 2016. 2016 is the latest hourly ozone published by the Irish EPA and Macehead Galway is considered to be in Zone D (a town with a population less than 15,000). Therefore, based on the guidance outlined in AG4 Galway is considered to be representative of ozone concentration at Kentstown, near Knockharley landfill.

Background concentrations

The modelled facility contribution was also added to maximum EPA monitored rural background concentrations and compared to the relevant ambient air quality guidelines, in accordance with AG4.

[12] www.meteireann.ie

[13] http://www.epa.ie/air/quality/monitor/

The table of relevant background monitoring data is presented below:

Table 7-6: Background pollutant data used within this assessment

Location	Pollutant	Hourly average pollutant concentration (µg/m³) unless stated			
		2014	2015	2016	Average
Monaghan_Kilkitt	NO_2 (µg/m³)	2.64	-	3.01	2.82
Monaghan_Kilkitt	SO_2 (µg/m³)	1.7	2.15	1.18	5.03
Monaghan_Kilkitt	PM_{10} (µg/m³)	8.89	9.22	8.14	8.75
Monaghan_Kilkitt	CO (mg/m³)	-	-	0.4	0.4
Kilkenny (Seville Lodge)	Benzene	0.09	0.13	0.2	0.14

Background concentrations for HCL or HF are not routinely monitored in Ireland or in the UK and are unlikely to be high in rural locations such as Kentstown near Knockharley landfill; for this assessment their background concentrations have been assumed to be zero.

In line with AG4, the above background levels are doubled when assessing against short term emission standards with the exception of PM_{10} where under standard practice this is not undertaken due to the small ratio between the annual and 24-hourly standard.

Assessing significance

To assess the significance of the process contribution to each pollutant's standard (short term and long term) the PC has been compared to AG4's Maximum Allowable Process Contribution:

Maximum Allowable Process Contribution = (AQS – Background Concentration) / 1.5).

This is key to ensuring that future developments can be permitted while ensuring compliance with Irish limit values.

The draft EPA "Guidelines on The Information to Be Contained in Environmental Impact Assessment Reports" (2017) describes the following seven generalised degrees of impact significance that are commonly used in EIA:

- **Imperceptible** - An effect capable of measurement but without significant consequences.
- **Not Significant** - An effect which causes noticeable changes in the character of the environment but without significant consequences.
- **Slight** - An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
- **Moderate** - An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
- **Significant** - An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
- **Very Significant** - An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
- **Profound** - An effect which obliterates sensitive characteristics

For each pollutant assessed, one of the significance descriptors was applied, taking into account the above descriptions.

7.3.2.2 Assessment of Vehicle Emission Impacts

The assessment of the impact of vehicle emissions during the operational phase was carried out using the same methodology as for the assessment of vehicle emissions for the construction phase and this is described in Section 7.3.1.1.

7.3.2.3 Assessment of Odour Emission Impacts

Estimation of the odour emissions generated was undertaken for both current (2018) and proposed future operational scenarios. An assessment has been undertaken using information gathered from:

- Site visits;
- Onsite odour measurement data;
- Dispersion modelling.

Specific consideration was given to the changes to the current site operations which are likely to occur as a result of the proposed development (e.g. in terms of variation in the quantity and type of waste received and location of the filling activities) and the contribution of odours from any additional odour sources which may be introduced to the site as part of the proposed biological waste treatment facility. The description of the proposed development is in Chapter 2 of Volume 2 of this EIAR.

The study assessed the potential odour emissions and predicted exposure levels under the following operational scenarios:

- Scenario 0: Baseline conditions in 2018.
- Scenario 1: Year 4 'do nothing'. The situation which is likely to occur in the final active deposition stages of the landfill if it continues to operate in line with current planning and licence conditions (i.e. the proposed development does not proceed).
- Scenario 2: Year 4 of proposed development.
- Scenario 3: Year 6 of proposed development. The situation which will occur in the final stages of the landfill if the proposed development is permitted.

For each operational scenario, the odour emissions generated from the landfill were estimated in terms of European odour units (ou_E/m^3)[14] by development of a 'site emission model' using on-site odour concentration measurements of the waste and landfill gas, operational details of the site supplied by the client and estimation of gas leakage using a landfill gas production model (current and future operating scenario).

In order to assess the veracity of this model and how it is likely to compare to real world conditions, a series of field assessments were also conducted under the current baseline conditions. This dual approach for assessment is consistent with current best practice.[15] Further details of the methodology are presented in Appendix 7.1.

The emission estimates derived from this approach were then inputted into a dispersion model which was applied to assess the level of exposure to odour that is likely to occur around the site under the full range of meteorological conditions representative of the area.

The outputs of the model were then compared against published odour impact criteria (see below) to assess how the risk of odour impact is likely to change as a result of the development.

[14] A European Odour Unit is defined that amount of odorant(s) that, when evaporated into 1 cubic metre of neutral gas at standard conditions, elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one European Reference Odour Mass (EROM), evaporated in one cubic metre of neutral gas at standard conditions. One EROM is equivalent to 123 mg n-butanol (CAS-Nr. 71-36-3) evaporated in 1 cubic metre of neutral gas this produces a concentration of 0,040 mmol/mol.

[15] Guidance on the assessment of odour for planning, Version 1.1 - July 2018, Institute of Air Quality Management, UK

The model was constructed using the AERMOD atmospheric dispersion model published by the US Environmental Protection Agency (US EPA), with meteorological data sourced from Dublin airport. Impact risk was assessed on the basis of the worst case meteorological year from a 5-year data set of sequential hourly average data.

The model was constructed and applied in accordance with guidance published by the model developer (the US EPA) and relevant guidance published by the Irish EPA[16], the UK Environment Agency[17] and the Institute of Air Quality Management (IAQM)[18].

All dispersion modelling for odour emissions was undertaken using the same base model construction as for the air quality assessment in Section 7.3.2.1, with the following exceptions:

- A receptor grid of 3.7 km by 3.7 km (50 m resolution), centred on the site, was utilised in the model. The height of the receptor is set at 1.5 m which represents the breathing level of humans.
- The 2012 meteorological year was considered the worst-case year for proposed operational conditions. [19]
- The model only considered emissions generated under the normal running conditions for the facility.
- The receptors presented in Figure 7-4 were also included within the dispersion model, to allow a comparison of predicted odour exposure levels between the modelled scenarios.

Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Discrete receptors considered within the dispersion model are presented as blue stars.

Figure 7-4: Discrete receptors considered within odour dispersion model

[16] Irish EPA (2010). Air Dispersion Modelling from Industrial Installations Guidance Note (AG4). Irish EPA

[17] IPPC H4 Technical Guidance Note "H4 Odour Management", Environment Agency (England), March 2011.

[18] Guidance on the assessment of odour for planning, Version 1.1 - July 2018, Institute of Air Quality Management, UK

[19] The worst case meteorological year has been defined on the basis of highest predicted odour exposure at a residential property in any of the future operational scenarios.

In general terms, odour impact is recognised as a symptom that develops because of intermittent but regular exposure to odours that are recognisable and have an offensive character. The key factors that contribute to the development of odour annoyance can be usefully summarised by the acronym FIDOL:

- Frequency of exposure
- Intensity or strength of exposure
- Duration of exposure
- Offensiveness
- Location sensitivity

In acknowledgement of these factors, odour impact assessment techniques have been developed in Europe and internationally that involve the application of atmospheric dispersion models and indicative odour impact criteria. These criteria are generally defined in terms of a minimum concentration of odour (reflecting the intensity/strength element of FIDOL) that occurs for a defined minimum period of time (reflecting duration and frequency element of FIDOL) over a typical meteorological year. The concentration element of these criteria can be increased or lowered to reflect variations in the offensiveness of the odours released from a specific type of facility, and the sensitivity of nearby sensitive locations.

The unit used to express exposure concentration in these criteria is the European odour unit (ou_E).[20]

In the UK and Ireland, the most commonly applied odour impact criteria are derived from research conducted by the UK Environmental Agency which were originally published in the UK guidance note H4. These criteria are also referenced in more recent guidance note AG4[21] published by the Irish Environmental Protection Agency. The criteria define odours in three offensiveness brackets as indicated in the table below and have been designed for application to permanent residential properties which are considered to be the most sensitive from an impact risk perspective.

Table 7-7: Impact criteria defined in H4 and AG4

Exposure level	Relative offensiveness of odour	Example industrial sectors
$C_{98,\ 1\text{-hour}} \geq 1.5$ ou_E/m^3	High (or most offensive)	Rendering, Fish Processing, Oil Refining, Creamery, WWTP, Fat & Grease Processing, biological landfill odours.
$C_{98,\ 1\text{-hour}} \geq 3$ ou_E/m^3	Medium	Intensive Livestock Rearing, Food Processing (Fat Frying), Paint-spraying Operations, Asphalt Manufacture
$C_{98,\ 1\text{-hour}} \geq 6$ ou_E/m^3	Low (or least offensive)	Brewery, Coffee Roasting, Bakery, Chocolate Manufacturing, Fragrance & Flavouring

It is important to note that whilst examples are provided of the industries which may generate odours that fall into each offensiveness category, the guidance does not specify specific criteria for all industrial sectors. It is also important to note that the criteria are intended as indicative benchmarks for development of odour impact *risk* but are not absolute standards and may vary due to local factors such as population density, complaint behaviour, receptor sensitivity etc. Selection of an appropriate criteria is therefore a matter of specialist judgement.

In terms of planning, further informative guidance has been published by the UK Institute of Air Quality Management (IAQM)[22].

[20] EN13725: 2003. Air Quality: Determination of odour concentration by dynamic olfactometry

[21] Air Dispersion Modelling from Industrial Installations Guidance Note 4 (AG4), Environment Protection Agency.

[22] Guidance on the assessment of odour for planning, published by IAQM: July 2018

This guidance states that based on the current evidence available to the authors, odour annoyance can develop at odour exposure levels of between $C_{98,\ 1\text{-hour}}$ = 1 ou_E/m^3 to $C_{98,\ 1\text{-hour}}$ = 10 ou_E/m^3 depending upon the offensiveness of the odour and local conditions.

Two matrices are then provided which outline the possible effect of odour exposure on receptors with different sensitivities (i.e. odours that are classified as 'most offensive' and 'moderately offensive') as indicated in the figures below. In these matrices the likely effect is considered at different exposure levels and receptor sensitivities, ranging from negligible to substantial. Where the effect is above 'slight', it is likely to be considered significant in EIA terms.

Odour Exposure Level C_{98}, ou_E/m^3	Receptor Sensitivity		
	Low	Medium	High
≥10	Moderate	Substantial	Substantial
5-<10	Moderate	Moderate	Substantial
3-<5	Slight	Moderate	Moderate
1.5-<3	Negligible	Slight	Moderate
0.5-<1.5	Negligible	Negligible	Slight
<0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are increases and decreases in odour exposure as a result of this development, in which case the appropriate terms "adverse" or "beneficial "should be added to the descriptors.

Figure 7-5: Proposed odour effect descriptors for impacts predicted by modelling- 'Most offensive' odours (Source: IAQM[21])

Odour Exposure Level C_{98}, ou_E/m^3	Receptor Sensitivity		
	Low	Medium	High
≥10	Moderate	Substantial	Substantial
5-<10	Slight	Moderate	Moderate
3-<5	Negligible	Slight	Moderate
1.5-<3	Negligible	Negligible	Slight
0.5-<1.5	Negligible	Negligible	Negligible
<0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are increases and decreases in odour exposure as a result of this development, in which case the appropriate terms "adverse" or "beneficial "should be added to the descriptors.

Figure 7-6: Proposed odour effect descriptors for impacts predicted by modelling- 'Moderately'' odours (Source: IAQM[21])

Review of the figures indicate that for odours that fall into the 'most offensive' category, the threshold for development of a risk of significant impact from an EIAR perspective occurs at exposure levels of $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$ for highly sensitive receptors (e.g. residential property), whilst for an odour that is considered to be moderately offensive, the threshold is $C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^3$. As exposure levels increase above these threshold levels, the probability of a significant impact occurring also increases.

Bearing in mind that odorous emissions from landfilling operations generally comprise a mixture of landfill gas and waste odour which fall into the high (or most) offensive category, these thresholds are generally consistent with Odournet's experience, which indicates that it is possible for a significant adverse odour impact to develop at exposure levels as low as $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$. However, it should be noted that such instances are relatively rare and hence the thresholds should be considered as precautionary. This position also appears to be supported by research published by SNIFFER[23] in a study that was co-funded by the Environmental Protection Agency (EPA), which states: 'for odour from landfill sites an impact criterion of $C_{98,\ 1\text{-hour}} = 3\ ou_E/m^3$ or less is usually applied in the UK and the Republic of Ireland for purposes of assessment and regulation'.

For the purposes of comparing the impact risk between the various operational scenarios studied in this case and evaluating the potential significance of impact in EIA terms, the following criteria for assessing potential have been applied:

- Landfilling operations (high offensive odours) threshold: $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$.
- Biological treatment facility emissions (moderately offensive odour) threshold: $C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^3$.

For odour, dispersion modelling of the existing environment (current baseline (April 2018)), is presented in Section 7.4.2.4.

7.3.2.4 Assessment of Climate Impacts

The assessment of the impact on climate during the operational phase was carried out using the same methodology as for the assessment of climate impacts for the construction phase and this is described in Section 7.3.2.

7.4 Assessment of Potential Impacts

7.4.1 Construction Phase

As already stated the principal potential sources of air emissions during the construction of the proposed facility are dust, PM_{10} and vehicle emissions. These impacts have been assessed individually below.

7.4.1.1 Dust Emissions

As discussed in section 7.3.1 above the IAQM dust guidance uses a 4-step assessment methodology to assess the risk of dust during construction.

Step 1 Screening

There are sensitive human receptors within 350 m of the site boundary and within 50 m of the route(s) used by construction vehicles on the public highway, so a full dust risk assessment was undertaken. There are no sensitive ecological receptors within 50 m of the site boundary or of the route(s) used by construction vehicles on the public highway, so no consideration has been made of ecological receptors with regards to dust.

[23] SNIFFER, Odour Monitoring and Control on Landfill Sites, ER31, February 2013; and Odour Management Plan Reports for Landfills, ER31, February 2013

Step 2a – Defining the Potential Dust Emission Magnitude

The magnitude of dust emissions, either small, medium or large is assigned to 4 aspects of construction that have the potential to cause a large amount of dust.

As stated in section 7.3.1 these are demolition, earthworks, construction and trackout. There is no planned demolition because of the proposed development at Knockharley, so this will not be assessed further.

Based on the scale and nature of the proposed works at the site, the magnitude of potential dust emission from the site was determined for earthworks, construction and trackout in Table 7.8.

Table 7-8: Assessment of Dust Emission Magnitude (IAQM)

Activity	Dust Emission Magnitude
Earthworks	Large
Trackout	Large
Construction	Medium

The basis for identifying the above magnitudes for each activity is outlined below:

- Earthworks: Total site area > 10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes.
- Trackout: >50 HDV (Heavy Duty Vehicles) (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m.
- Construction: Total buildings volume > 100,000 m^3, but large areas of these buildings will be hollow as the main function of volume is to facilitate plant operation and main activities are reception and composting and weathering.

Step 2b – Defining the Sensitivity of the Area

The sensitivity of the area is then defined by the nature of the receptor and the number of receptors and distances from construction operations.

The sensitivity of the area with regards to:

- Dust sensitivity is considered to be low; while the main nearby receptors are residential and would expect a high level of amenity there are less than 10 receptors within 100 m of likely area of construction or trackout.
- PM_{10} sensitivity is considered to be low; the background levels for PM_{10} are around 9 μg/m^3 which is considerable lower than 24 μg/m^3 where IAQM guidance indicates that sensitivity may increase; dependant on the number of nearby receptors.
- Ecologically sensitive receptors are considered to be low; the closest NHA/proposed NHA (pNHA) is Balrath Woods pNHA located circa 620 m from the site boundary and the closest European site is River Boyne and River Blackwater candidate Special Area of Conservation (cSAC) located approximately 4.3km from the site boundary.

For both assessments, the source of dust deposition was conservatively taken as the centre of the proposed IBA facility, approximately 100 m north east of the current office administration buildings located on site.

Step 2c - Define the Risk of Impacts

The dust emission magnitude determined in step 2a is combined with the sensitivity of the area determined at step 2b to determine the risk of impacts with no mitigation applied for each section (construction, and trackout). As the sensitivity of the area was determined to be low, IAQM suggests that the risk is always considered to be low regardless of the emission magnitude, with the exception for demolition works which are not considered in this assessment.

The results of the assessment are presented below:

Table 7-9: Risk of Impact

Activity	Earthworks	Construction	Trackout
Dust Soiling	Low Risk	Low Risk	Low Risk
Human Health	Low Risk	Low Risk	Low Risk
Ecological	Negligible	Negligible	Negligible

With regard to dust (dust soiling) and PM_{10} (human health), the risk from earthworks, construction and trackout activities during the construction phase is deemed to be Low Risk. Less than 10 sensitive receptors (residents/buildings) are located to the north and east of the redline (planning) boundary. Commercial forestry is also located within the site and this includes the areas of the northern and eastern boundaries of the site. Existing forestry will help to buffer dust and PM_{10} contributing to further mitigation of the Low Risk impact to sensitive receptors located within 100 m from the redline boundary.

With regard to ecology, the risk from earthworks, construction and trackout activities during the construction phase are deemed to be Negligible as ecologically sensitive receptors are located outside the zone of potential impact from dust and PM_{10}.

7.4.1.2 Vehicle Emissions

The baseline air quality levels (for Zone D in which the site is located) were sourced from the EPA's three most recent ambient air quality reports (2015 - 2013) which were averaged. Existing traffic flows and predicted construction traffic flows as well as vehicle composition, average speed and closest sensitive receptors for the local road network (National road N2 and Regional road R150) were attained. This information was then inputted into a DMRB screening model to predict existing and construction phase traffic emissions for the National road N2 and Regional road R150. The closest sensitive receptor for the N2 was located 10 m from the national road while the closest sensitive receptor for the R150 was 3 m from the regional road. Existing (2018) and the construction phase/year 1 (2019) emissions of CO, NO_x, NO_2 and PM_{10} were calculated for the N2 and R150 between the N2 and Duleek (see Table 7-11 for results).

The results were then compared with Air Quality Standards Regulations 2011 limits (Table 7-10) which indicate that traffic emissions during year 1 (2019) of the development will remain within acceptable Air Quality Standards Regulations 2011 limits. The increase in traffic emission between existing traffic emissions and year 1 (2019) (Table 7-11) were then compared with Table 7-1 NRA's Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations and Table 7-2 Descriptors for changes in Annual Mean Nitrogen Dioxide, PM10 and PM2.5 at Receptors which indicates that the increase in traffic emissions will be imperceptible.

As results indicate the impact from traffic emissions from the construction phase will be imperceptible, detailed dispersion modelling was not required, nor were mitigation measures.

To conclude, the impact from increased traffic flows will have an imperceptible impact on sensitive receptors along N2 (closest receptor 10m from road edge) and R150 (closest receptor 3m from road edge).

Table 7-10: Air Quality Standards Regulations 2011 limits

Pollutant	Air Quality Limits
CO	10,000 μg/m^3 or 8620 ppb maximum daily 8 hour mean
NO_x	30 μg/m^3 measured over a calendar year
NO_2	200 μg/m^3 or 105ppb measured over 1 hr or 40 μg/m^3 or 21 ppb measures over a year
PM_{10}	50 μg/m^3 measured over 24hrs and 40 μg/m^3 measured over a calendar year

Table 7-11: Predicted Levels of Pollutants from Traffic Emissions for Year 1 (2019)

N2 south of site					
Pollutant	**CO (mg/m^3)**	**NOx (μg/m^3)**	**NO_2 (μg/m^3)**	**PM_{10} Annual Mean (μg/m^3)**	**PM_{10} >50 μg/m^3**
Present (2018)	0.45	17.03	8.98	13.58	0.00
Year 1 (2019)	0.45	16.97	8.96	13.58	0.00
Increase/decrease	**0.00**	**-0.06**	**-0.02**	**0.00**	**0.00**
R150 between N2 and Duleek					
Present (2018)	0.43	12.23	7.45	13.19	0.00
Construction Phase (2019)	0.43	12.21	7.44	13.19	0.00
Increase/decrease	**0.00**	**-0.02**	**-0.01**	**0.00**	**0.00**

7.4.1.3 Climate Impacts

There is the potential for the emission of greenhouse gases such as CO_2 and NOx to the atmosphere during the construction of the development from general earthworks, forestry felling, vehicle emissions, the use of materials such as concrete and the contribution from fugitive landfill gas within the site. The site is located within an agricultural environment and connected to urban areas via national and regional roads. Within the agricultural environment greenhouse gases are released seasonally via harvesting and tilling of the land and this would be the norm within the area of the site. While traffic will increase during the construction phase, the increase in emissions (see Section 7.4.1.2) will be imperceptible for sensitive receptors. It can be deduced that while there will be an increase in the production of greenhouse gases from the construction phase, compared with what is the norm for the area, the impact to local and national climate will be imperceptible. In addition, the generation of renewable electricity from waste will also off-set or avoid carbon dioxide emissions generated from energy generation at traditional fossil fuel plants.

7.4.2 Operational Phase

Dust particles may be generated from the movement of vehicles around the site. Dust emissions may also be generated from the proposed landfilling of non-hazardous stabilised and inert waste at the northern face of the landfill and placement of IBA. Operational controls such as maintaining high moisture content of IBA will be undertaken to ensure a high degree of compaction within the landfill to prevent dust emissions.

Similar to the construction dust emissions impacts outlined in Section 7.4.1, vehicle movement occurring onsite, the placement of IBA and the continued operation of the landfill will generate airborne dust/particulate emissions.

However, these activities will be smaller in nature than the construction of the IBA facility, screening berms, leachate management facility, ancillary infrastructure, surface water management infrastructure, ESB substations, landfill cells and biological treatment facility and therefore the risk from dust emissions is still considered to be low.

With regard to ecology, the risk from earthworks, construction and trackout activities during the operational phase are deemed to be Negligible as ecologically sensitive receptors are located outside the zone of potential impact from dust and PM_{10}.

Smaller dust particulates such as PM_{10} can be emitted from the existing gas engines and the impact of these emissions are assessed using the air prediction model AERMOD. The results of this assessment are provided in later sections.

7.4.2.1 Vehicle Emissions

The baseline air quality levels (for Zone D in which the site is located) were sourced from the EPA's three most recent ambient air quality reports (2015 - 2013) which were averaged. Existing traffic flows and predicted operation traffic flows as well as vehicle composition, average speed and closest sensitive receptors for the local road network (National road N2 and Regional road R150) were attained. This information was then inputted into a DMRB screening model to predict existing and operational phase traffic emissions for the National road N2 and Regional road R150. The closest sensitive receptor for the N2 was located 10 m from the national road while the closest sensitive receptor for the R150 was 3 m from the regional road. Existing (2018) and the operation phase (2024/ Year 6) emissions of CO, NO_x, NO_2 and PM_{10} were calculated for the N2 and R150 between the N2 and Duleek (see Table 7-12 for results).

The results were then compared with Air Quality Standards Regulations 2011 limits (see Table 7-10) which indicate that traffic emissions during the operation phase (2024/Year 6) of the development will remain within acceptable Air Quality Standards Regulations 2011 limits. The increase in traffic emissions between existing traffic emissions and the operation phase (2024/Year 6) (Table 7-12) were then compared with Table 7-1 NRA's Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations which indicate that the increase in traffic emissions will be imperceptible. The increase in traffic emissions between existing traffic emissions and the operation phase (2024/Year 6) traffic emissions (Table 7-12) were then compared with Table 7-2 NRA's Descriptors for changes in Annual Mean Nitrogen Dioxide, PM_{10} and $PM_{2.5}$ at Receptors. The comparison indicates that during 2024 (operation phase) along the N2, the impact will be imperceptible. Along the R150 there will be a medium increase in NO_2 and a small increase in $PM_{10.}$ However according the NRA (2011) (see Table 7-2) these increases will result in an impact deemed negligible.

As results indicate the impact from traffic emissions for the operation phase will be imperceptible for N2 and an imperceptible/negligible for the R150, detailed dispersion modelling was not required, nor were mitigation measures.

To conclude, the impact from increased traffic flows will have an imperceptible impact on sensitive receptors along the N2 (closest receptor 10m from road edge) and a negligible/imperceptible impact on the R150 (closest receptor 3 m from road edge).

Table 7-12: Predicted Levels of Pollutants from Traffic Emissions for 2024 (Year 6)

N_2 south of site					
Pollutant	**CO (mg/m^3)**	**NOx ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**PM_{10} Annual Mean ($\mu g/m^3$)**	**PM_{10} >50 $\mu g/m^3$**
Present (2018)	0.45	17.03	8.98	13.58	0.00
2024 (Year 6)	0.45	17.04	8.98	13.61	0.00
Increase/decrease	0.00	0.01	0.00	0.03	0.00
R150 between N_2 and Duleek					
Present (2018)	0.43	12.23	7.45	13.19	0.00
2024 (Year 6)	0.46	19.4	9.68	13.76	0.00
Increase/decrease	0.06	7.17	2.23	0.57	0.00

7.4.2.2 Landfill Gas Utilisation Emissions

Emissions from the landfill gas flares and utilisation engines have been modelled using the air prediction model AERMOD. Current baseline or background concentrations have been discussed in section 7.3.2.1 and in summary the concentration for all pollutants is low and not approaching current EU limit values.

Model Input data

A landfill gas production model was prepared. This model predicts a peak in landfill gas production from the proposed landfill of approximately 2,155 m^3/hr in 2024. Assuming a 100% gas collection efficiency, then a maximum capacity of 2,155 m^3/hr is required to be utilised or flared.

The existing capacity of the landfill engines and flares onsite is:

- 4 no. landfill engines with a combined capacity of approximately 3,600 m^3/hr
- Flare 1 has a capacity of 1,500 m^3/hr
- Flare 2 has a capacity of 1,500 m^3/hr
- Flare 3 has a capacity of 2,500 m^3/hr
- Flare 4 has a capacity of 500 m^3/hr. This is used for odour control.

Flare 3 cannot be used in conjunction with the landfill gas engines as it provides the pulling power for the engines. This gives a total gas handling capacity of 6,600 m^3/hr. This does not include flare 4 which is an open flare and used for odour control only. Therefore, there will be sufficient landfill gas handling capacity in the landfill gas management plant at the site in the future (6,600 m^3/hr capacity vs 2,155 m^3/hr predicted).

Landfill gas is utilised in the landfill gas engines at Knockharley to generate electricity which is fed to the national grid. The combustion of landfill gas in engines and flares results in the conversion of methane to carbon dioxide and water. The avoidance of greenhouse gas emissions is crucial as its global warming potential is 21 times greater than that of carbon dioxide. In addition, the generation of renewable electricity from waste will also off-set or avoid carbon dioxide emissions generated from energy generation at traditional fossil fuel plants.

Emissions from the engines and flares were modelled as point sources. Table 7.13 outlines the physical parameters of the emission sources which are based on the results of the 2017 stack emission testing[24] and Table 7.14 shows the emission concentrations applied in the modelling.

Table 7-13: Summary of Physical Parameters Input to the Model

Source	Stack (Release) Height (m)	Stack Diameter (m)	Exhaust Temperature (K)	Actual Flow Rate (m^3/s)	Normalised Flow Rate (m^3/s)
Enclosed Flare 1	8.75	1.6	1323	2.92[1]	0.39[4]
Enclosed Flare 2	10	1.6	1298	2.92[1]	0.40[4]
Gas Engine 1	10	0.4	683	0.82[2]	0.27[3]
Gas Engine 2	10	0.4	706	0.74[2]	0.24[3]
Gas Engine 3	10	0.4	702	0.78[2]	0.26[3]
Gas Engine 4	10	0.4	729	0.78[2]	0.24[3]

[1] At 9% O_2 and 101.3 kPa
[2] At 6% O_2, 10% moisture and 101.3 kPa
[6] Assumes an air to fuel ratio of 7:1
[3] At reference conditions of 5% O_2, dry, 273K and 101.3 kPa
[4] At reference conditions of 3% O_2, 273K and 101.3 kPa

Table 7-14: Emission concentrations Input to the Model

Parameter	Emission concentration mg/m³					
	Engine 1	Engine 2	Engine 3	Engine 4	Flare 1	Flare 2
NO_x as NO_2	500	500	500	500	150	150
SO_2	1290	1353	1332	1312	1584	6264
CO	1400	1400	1400	1400	50	50
Particulates	130	130	130	130	-	-
Total non-Methane VOC (expressed as benzene)	75	75	75	75	-	-
Hydrogen Chloride	50	50	50	50	50	50
Hydrogen Fluoride	5	5	5	5	5	5

Pollutant concentrations for NOx, particulates, hydrogen chloride and hydrogen fluoride have been taken from the ELVs in the facility's IE Licence (W0146-02). The concentration for carbon monoxide has been taken from the ELV presented in AG7 published in 2012. The concentration for NMVOC has been taken from the typical emission value presented in AG7. In the absence of a limit of SO_2 in the licence or AG7, the concentration for sulphur dioxide has been taken from the 2017 flare and gas engine monitoring data[25]. Modelling took place in advance of the 2018 stack testing regime which was carried out in August, therefore 2017 stack testing data was used.

The stack emission testing results for the engines are shown in Table 7.15 and the results for the flares are shown in Table 7.16.

[24] Air Scientific Air Emissions Compliance Monitoring Emissions Reports (monitoring date 28th September 2017)
[25] Air Scientific Air Emissions Compliance Monitoring Emissions Reports (monitoring date 28th September 2017)

Table 7-15: Stack Emission Testing Result from Gas Utilisation Engines (28/09/2017)

Parameter	Licence ELV for Engines* Nmg/m³	Measured concentration mg/m³			
		Engine 1	Engine 2	Engine 3	Engine 4
NO_x as NO_2	500	300	258	239	221
SO_2	-	1290	1353	1332	1312
CO	1400**	1088	1045	1038	1033
Particulates	130	3.3	2.8	1.4	2.3
Total non-Methane VOC	-	-	<0.1	<0.1	<0.1
Hydrogen Chloride	50	0.3	<0.3	<0.3	<0.3
Hydrogen Fluoride	5	4.7	<0.3	0.3	2.3

*There are recommended ELVs for engines commissioned after 2005 for NOx (500 mg/m³), CO (1,400 mg/m³) and TVOC (1,000 mg/m³) (EPA, 2012[26])
**The ELV for CO was increased from 650 mg/m³ to 1,400 mg/m³ (EPA approved)

Table 7-16: Stack Emission Testing results from Gas Flares (28/09/2017)

Parameter	Licence ELV for Flares * mg/m³	Measured concentration mg/m³	
		Flare 1	Flare 2
NOx as NO_2	150	52.3	51.6
SO_2	-	1584	6264
CO	50	<1.7	<1.7
Hydrogen Chloride	50	0.5	<0.4
Hydrogen Fluoride	5	<0.4	4.2

[1] Dry gas referenced to 273k and 3% oxygen

* There are recommended ELVs for flares commissioned after 2003 for NOx (150 mg/m³), CO (50 mg/m³) and TVOC (10 mg/m³) (EPA, 2012[27])

Air Modelling Results

Predicted process contributions (PC) for the worst-case year (2012) of a 5 years meteorological dataset (2012-2016) are presented at the receptor with the highest PC and compared with the relevant limit values (air quality standard).

The worst-case year has been defined as the year where the PC is the highest in comparison to its applicable limit value (presented in 2008/50/EC), in this case this is 24-hour SO_2 limit value in 2012. The predicted concentrations are summarised in Table 7.17 over.

[26] Guidance Note on Landfill Flare and Engine Management and Monitoring, AG7, EPA, 2012.

Table 7-17: Summary of PC to Limit Value at Most Sensitive Receptor

Parameter	Period	Modelled ground level concentration (ug/m³) at most sensitive human receptor	Modelled ground level concentration (ug/m³) at most sensitive human receptor as a percentage of Limit Value	Limit Value (ug/m³) [27]
NOx as NO_2	1-HR - 99.79%	22.5	11.2%	200
	Annual	1.9	4.7%	40
CO	8-HR	50.1	0.5%	10,000
SO_2	1-HR - 99.73%	130.4	37.3%	350
	24-HR - 99.18%	53.7	43.0%	125
Particulates	24-HR – 90.41%	1.4	2.8%	50
	Annual	0.5	1.2 %	40
HCL	1-HR -100%	3.2	0.4 %	750
HF	1-HR – 100%	0.3	0.2 %	160
	Annual	<0.1	0.1%	16
TNMVOC (as benzene)	Annual	0.3	5.4%	5

The maximum predicted receptor concentrations are added to the estimated background concentration for the area to give the total predicted environmental concentration (PEC) for comparison with the relevant air quality objectives. The background for short term standards, except for PM_{10} have been doubled in accordance with guidance in AG4. This is shown in Table 7.18.

[27] Limit values from 2008/50/EC, 2004/107/EC and Environment Agency Air Emissions Risk Assessment (https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit)

Table 7-18: Summary of PC Plus Background at Most Sensitive Receptors

Parameter	Period	Modelled Ground level Concentration (ug/m^3) at most sensitive human receptor	Modelled Ground level Concentration + Background Concentrations (ug/m^3) at most sensitive human receptor	Modelled Ground level Concentration + Background Concentrations as percentage of limit value	Limit Value (ug/m^3) [28]
NOx as NO_2	1-HR - 99.79%	22.5	28.1	14.1%	200
	Annual	1.9	4.7	11.7%	40
CO	8-HR	50.1	850.1	8.5%	10,000
SO_2	1-HR - 99.73%	130.4	140.5	40.1%	350
	24-HR - 99.18%	53.7	58.7	47.0%	125
Particulates	24-HR – 90.41%	1.4	10.1	20.3%	50
	Annual	0.5	9.2	23.0	40
TNMVOC (as benzene)	Annual	0.3	0.4	8.2%	5

The PC has also been compared against the maximum allowable PC (as outlined in the 'Assessing Significance' section of this chapter, Section 7.3.2.1). This is shown Table 7.19 below.

Table 7-19: Comparison of PC to Maximum allowable PC

Parameter	Period	Modelled Ground level Concentration (ug/m^3) at most sensitive human receptor	Maximum Allowable PC	Modelled Ground level Concentration as percentage of maximum allowable PC
NOx as NO_2	1-HR - 99.79%	22.5	131	17%
	Annual	1.9	25	8%
CO	8-HR	49.5	6400	<1%
SO2	1-HR - 99.73%	130.4	230	57%
	24-HR - 99.18%	53.7	80	67%
Particulates	24-HR – 90.41%	1.4	28	5%
	Annual	0.5	21	2%
HCL	1-HR -100%	3.2	500	<1%
HF	1-HR – 100%	0.3	107	<1%

[28] Limit values from 2008/50/EC

Parameter	Period	Modelled Ground level Concentration (ug/m³) at most sensitive human receptor	Maximum Allowable PC	Modelled Ground level Concentration as percentage of maximum allowable PC
	Annual	<0.1	11	0.2
TNMVOC (as benzene)	Annual	0.3	3	8.3%

A modelling exercise was conducted to assess the impact of emissions from the landfill gas flares and utilisation engines. The results of the modelling assessment indicate that predicted emissions are in compliance with the statutory limits set out in the EU Ambient Air Quality Directive (EU 2008/50/EC) and other relevant standards (2004/107/EC, the Air Quality Standards and Environment Agency guidance) at any nearby sensitive receptors. The predicted concentrations are below AG4's maximum allowable PC for all pollutants.

On this basis the significance of impact of emissions from the gas utilisation plant on human health is considered to be 'Not significant'.

The results of the Habitats Directive assessments indicate that predicted annual concentrations of NOx as a result of the emissions from the facility are below 0.1 µg/m³ at all of the four designated European sites. This is very substantially below the annual critical level for the protection of vegetation & natural ecosystems (30 µg/m³).

On this basis the significance of impact of emissions from the gas utilisation plant on local designated habitats is considered to be 'Imperceptible'.

Cumulative impacts of traffic and stack emissions

A summary of the cumulative impact of traffic and stack emissions associated with the development is presented in the Table below. As a conservative approach, the impact predicted from traffic has been added to the receptor with the worst-case modelling from the gas utilisation plant.

Table 7-20: Summary of the Cumulative Impact of Traffic and Stack Emissions

Parameter	Period	Modelled Ground level Concentration (ug/m³) at most sensitive human receptor	Predicted concentration increase from road traffic (ug/m³)	Total concentration (ug/m³)	Modelled Ground level Concentration as percentage of allowable process contribution
NOx as NO_2	1-HR - 99.79%	22.5	4.5	27.0	20.5%
	Annual	1.9	2.2	4.1	16.4%
Particulates	24-HR – 90.41%	1.4	0.6	2.0	7.2%
	Annual	0.5	0.6	1.1	5.3%
CO	8-HR	50.1	60.0	110.1	1.7%

The table above indicates that the impact on overall air quality is well below the maximum allowable PC after considering the emissions from increased traffic associated with the proposed development.

In conclusion, the existing and proposed air emissions from both the landfill gas plant and traffic at Knockharley landfill are within the relevant air quality standards and will not impact significantly on the ambient air quality of the area.

7.4.2.3 Biological Treatment Facility Emissions

Emissions from the proposed biological treatment facility will be discharged to air through a biofilter. Potential emissions from the biofilter will include ammonia, hydrogen sulphide and bioaerosols.

Composting is a process that utilises a range of micro-organisms to consume the organic portion of waste material. During the composting process, waste material is moved through the system resulting in the agitation of the material and the dispersal of fine particles into the air. These particles tend to be composed of a range of micro-organisms and organic constituents of microbial and plant origin and are generally known as bioaerosols. Bioaerosols consist of a range of fungi, bacteria, actinomycetes, protozoa, algae and endotoxins (outer cell wall of bacteria). In most cases, these micro-organisms are bound to fine organic particles. Bioaerosols are present everywhere and associated with various sources such as composing, agriculture, handling cereal grains, wood, hay, cotton, wool, etc. Therefore, it is difficult to associate concentrations measured downwind of a source to the correct source.

As temperature varies during the composting process, the types of bioaerosols also vary. The composting process generally begins with medium temperatures (mesophilic phase up to 40°C) and is dominated by mesophilic micro-organisms, but then progresses to higher temperatures (the thermophilic phase over 40°C) in later stages. During the thermophilic phase, thermophilic and thermotolerant fungi and bacteria are essential for the composting process to continue. In the thermophilic phase the numbers of actinomycetes (resemble fungi but are filamentous spore forming bacteria) and fungi, particularly Aspergillus fumigatus, increase.

In relation to the measurement and sampling of bioaerosols, the focus to date has largely been on fungi and bacteria. *Aspergillus fumigatus* has been used as the indicator organism of choice in a number of EPA licences issued for composting facilities to date. *Aspergillus fumigatus* is a very common fungus that is associated with soil, hay, straw, manure and grass as well as composting waste material.

A number of reports have been prepared to assess the risk of bioaerosols emissions particularly from waste composting facilities on workers and on the wider environment. The most recent documents were prepared by:

- Health and Safety Executive (HSE) in 2010 is entitled 'Bioaerosol emissions from waste composting and the potential for workers' exposure' (HSE, 2010). In this report, bioaerosols were sampled at a number of composting sites. The dispersion of bioaerosols downwind was also assessed by monitoring at distances downwind of activities. Of the 25 composting sites assessed in this report, 20 sites undertook composting activities outdoors.
- Sniffer in 2014 is entitled "Understanding biofilter performance and determining emission concentrations under operational conditions assess the variation of emissions between different technologies used to abate pollutants from waste management sites".

The results of the HSE and Sniffer reports found that:

- There was a general trend of rapidly decreasing bioaerosols with distance.
- Bioaerosols concentrations 50 m upwind of a facility are within 'typical' background levels of less than 1,000 cfu/m^3.
- 100 to 250 m downwind of the majority of facilities, less than 1,000 cfu/m^3 was recorded. 93% of bacteria and 98% of *Aspergillus fumigatus* were less than 5,000 cfu/m^3 and could be considered to be within the range of 'typical' background levels.
- There was little evidence that compost facilities have a major contribution to the overall bioaerosol concentrations by a distance of 250 m from activities.

- Removal of hydrogen sulphide and ammonia using a combination of acid scrubber and biofilter was found to be greater than 90% efficiency.

This setback distance of 250 m is also referenced in a number of other reports such as:

- UK Environmental Agency policy on composting and potential health effects from bioaerosols (2007)
- UK Environmental Agency report 'Development of Amenity Risk Assessments at Organic Waste Treatment Facilities' (October 2008)
- A literature evaluation on Bioaerosols and Composting undertaken by Cré, the Composting Association of Ireland and funded by the Irish EPA (2004).

The proposed biological waste treatment facility is greater than 250 m from the nearest sensitive receptors (residential properties). The nearest sensitive receptor is 346 m from the closest point on the building. This is outside the recommended setback distance outlined. In addition, all activities associated with the dry fermentation/composting process proposed will be carried out indoors, with an air handling system and fast shutting doors which has a fundamental impact on the emissions of bio-aerosols from the proposed facility, with emissions being minimised to the point source emissions from the biofilter. This will further reduce any impacts associated with the facility.

With regards to ammonia and hydrogen sulphide, the concentrations that will be produced are unknown and will vary significantly dependant on the waste accepted and the type of technology used. A paper published by SEPA[29] indicates that removal of these compounds by a biofilter and scrubber type system will be greater than 90%. Given the distance of the receptors from the stack (>350m), the enhanced dispersion characteristics of the biofilter emissions stack (20 m tall stack with an exit velocity of 27 m/s) and relatively high limit values for these pollutants the predicted impact is low.

7.4.2.4 Odour emissions

The proposed changes in operation to Knockharley landfill to accept 440,000 tpa of varying types of waste has the potential to influence odour emissions generated from the site in three fundamental ways:

1. The construction of a biological waste treatment facility will introduce new sources of odour to the site which may act in combination with emissions generated from landfilling activities.
2. The quantity and quality of the waste received at the site will change and over time the location of the operational area will change as the site develops. This includes construction of an IBA facility.
3. The construction of leachate storage tanks to store the increased leachate generated from the increased acceptance of waste.

The implications of each are discussed in greater detail below and in Appendix 7-1.

Construction of the new biological treatment facility

The proposed biological waste treatment facility will undertake activities that have the potential to generate odour emissions. These include:

- reception of MSW fines and MSW baled waste
- composting activities

The composting is undertaken in concrete tunnels and all reception and processing of MSW fines occurs indoors, with both the tunnels and reception area ventilated via a combination acid scrubber and biofilter OCU. With odour management and mitigation as per 7.5.2, the only potential release of emissions will be from the biofilter.

[29] Sniffer. 2014. Understanding biofilter performance and determining emissions concentrations under operational conditions.

Changes to the landfill operations

The total quantity of waste that will be accepted at the site will increase to 440,000 tpa if permission is granted for the proposed development, reaching a peak in terms of the total cumulative quantity of waste deposited in the landfill approximately 6 years after the new operations commence. Table 7-21 shows an approximation of the amount of different types of waste that is proposed to be accepted. If the facility attracts waste at the maximum rate, the landfill is expected to run out of void during year 6. At that point both the IBA facility and the biological treatment facility will continue to operate.

The odour impact assessment considered the odour emissions and exposure levels under the following operational scenarios:

- Scenario 0: Baseline conditions in 2018.
- Scenario 1: Year 4 'do nothing'. The situation which is likely to occur in the final active deposition stages of the landfill if it continues to operate in line with current planning and licence conditions (i.e. the development does not go ahead).
- Scenario 2: Year 4 of proposed development.
- Scenario 3: Year 6 of proposed development. The situation which will occur in the final stages of the landfill if permission is granted.

65,000 tpa of biodegradable waste (BMW) was inputted into the landfill gas prediction model to inform odour modelling. This figure was selected on the basis that if 100% waste accepted at the facility was MSW, of which 15% was BMW. This is a worst-case scenario as it is proposed to accept a variety of fractions of waste other than MSW.

Table 7-21: Summary of Quantities of each Waste Type Received

Summary of changes to operational conditions	Scenario 0: Current operations (2018)	Future Operations		
		Scenario 1: Do nothing Year 4 + active deposition	Scenario 2: Proposed development Year 4	Scenario 3: Proposed development Year 6
Biodegradable municipal waste and fines (tpa)	40,000	40,000	65,000	65,000
Biological treatment facility in operation (tpa)	no	no	25,000	25,000
Total landfill gas generation potential (m3/hour)	1,620	1,438	2,059	2,150
Filling of stabilised, inert waste and MSW* (tpa)	48,000	48,000	225,000***	225,000***
Acceptance of incinerator bottom ash (tpa)	yes**	yes**	150,000	150,000

*non-biodegradable fraction
**IBA tonnage included in stabilised and inert fraction
***inclusive of 25,000 tpa stabilised in biological treatment facility

Permission is sought for the intensification of the rate of waste acceptance within the current permitted footprint and this will be accommodated by increasing the height of the final contours. The schedule of filling of both stabilised waste and non-stabilised waste is also proposed to change; stabilised waste will be deposited starting at the north end of the landfill (cells 27/28 to cells 20/22), with non-stabilised waste continuing to fill from the south. This has been proposed in order to reduce the odour exposure levels at the residential receptors to the north of the landfill, along with the benefits of separating leachate by type and separating aerobic from anaerobic cells.

The stabilised waste, along with inert waste and non-biodegradable MSW is assumed to be inert and therefore will not continue to break down and produce landfill gas, therefore the only emissions associated with the stabilised waste will be the initial deposition of waste within the landfill. The proposed phasing and fill sequence is described in more detail in Chapter 2 of Volume 2 of this EIAR.

The use of hermetically sealed geo-multicovers for intermediate capping is expected to enhance containment of landfill gas and reduce fugitive odour releases from these cells.

Construction of leachate storage tanks

During visits to the site in 2010 and 2018 odour from the current leachate storage was only (barely) detectable in the immediate area of the lagoon. As a result, this area was not considered to be a significant generator of emissions from an off-site exposure perspective. Under proposed operations the additional leachate will be stored within covered tanks and lagoons and is therefore unlikely to cause any significant offsite impact if the existing mitigation measures are implemented for new leachate infrastructure.

Estimation of odour emissions

For each operational scenario, the odour emissions generated from the landfill were estimated in terms of European odour units (ou_E) by development of a 'site emission model' using on-site odour measurements of the waste and landfill gas, operational details of the site supplied by the client and estimation of gas leakage using a landfill gas production model (current and future operating scenario).

In order to assess the veracity of this model and how it is likely to compare to real world conditions, a series of field assessments were also conducted under the current baseline conditions. This dual approach for assessment is consistent with current best practice.[30] Further details of these techniques are presented in Appendix 7.1.

A summary of the odour emissions estimated for each operational condition are presented in Table 7-22 below:

Table 7-22: Estimated emissions for each operational scenario

Activity	Source	Time weighted emission [x 10^3 ou_E/s]			
		Scenario 0	Scenario 1	Scenario 2	Scenario 3
Landfilling	Active cell operations	24.9	15.9	26.1	26.1
	Intermediate and final capping	73.4	62.4	39.2	41.8
	Subtotal	98.3	78.3	65.3	67.9
Biological treatment	Odour control plant	n/a	n/a	80.0	80.0
	Total	**98.3**	**78.3**	**145.3**	**147.9**

[30] Guidance on the assessment of odour for planning, Version 1.1 - July 2018, Institute of Air Quality Management, UK

Review of the table above indicates that the following:

1. Under the baseline conditions (Scenario 0), emissions from landfilling activities are predicted to be higher than for the future operational scenario (year 4) under current licence conditions (Scenario 1). This is linked to the current gas generation rates and number of cells currently with intermediate capping in place. Going forward, it is assumed that all cells will have permanent capping applied within a year of filling thus reducing potential fugitive emissions released to atmosphere.
2. The total emissions generated from the landfilling operations are predicted to decrease as a result of the proposed development in comparison to the current operational scenario (Scenario 0) and year 4 operation if the proposed development does not go ahead (Scenario 1). This is due to the enhanced containment of landfill gas emissions which will be achieved by the proposed development.
3. In overall terms, the emissions from the proposed development are predicted to increase due to the inclusion of a new biological treatment facility (Scenario 2 and 3). However, enhanced odour control techniques provisions will be provided to ensure any odours from this facility are treated prior to release through an elevated stack which will serve to disperse residual odours in the atmosphere. The offensiveness of the odours released will also be lower due to the nature of the treatment process and treatment of the air prior to release in a biofilter.

Odour dispersion modelling

In order to assess the impact of the operational scenarios, a dispersion model was applied to assess the likely levels of odour exposure for the worst meteorological year and evaluate odour impact risk.

Since the odours from the biological treatment of waste had a different character and offensiveness rating to the landfill odours, these emissions were modelled separately. The modelled scenarios were therefore as follows:

Table 7-23: Modelled odour emission scenarios

Odour Type	Odour Model Scenario	Corresponding Operational Scenario
Landfilling	1	Scenario 0
	2	Scenario 1 (landfill activities only)
	3	Scenario 2 (landfill activities only)
	4	Scenario 3 (landfill activities only)
Treated odours from biological treatment	5	Scenario 2&3 (biological treatment only)

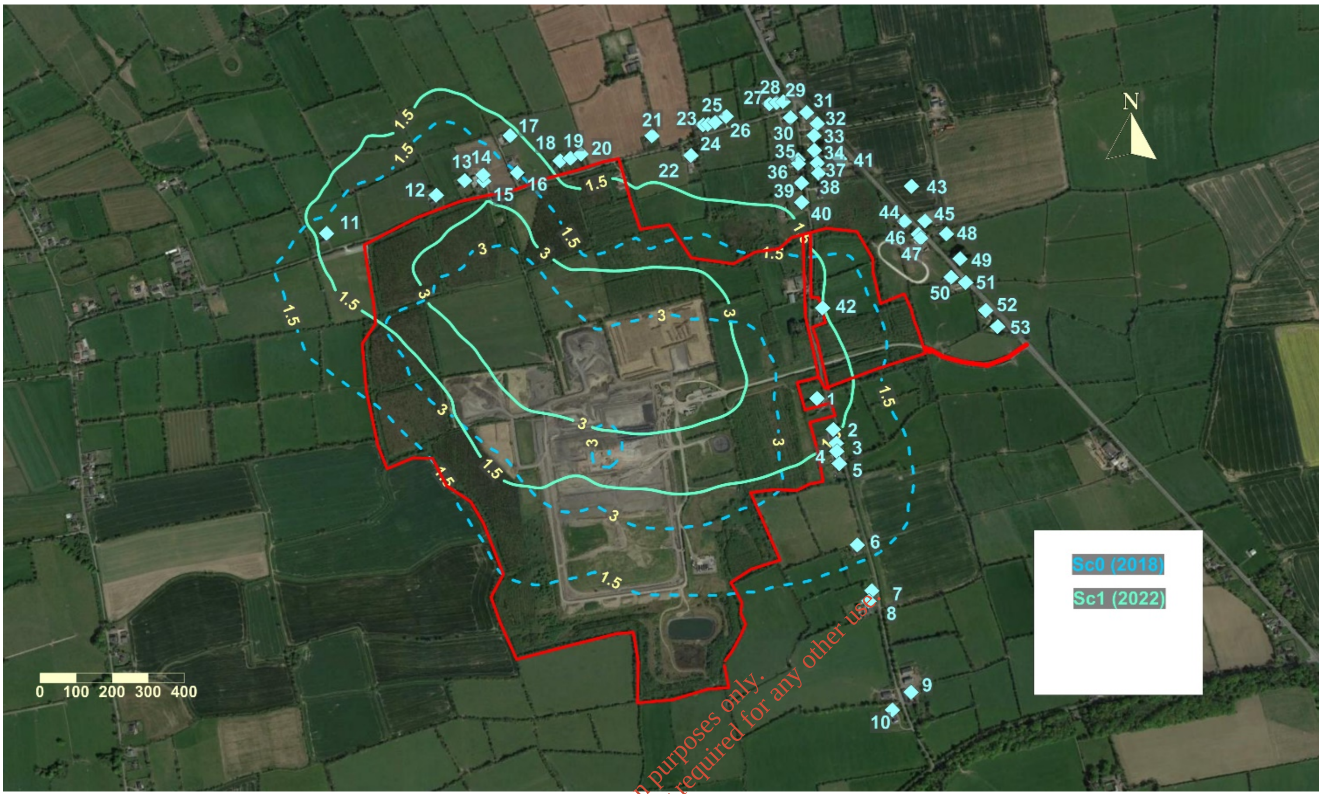
The following significance criteria were applied:

- Landfilling operations: $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$.
- Biological treatment facility emissions: $C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^3$.

Odour impact of landfilling operations

The outputs of the dispersion modelling are presented below for each modelled scenario. The figures present isopleths defining the area where the predicted odour exposure level is equal to $C_{98,\ 1\text{-hour}} = 1.5\ ou_E/m^3$ and $C_{98,\ 1\text{-hour}} = 3\ ou_E/m^3$.

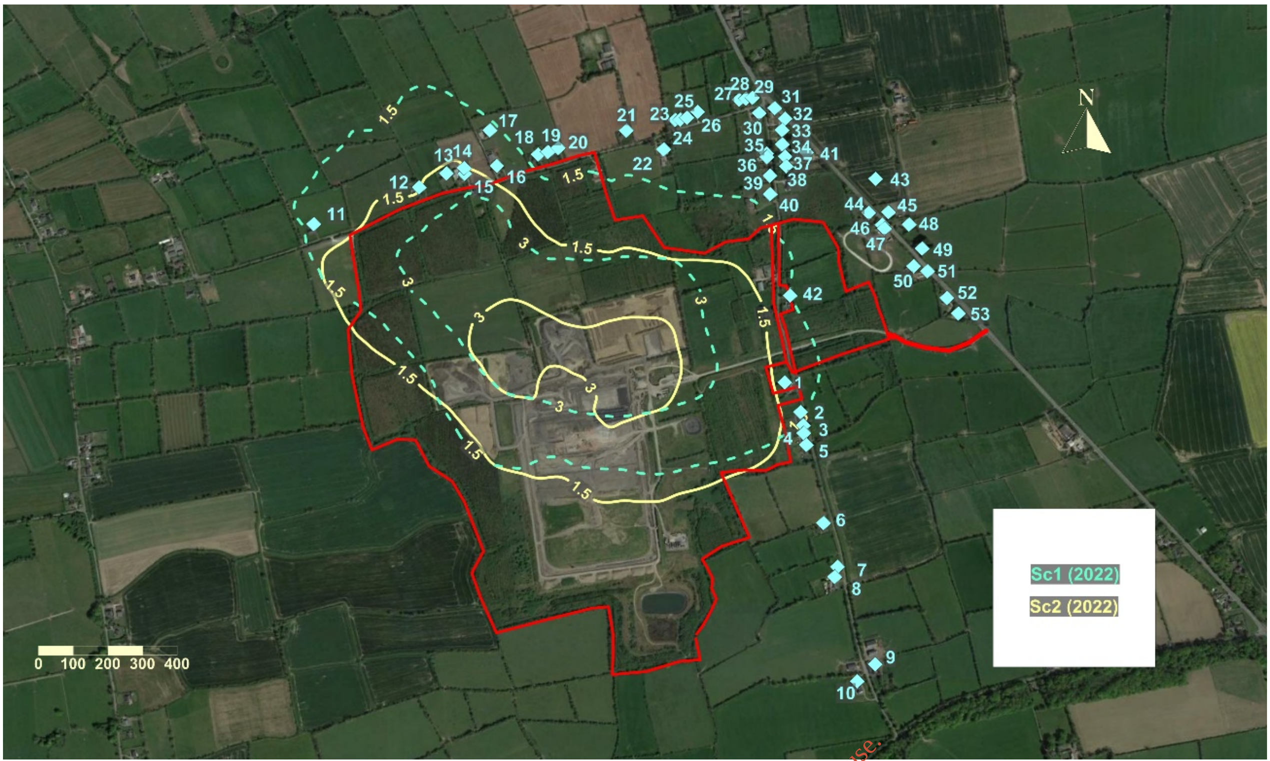
The plots present results from the 2012 meteorological data, the worst-case year of the dataset (2012-2016).[31]



Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Residential properties are presented as blue stars.

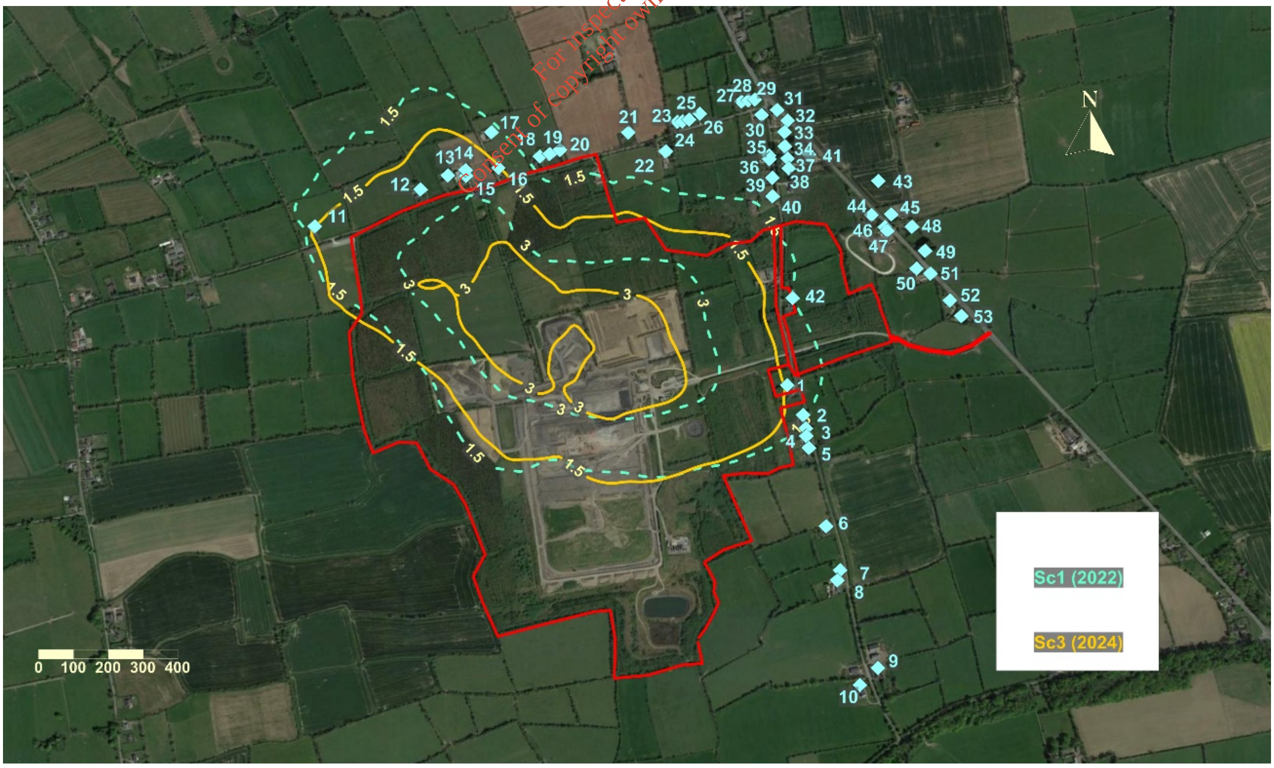
Figure 7-7: Predicted odour exposure levels from landfilling operations for Scenario 0 and Scenario 1 (Year 4 'do nothing')

[31] The worst case meteorological year has been defined on the basis of highest predicted odour exposure at a residential property in any of the future operational scenarios.



Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Residential properties are presented as blue stars.

Figure 7-8: Predicted odour exposure levels for landfill operations for Scenario 1 (Year 4 do nothing) & Scenario 2 (year 4 development)



Map imagery: Google Earth. The red line indicates the planning boundary of the facility. Residential properties are presented as blue stars.

Figure 7-9: Predicted odour exposure levels for landfill operation for Scenario 1 (Year 4 do nothing) & Scenario 3 (year 6 development)

Table 7-25 presents a summary of the area of land predicted to be exposed to $C_{98,\ 1\text{-hour}} \geq 3.0\ ou_E/m^3$ for each model scenario.

Table 7-24: Predicted odour exposure ($C_{98,\ 1\text{-hour}}$) at modelled discreet receptor locations

Receptor	Maximum $C_{98,\ 1\text{-hour}}$				Predicted change in odour exposure in comparison to baseline		Predicted change in odour exposure in comparison to Sc1	
	Sc0: Baseline	Sc1: Yr 4 do nothing	Sc2: Yr 4 development	Sc3: Yr 6 development	Sc2 Yr 4	Sc3 Yr 6	Sc2 Yr 4	Sc3 Yr 6
1	2.15	1.77	1.37	1.46	-36%	-32%	-22%	-17%
5	2.14	1.32	1.30	1.19	-39%	-44%	-1%	-10%
6	1.68	0.81	0.89	0.77	-47%	-54%	+11%	-4%
11	1.74	1.81	1.29	1.56	-26%	-10%	-29%	-14%
12	1.91	2.46	1.43	1.76	-25%	-7%	-42%	-28%
15	2.07	2.58	1.65	2.03	-20%	-2%	-36%	-21%
16	1.49	2.22	1.27	1.53	-15%	+4%	-43%	-30%
18	1.09	1.20	0.76	0.81	-30%	-26%	-37%	-33%
22	0.93	1.14	0.67	0.88	-28%	-6%	-41%	-23%
40	0.98	1.33	0.78	0.95	-21%	-2%	-42%	-28%
42	2.00	1.57	1.27	1.31	-36%	-34%	-19%	-16%

Table 7-25: Area encompassed within $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$ isopleth and $C_{98,\ 1\text{-hour}} \geq 3.0\ ou_E/m^3$ isopleth

Scenario	$C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$ isopleth area		$C_{98,\ 1\text{-hour}} \geq 3.0\ ou_E/m^3$ isopleth area	
	Area of land exposed (km²)	Percentage reduction relative to baseline	Area of land exposed (km²)	Percentage reduction relative to baseline
Sc0: Baseline (2018)	1.47	-	0.53	-
Sc1: Year 4 do nothing	1.09	26%	0.36	32%
Sc2: Year 4 development	0.81	45%	0.14	74%
Sc3: Year 6 development	0.85	42%	0.18	66%

Review of the model outputs prompts the following observations:

Review of the current baseline impact isopleths (Sc0 Figure 7-7 and Table 7.5) indicate that the area of land that is exposed to odours above the risk threshold of $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$ is approx. 1.47 km^2 and includes 12 no. properties located to the north and east of the site.

Comparison of Sc0 (current baseline) and Sc1 (year 4 do nothing) (Figure 7-7 and Table 7-25) indicates that odour exposure levels around the site are generally predicted to reduce, leading to a reduction in the land exposed to odour levels above the impact threshold by 26%. The development of the landfill to the north does however push the exposure isopleths northwards and leads to an increase in predicted odour exposure at the properties located to the north of the site in comparison to current baseline conditions. A corresponding reduction in odour exposure is predicted to the east of the site. The number of properties potentially at risk of significant odour impact is 10.

Comparison of Sc1 (year 4 do nothing) with Sc2 (year 4 with development) (Figure 7-8 and Table 7-25) indicates that the proposed development has a beneficial effect on offsite exposure in comparison to the do-nothing scenario. In this scenario, the area of land potentially exposed to odours above the risk threshold reduces by 47% in comparison to the current baseline. The number of properties at risk of potentially significant impact reduces to 4, all of which are located to the north.

Comparison of Sc3 (year 6 with the proposed development) and Sc2 (year 4 with the proposed development) indicates a slight increase in odour exposure during the final years of the landfill although the number of properties at risk of potentially significant impact is 6. This risk is likely to persist until the operational cells are closed and permanent capping is installed.

An increase in odour exposure between Sc0 and Sc3 is predicted for one of the discrete receptors (No. 16) included in the odour dispersion model. This increase results from the progression of landfilling activities to more northerly cells. However, this increase in odour exposure is expected even if the proposed development does not proceed and compared to the 'do nothing' scenario, this receptor is predicted to experience a reduction in odour exposure for operating conditions if the proposed development proceeds.

Table 7-25 also shows that there is a predicted increase in odour exposure for Receptor 6 between the 'do nothing' scenario (Sc1) and Year 4 of the proposed development (Sc2). The predicted odour exposure at this location is below levels where adverse odour impact is expected to develop for all future operational scenarios considered, so this increase in odour exposure is not significant when considering risk of odour exposure using IAQM planning guidance[32] criteria.

[32] Guidance on the assessment of odour for planning, published by IAQM: July 2018

It is therefore evident that the development will lead to an overall reduction in offsite odour exposure and impact risk in comparison to the baseline and the 'do nothing' situation, up until 2022, when the existing planning approval expires. A potentially significant risk of odour impact will remain to a handful of properties to the north of the site during the remaining life of active deposition and subsequent completion of permanent capping which is estimated to be in the order of 2 no. years. Although an odour exposure of $C_{98, 1\text{-hour}} \geq 1.5$ is considered 'significant' according to IAQM planning guidance criteria, and in Odournet's experience it is possible for a significant adverse odour impact to develop at exposure levels as low as $C_{98, 1\text{-hour}} \geq 1.5$ ou_E/m^3, it should be noted that such instances are relatively rare and hence the thresholds should be considered as precautionary.

Odour impact of biological treatment facility

The model output for the biotreatment facility is presented in Table 7-26 below:

Table 7-26: Predicted odour exposure ($C_{98, 1\text{-hour}}$) at modelled discreet receptor locations

Receptor	Maximum $C_{98, 1\text{-hour}}$
	Biological Treatment Facility
1	1.54
5	1.14
6	1.14
11	0.37
12	0.42
15	0.46
16	0.47
18	0.43
22	0.15
40	0.35
42	0.78

Review of the predicted exposure levels indicates that the odour exposure at all modelled receptors fall below the levels at which a significance impact is predicted. The predicted odour exposure is below $C_{98, 1\text{-hour}} = 3$ ou_E/m^3 across the entire model domain. As a result, the impact risk posed by this element of the development is considered to be negligible.

7.4.2.5 Climate Impacts

Under the Kyoto Protocol, Ireland is obliged to reduce its greenhouse gas emissions to a level that is 13% above 1990 levels by 2012.

The Paris Agreement consists of a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C and to drive efforts to limit the temperature increase even further to 1.5 °C above pre-industrial levels. It requires countries to make their own unique contribution to the prevention of dangerous climate change. Ireland, through the European Union, indicated its commitment through the agreement to reduce greenhouse gas emissions by at least 40% by 2030, compared with 1990 levels.

Under the European Commission's 2020 Climate and Energy Package, EU members must meet 2020 reduced greenhouse gas emission. According to recent EPA (2018) greenhouse gas emission projections, Ireland will not meet 2020 targets.

The proposed biological waste treatment facility will provide alternative infrastructure to stabilise 25,000 tpa of biodegradable material. The facility will treat waste in compliance with the EPA standard for bio-stabilised residual wastes (Respiration Activity after four days (AT4) of <7 mg O2/g DM). This stabilised waste will then be placed in an inert/stabilised cell along with stabilised waste treated at other biological treatment facilities, thereby reducing environmental impacts of landfilling, such as landfill gas generation. The stabilised material will be recovered rather than disposed. Landfill gas is utilised in the landfill gas engines at Knockharley to generate electricity which is fed to the national grid. The combustion of landfill gas in engines and flares results in the conversion of methane to carbon dioxide and water.

The avoidance of greenhouse gas emissions is crucial as its global warming potential is 21 times greater than that of carbon dioxide. In addition, the generation of renewable electricity from waste will also off-set or avoid carbon dioxide emissions generated from energy generation at traditional fossil fuel plants. Based on the quantity of methane captured for utilisation in 2013, peak gas generation and in 2017, it is calculated that the proposed development will utilise 4,947 tonnes of methane during the year of peak landfill gas generation (2024), which will displace the need for that quantity of fossil fuel, e.g. methane in natural gas. This is approximately 104,000 tonnes of carbon dioxide equivalent at peak gas generation.

During the operation phase the site will have an overall positive impact on both local and national climate due to the collection and conversion of landfill gas that would have directly contributed to greenhouse gas emissions and the generation of renewable electricity which will help to contribute towards Ireland's move from dependence on fossil fuels to use of renewable energy.

7.4.3 Cumulative Impacts

There are a number of facilities within the surrounding hinterlands that operate under licences issued by the EPA:

- Kentstown Sow Unit (transferred to Marry Pig Farms Limited) is located approximately 4 km south of the Knockharley Landfill facility in Danestown. It is operated under an IE licence P0456-01 from the EPA. It is a piggery with approximately 4,000 pigs and employs 3 people. Planning permission was granted in January 2015 for the demolition and reconstruction of facility buildings
- There is a poultry farm in Gerrardstown, Garlow Cross, located approximately 3.5 km south west of the facility. The poultry farm produces eggs and currently has capacity for 40,000 layers and is licensed for 117,500 layer spaces. The facility is licensed by the EPA through IE licence P0917-01. The 2015 AER lists one employee.
- A poultry farm in Garballagh, Duleek rears c. 3,000 broilers per annum. It is operated under IE licence P0887-01. It is approximately 4 km west of the facility and employs one person.
  Dunbia operates a meat processing facility in Beauparc under IE licence P0811-02 the operation of slaughterhouses with a carcass production capacity greater than 50 tonnes per day. It has over 70 employees and is 3.5 km north of the facility.
- Cooksgrove Ltd., trading as Euro Farm Foods, operates as cattle slaughterhouse in Cooksgrove, Duleek. It has an IE licence P0822-01 with a throughput of 300 cattle a day. It has over 100 employees. The facility is approximately 8 km west of the Knockharley Landfill facility.
- Nurendale Ltd. trading as Panda Waste Services Ltd. owns and operates a large Materials Recovery Facility at Rathdrinagh Cross Roads, approximately 4 km north east of the facility on the N2 to Slane. It is operated under a licence from the EPA, W0140-04 and is licenced to accept up to 250,000 tonnes per annum of household, commercial and industrial waste, biowaste and biodegradable waste, and construction and demolition waste and the facility employs approximately 160 people. A licence review application for, *inter alia*, the acceptance and processing of incinerator bottom ash is at time of writing under consideration by the Agency.
- Advanced Environmental Solutions (AES) Ltd. owns and operates a waste transfer facility in Navan under IE licence no. W0131-02, approximately 10 km west of Knockharley Landfill. The licensed capacity of the facility is 95,000 tonnes per annum. The facility has approximately 15 employees.

- Perma Pigs Limited, is an operational pig farm located at Littlegrange, Drogheda, County Louth, approximately 9 km north east of Knockharley Landfill. Perma Pigs Limited operates under EPA licence P0431-02. It is a piggery with No. 9,868 stock at the farm according to 2017 AER and is licensed to house 11,490 pigs, ranging from dry sows to weaners. The 2017 AER lists 5 no. employees.

- Irish Cement Limited, located at Platin Works, Platin, Drogheda, County Meath operates a cement production which includes a limestone quarry under the EPA licence register number P0030-05. The facility is approximately 10 km north east of Knockharley Landfill. Irish Cement EPA licence allows for the acceptance of alternative fuel which include meat and bone meal (40,000 tonnes per annum), chipped tyres (30,000 tonnes per annum) and solid recovered fuel (90,000 tonnes per annum). The 2016 AER lists 103 no. employees. Irish Cement Limited has submitted a licence review application to the EPA (P0030-06) to allow for the further replacement of fossil fuels with alternative fuels and the use of alternative raw materials (600,000 tonnes of waste per annum) at their Cement Works in Platin, Co. Meath.

- A poultry farm, located at Dowth, Slane, County Meath, approximately 7 km north east of Knockharley Landfill. The poultry farm produces eggs and currently has capacity for No. 78,000 birds (broilers) at the farm. The facility is licensed by the EPA - IE licence P0951-01. The 2016 AER lists one employee.

- Indaver Ireland Limited operate a waste incineration plant at Carranstown, Duleek, Co. Meath under EPA IE licence no. W0167-03. The plant is approximately 10 km north east of Knockharley Landfill. It is licensed to accept up to 235,000 per annum of household, commercial and industrial waste, sewage and industrial waste, aqueous waste and construction and demolition waste and hazardous waste and the facility employs approximately thirty-nine people.

Each of these facilities is licensed by the EPA and subject to monitoring as part of their licences. These licensed facilities cumulatively are unlikely to have a negative impact. Due to the distance between the aforementioned developments and Knockharley Landfill no impact is envisaged with regard to odour emissions, vehicle emissions, landfill gas utilisation emissions or dust. With regards to climate, the impact during the construction phase of Knockharley Landfill will be imperceptible and no cumulative impact is therefore envisaged. During the operation phase of Knockharley Landfill, the impact on climate will be an overall positive one and no cumulative impact is envisaged on climate.

There are a are a number of permitted housing and commercial building developments within the surrounding hinterlands:

- Application No. AA170888 - 39 residential units, 4,358sqm open space, 78 carparking space and associated work (ABP 301299-18). Located 1.5 km from site.
- Application No. AA170637 - 29 guest suites, gate lodge, 107 car parking spaces and other works. Located 1.5km from site. Located 6.5 km from site.
- Application No. LB170035 - community facility - recreation hall, training areas. astro turf area, 100m sprint lane, changing rooms, office, meeting room, carpark. Located 6 km from site.
- Application No. LB180687 - 11 housing units. Located 6.5 km from site.
- Application No. LB170187 - refurbishment of protected structure for a 19 bed hotel. Located 7 km from site.
- Application No. NA160607 - 218 units, demolition of existing outbuildings, ancillary works. Located 9.3 km from site.
- Application No. NA170997 - construction of 5 buildings - carpark, apartment blocks, solar panels on roof, substation and other associated site works - res / mixed dev ABP REF: 300959-18. Located 8.5 km from site.
- Application No. NA161219 - advanced technology building (other apps for buildings, carpark etc within this area / business park). Located 8.5 km from site.

Due to the nature of housing and commercial building developments, there is no cumulative impact from odour emissions or landfill gas utilisation emissions between the aforementioned developments and Knockharley Landfill. Due to the distance between Knockharley Landfill and housing/commercial developments no impact is envisaged with regard to dust emissions.

With regards to climate impacts and vehicle emissions, the impact during the construction phase of Knockharley Landfill will be imperceptible and no cumulative impact is therefore envisaged. During the operation phase of Knockharley Landfill, the impact on climate will be an overall positive one and no cumulative impact is envisaged on climate.

There are a number of solar farm developments which have been applied for, and permitted developments within the surrounding hinterlands:

- Application No. LB180570 - solar farm 3 MW and substation and associated site work. Located 2.5 km from site.
- Application No. AA180383 - solar farm 8.7 MW on 10.82 hectares. Located 9.5 km from site.
- Application No. AA170706 - solar farm 15 MW on 25.76 hectares. Located 9.8 km from site.
- Application No. LB160898 - solar farm 75 MW (ABP Ref. PL17248146) 150.29 hectares. Located 5 km from site.
- Application No. AA180145 – 3 MW solar farm on capped landfill. On site.

Solar farm developments by their nature produce no odour, landfill gas utilisation emissions, limited dust or PM_{10} during construction and decommissioning and no dust or PM_{10} during operation. The potential impact of vehicle emissions from the proposed development at Knockharley Landfill is imperceptible and therefore there will be no cumulative impact with solar farm developments. No cumulative impact is therefore envisaged between the aforementioned solar farms and Knockharley Landfill. Solar farms do however, offer an alternative to fossil fuels; providing renewable energy. During the construction phase of Knockharley the impact to climate will be imperceptible and no cumulative impact is envisaged between Knockharley Landfill and the aforementioned solar farms. During the operation phase of Knockharley Landfill, there will be a positive impact on climate. Cumulatively, Knockharley Landfill and the aforementioned solar farms will have an overall positive impact during their operation.

7.5 Mitigation Measures

7.5.1 Construction Phase

7.5.1.1 Dust Emissions

As per the IAQM methodology outlined in Section 7.3.1, Step 3 determines site-specific mitigation for the activities carried out.

The results of Steps 1 and 2 determined dust impact is considered low risk. The implementation of the following mitigation measures will result in an imperceptible impact from dust or PM_{10} during the construction phase of the proposed development.

- The developer in association with the contractor will develop and implement a dust control plan. This plan will address aspects such as excavations, filling activities & temporary stockpiling. The plan will be prepared prior to any construction activities and will be established and maintained through the construction period. Dust controls will be as per the CEMP in Appendix 2.0 of Volume 3 of this EIAR. The dust control plan will include the following mitigation measures:
  - All vehicles will comply with the onsite speed limit. The speed limit will be reduced appropriately on internal haul routes in extremely dusty environments
  - Stockpiles (soil) during the construction phase will be sprayed during periods of dry weather in order to suppress dust migration from the site.
  - The earthen berms will be replanted in forestry immediately following construction in order to establish vegetated cover to prevent windblown erosion and associated dust emissions.
  - Availability of a water bowser to spray work areas and haul road. The amount of water sprayed will be sufficient to suppress the dust and not be such as to allow any run-off into watercourses.
  - The earthworks foreman will inspect internal haul roads as part of his daily supervision of the site. If dust is causing a problem a water bowser will be engaged.
  - Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only. Furthermore, any road that has the potential to give rise to fugitive dust shall be regularly watered, as appropriate, during dry and/or windy conditions.
  - Public roads outside the site shall be regularly inspected for cleanliness and cleaned as necessary. Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind. Water misting, or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.
  - Vehicles exiting the site will use the wheel wash at the administration area to mitigate track out onto the public road.
  - All loads which could cause a dust nuisance will be covered to minimise the potential for fugitive emissions
- In the event of dust complaints, they will be recorded and actioned in accordance with the licence for the facility and the complaints procedure.
- A monitoring programme at the site will continue to measure dust and PM_{10} in accordance with the IE licence for the facility. The results of monitoring will inform the licensee of the effectiveness of dust control and mitigation.

7.5.1.2 Vehicle Emissions

Predicted vehicle emissions associated with the proposed development are within the relevant air quality guidelines and therefore will have a neutral impact on ambient air quality. No mitigation measures are therefore required.

7.5.2 Operational Phase

7.5.2.1 Dust Emissions

The risk of impact from dust during the operational phase is considered to be low whilst the risk to ecology is deemed to be negligible.

The facility is currently operating and carrying out construction activities (cell construction and landfill capping) in compliance with dust and PM_{10} limits in the licence. The following management mitigation measures will continue to be implemented at the site to prevent dust nuisance during the operation of the facility:

- The existing access road from the N2 to the administration area is surface sealed as are other internal roadways where required. The IBA facility haul roads will be surfaced to mitigate dust.
- Speed limits are in place on site to mitigate dust nuisance.
- The access roads and internal site roads will be sprayed during periods of dry weather in order to suppress dust migration from the site.
- All vehicles leaving the site are and will be required to pass through the wheel wash.
- A water bowser and road sweeper is used daily to control dust nuisance.
- IBA stockpiles will be weathered under cover in the IBA facility building.
- All IBA handled at the facility will be handled at an appropriate moisture content to prevent dust emissions.
- Waste including IBA will be hauled in covered trucks to prevent windblown dust.
- All waste disposed of in the landfill is covered daily.
- A monitoring programme at the site will continue to measure dust and PM_{10} in accordance with the IE licence for the facility
- A biofilter will remove dust emissions generated from the biological waste treatment building and therefore preventing any release of dust to the atmosphere.
- All waste handling at the biological waste treatment facility including handling of finished product will be carried out indoors under negative air pressure and the building will be fit with fast action roller shutter doors.

7.5.2.2 Landfill Gas Plant Emissions

Predicted emissions from the landfill gas plant onsite are within the relevant air quality guidelines and therefore will not have a significant impact on ambient air quality. However, ensuring the servicing of the flares, in particular flare number 2 will reduce the risk of impact from SO_2 at nearby receptors.

7.5.2.3 Vehicle Emissions

Predicted vehicle emissions associated with the proposed development are within the relevant air quality guidelines and therefore will not impact on ambient air quality. No mitigation measures are required.

7.5.2.4 Odour

The proposed operations at Knockharley will involve the following activities that have the potential to generate odour emissions:

- Reception of MSW fines for composting within a biological treatment building
- Landfilling of waste and fugitive emissions associated with landfill gas

The Odour Management Plan for the existing facility will be updated for the proposed development and submitted to the EPA for approval with the licence application.

However, in accordance with best practice a range of odour control measures, which are included in the mitigation measures identified below, will be incorporated into the design to mitigate such potential emissions.

There is a description of the proposed development in Chapter 2 of this EIAR. Odour mitigation measures have been incorporated into the preliminary design of the facility. These include:

- Modification of the filling schedule so stabilised and inert waste and non-biodegradable fractions of MSW will commence filling from cells 27/28 and move south. Waste with a potential to generate landfill gas will not be landfilled north of cells 21/22, to reduce exposure to receptors to the north thus mitigation by design.
- The proposed development will use hermetically sealed geo-multicovers for intermediate capping to mitigate the potential for fugitive emissions through the intermediate capping.
- All waste activities at the biological treatment facility will be carried out within a ventilated building which will be extracted to a biofilter odour control system. The building will operate under negative pressure with up to 3 air changes per hour. Ventilation pipe work installed in the headspace of the building will be connected to a high-volume medium-pressure blower that will draw off the warm, buoyant building air that will be generated by a combination of emissions from the input materials in the intake area and from fugitive emissions from the movement of the material between composting tunnels.
- The main entrances to the biological treatment facility building will be fitted with rapid response roller shutter doors. A closed-door management strategy will be enforced.
- Treated emissions from the odour control plant in the biological treatment facility building will be discharged via a 20 m stack to enhance dispersion.
- Vehicles exiting the biological treatment facility through the roller shutter door on the western flank will be subjected to cleaning procedures in accordance with the DAFM Conditions Document in a designated cleaning area located outside of this door.

The following key mitigation measures which are currently in place at the facility will continue:

- Scrutiny and screening of waste intake to prevent particularly odorous material being accepted at the landfill for disposal. Regular patrols of the site will be undertaken to identify any odour problems and any complaints received will be promptly investigated.
- The immediate compaction of the waste within a small controlled area will minimise the available area for odours to escape from the daily tipping area. Additionally, operating procedures at the facility will require immediate landfilling of waste once tipped or ejected from trailers.
- The primary odour control measure is the use of daily cover in accordance with the provisions of the licence. Daily cover comprises a minimum of 150 mm of soil-like material covered with a 100 mm deep layer of woodchip, the microbial population on the latter being a well-documented medium used to treat odorous compounds in bio-filters. Before being covered the waste is compacted.
- Leachate is removed regularly by a licensed waste contractor thus minimising the potential for odours which can form as a result of leachate stagnating and becoming anaerobic. The leachate lagoon is covered and exhaust fumes from the vacuum tankers are vented through carbon filters. Any additional leachate tanks and lagoons will be property enclosed and maintained at all times.
- A mobile fog spray system is present on site and is used as required.
- Long term odour control will be achieved via the active landfill gas extraction system, which collects landfill gas under negative pressure, reducing the potential for odours to be released in an uncontrolled manner. This is a requirement of the existing licence and any future licence. The design of the landfill gas extraction system is subject to EPA approval. The design of the system will mitigate uncontrolled landfill gas.

The existing gas extraction system comprises the following:

- horizontal sacrificial gas extraction pipework in the waste disposal cells (to facilitate extraction, under negative pressure, of landfill gas, as may be required in cells designated for the placement of non-stabilised waste)
- a network of vertical landfill gas extraction wells (constructed progressively with the development of the landfill, at 50 metre lateral and longitudinal centres. Additionally, vertical wells shall be drilled into the waste as required and determined by surveys of fugitive emissions, in order to minimise or eliminate landfill gas migration. The additional drilled wells shall be installed between the constructed main gas extraction wells, so as to reduce the distances between the individual wells and to increase the capture rate of landfill gas. Where appropriate, sacrificial vertical "pin" or "spike" wells will also be installed. It shall be ensured that the vertical gas wells are sealed at surface with bentonite as required in order to minimise the ingress of oxygen and the potential for migration of landfill gas.)
- pipework to convey landfill gas from the wells to the landfill gas utilisation plant
- landfill gas utilisation plant (Section7.4.2.2)
- All vertical and horizontal landfill gas extraction wells shall be connected to the gas collection pipe network which shall consist of a 355 mm ring main around the landfill footprint and 180 mm branches laid across the landfill surface. Each individual landfill gas well, as well as each individual branch shall, prior the point of connection into the next higher collection level (i.e. well-branch connections and branch-ring main connections) be equipped with shut-off valves, in order to enable flow restriction or isolation of individual wells or branches.
- In order to continuously remove condensate from the landfill gas extraction network and therefore avoid uncontrolled flow restriction and pulsating, the ring main shall be connected to the gas flaring and utilisation plant via condensate knockout pots. The condensate accumulating in these pots shall be removed by pneumatic/electric pumps and piped back into the leachate riser pipes, from where it can drain to the cell base and be removed with the leachate.
- Daily checks of the landfill gas field and combustion plant shall be undertaken to ensure optimum operation. Monitoring of internal and external landfill gas wells is carried out in accordance with the licence.
- The landfill gas collected in the landfill gas extraction and collection network shall, after passing through the condensate knockout pots, be flared off in an enclosed flare or utilised in landfill gas combustion engines with electricity generation, as appropriate. Contingency arrangements are currently in place in accordance with the licence to avoid gas venting in the case of plant failures.
- Operational procedure for the operation of landfill gas flares addresses the operational requirements to optimise the combustion rates and maintain compliance with emission limits and monitoring requirements. Any significant downtime of landfill gas flares or other utilisation equipment shall be logged by Bioverda Power Systems (landfill gas plant operator). Should significant downtime of landfill gas flares or other utilisation equipment occur and cause potential for environmental pollution, the Environmental Protection Agency shall be notified in accordance with procedure EMS-OP-23.

The landfill gas system is described in more detail in Chapter 2 of Volume 2 of the EIAR.

- The use of odour assessments and VOC surface emission surveys in accordance with the licence and the EPA guidance documents to determine any issues that may have a potential impact and implementation of mitigation measures.

7.5.2.5 Climate

The proposed development will positively impact the local and national climate. Benefit to the climate will be by reducing the emission of greenhouse gases via stabilisation of biodegradable waste prior to landfilling capture of methane and other trace gases in in landfill gas. The generation of renewable electricity predicted at 2MW from waste and the proposed solar farm (3 MW) will also off-set or avoid carbon dioxide emissions generated from energy generation at traditional fossil fuel plants.

Therefore, no mitigation measures are required.

7.6 Predicted Residual Impacts

Dust
Step 4 of the IAQM methodology for the assessment of dust emissions is the determination of residual impacts and whether or not they are significant.

In the absence of mitigation measures, there is a Low Risk of dust impact. Taking into account the current operational controls in place to manage dust, the licence requirements and the proposed mitigation measures, there will be no residual dust impact.

Traffic
The estimation of vehicle emissions from the construction and operation of the proposed development indicate the impact from traffic emissions will be imperceptible /negligible. Mitigation measures are not required and there are no residual impacts.

Landfill Gas Plant
Predicted emissions from the landfill gas plant onsite are within the relevant air quality guidelines and therefore will not have a significant impact on ambient air quality. Monitoring will be carried out in accordance with the licence and servicing in accordance with the manufacturers recommendations. There are no residual impacts.

Odour
The odour exposure levels that are predicted to occur around the site as a result of landfilling operations are predicted to be lower than the current baseline and the 'do nothing' situation for the first 4 years, if the proposed development goes ahead. The development is therefore predicted to have a beneficial effect on odour exposure and impact risk during this period. The number of houses exposed to odour levels that exceed the threshold where a potentially significant risk of odour impact could develop falls from 12 no. residential properties under baseline conditions and 10 no. in year 4 of 'do nothing', to 4 no. residential properties in year 4 of the proposed development.

A risk of impact will remain whilst the landfill is operating beyond year 4 which is predicted to be at its highest in the final year of the landfill (year 6). Under this scenario, 6 no. properties are predicted to be exposed to odour levels that exceed the threshold where a potentially significant risk of odour impact could develop, based on application of the precautionary indicative odour impact criteria applied in the study.

The odour emissions from the biological treatment facility are not predicted to pose any risk of impact at any area within or outside the facility.

Climate
Benefit to the climate will be by reducing the emission of greenhouse gases by diverting biodegradable waste from landfill for treatment and by the generation of energy in the landfill gas utilisation plant, export to the national grid and the subsequent savings of fossil fuels at a power plant.

7.6.1 Monitoring

Existing and Proposed Environmental Monitoring Locations are shown on Drawing No. LW14-821-01-P0050-004 and Drawing No. LW14-821-01-P0050-005 in Volume 4 of this EIAR.

Landfill gas monitoring will continue in compliance with the licence at perimeter monitoring wells and at in-waste wells. Landfill gas perimeter monitoring wells will be installed 12 months prior to waste acceptance at 50 m centres outside the landfill body. In-waste wells will be installed during and following landfilling.

Dust and PM_{10} monitoring will continue in compliance with the licence. There are no new proposed monitoring locations. Dust monitoring point DM2 will be moved east to the boundary line during the construction of the screening berm and it is proposed to return it to its existing location once the berm is constructed where it will sit on the berm clear of the tree line.

Stack emissions monitoring will continue in compliance with the licence.

All monitoring will be completed by suitably qualified personnel and samples will be analysed at an accredited laboratory. Monitoring equipment will be calibrated when required and records maintained.

All results will continue to be reported to the EPA in accordance with the Schedules of the licence.

Odour monitoring will continue to be carried out in compliance with AG5[33],

Monitoring of bioaerosols will be included in the new monitoring regime. New monitoring points relevant to the proposed development will be included in future monitoring. These proposed monitoring points are shown in Drawing No. LW14-821-01-P0050-008 in Volume 4 of this EIAR.

Ongoing monitoring will measure the effectiveness of the mitigation measures proposed in this development and if breaches of the EPA licence limit values or conditions are recorded, facility operations and mitigation measures will be reviewed, and corrective action procedures put in place.

A continuous monitoring system under SCADA control will monitor the operation of the air control system at the biological waste treatment facility. Any deviations in key design parameters will be detected and appropriate preventative maintenance will be undertaken to minimise air emissions.

7.7 Summary of Effects

This chapter examined the potential impacts of the proposed development on climate and air quality in the surrounding environment. Both the construction and operational impacts of the development were assessed. Potential impacts associated with the proposed development on climate and air quality are vehicle emissions, dust/particulate emissions, landfill gas utilisation emissions, biofilter emissions and odour emissions. Dust and vehicle emissions from the construction phases of the project were assessed and it was concluded that construction activities will not significantly affect the surrounding environment.

Operational emissions from the landfill gas utilisation plant and the biological treatment plant were assessed using the air dispersion model AERMOD, to predict the maximum ground level concentrations of pollutants from the proposed development. The results were compared against the relevant ambient air quality standards and guidelines. The results of the conservative modelling assessment indicate that predicted emissions are in compliance with the statutory limits set out in the EU Ambient Air Quality Directive (EU 2008/50/EC) and other relevant standards (2004/107/EC, the Air Quality Standards and Environment Agency guidance) at any nearby sensitive receptors. The predicted concentrations are also within the maximum allowable PC as defined by AG4 guidance even assuming a very conservative operational scenario that involved the combustion of 6,600 m^3/hr of landfill gas. In conclusion, the proposed air emissions from both landfill gas utilisation plant and the proposed biological waste treatment facility at Knockharley landfill, will not significantly impact on the ambient air quality of the area.

In addition, the proposed biological waste treatment facility is greater than 250 m from the nearest sensitive receptors. This is outside the recommended setback distance where there is a risk of impacts of bioaerosols.

Also, all activities associated with the composting process proposed will be carried out indoors under negative air pressure, meaning that the only emissions will be from the biofilter. This further reduces any risk of impacts associated with the facility.

Due to mitigation measures in place already, and additional mitigation measures as set out, dust emissions from vehicle movement onsite will not significantly affect the surrounding environment. Traffic pollutants of most concern were also examined using a basic air quality prediction screening model and predicted traffic emissions from existing and proposed traffic flows are within the relevant air quality guidelines and therefore will not impact significantly on ambient air quality.

From an odour emissions perspective, the total odour emissions generated from landfilling activities are predicted to decrease as a result of the proposed development in comparison to current baseline levels and the emissions that would occur if the proposal did not go ahead (2022). This is due to the enhancement in capping proposed as part of the development and the fact that the majority of additional waste which will be accepted by the landfill is stabilised, inert or non-biodegradable and hence has a low odour generation potential.

[33] Odour Impact Assessment Guidance for EPA Licensed Site AG5 EPA, 2010

Additional emissions will be generated from the biological waste facility, however, such emissions will be treated in an odour control system prior to release through a 20 m stack which will enhance dilution and dispersion.

The emissions from the biological treatment facility are not predicted to pose any risk of impact at any area within or outside the facility.

The odour exposure levels that are predicted to occur around the site as a result of landfilling operations are predicted to be lower than the current baseline and the 'do nothing' situation for the first 4 years, if the development goes ahead. The development is therefore predicted to have a beneficial effect on odour exposure and impact risk during this period. The number of houses exposed to odour levels that exceed the threshold where a potentially significant risk of odour impact could develop falls from twelve no. under baseline conditions and ten no. in year 4 of 'do nothing', to four no. in year 4 of the development. The odour exposure in year 4 of the development at these 4 no. properties is predicted to fall in the range of >1.5 ou_E/m^3 to <1.7 ou_E/m^3.

A risk of impact will remain whilst the landfill is operating beyond year 4 which is predicted to be at its highest in the final year of the landfill (year 6). Under this scenario, six no. properties are predicted to be exposed to odour levels that exceed the threshold where a potentially significant risk of odour impact could develop. The odour exposure in year 6 of the development at these 6 no. properties is predicted to fall in the range of >1.5 ou_E/m^3 to <2.1 ou_E/m^3. The emissions from the biological treatment facility are not predicted to pose any risk of impact at any area within or outside the facility.

The overall conclusion of the odour impact assessment is that the development will have a beneficial effect on odour exposure and impact risk in comparison to the do-nothing scenario in the next four years. A residual risk of impact will remain to up to 4 no. properties during this period and up to 6no. properties until the landfill is completed, based on application of the precautionary indicative odour impact criteria applied in the study.

From a climate perspective, the proposed development will positively impact the local and national climate. Benefit to the climate will be by reducing the emission of greenhouse gases by diverting biodegradable waste from landfill for treatment and by the generation of energy in the landfill gas utilisation plant and the subsequent savings of fossil fuels at a power plant.

7.8 References

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