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DESKTOP ODOUR IMPACT ASSESSMENT OF PROPOSED ODOUR CONTROL SYSTEM TO BE LOCATED IN KILLARNEY WASTE DISPOSAL LTD AUGHACUREEN, KILLARNEY, CO. KERRY.

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF KILLARNEY WASTE DISPOSAL LTD

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ATTENTION: Mr. Jim O Callaghan
PREPARED BY: Dr. Brian Sheridan
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This document is submitted as an assessment of information for the proposed installation of an OCU at the named operational facility located in Aughacureen, Killarney, Co. Kerry.

Respectively submitted,

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For and on behalf of Odour Monitoring Ireland™

Document Amendment Record

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Project: DESKTOP ODOUR IMPACT ASSESSMENT OF PROPOSED ODOUR CONTROL SYSTEM TO BE LOCATED IN KILLARNEY WASTE DISPOSAL LTD AUGHACUREEN, KILLARNEY, CO. KERRY.

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Executive summary

Odour Monitoring Ireland Ltd was commissioned by Killarney Waste Disposal Ltd to perform a desktop odour impact assessment of the proposed odour control system to be located in Killarney Waste Disposal Ltd processing facility located in Aughacureen, Killarney, Co. Kerry. Details and specifics describing the proposed odour control system operation were provided to Odour Monitoring Ireland Ltd in supporting documentation from the client.

The main aims of the study were to assess the likely odour impact in the vicinity of the operational facility following the installation of an odour control system based on the supplied facts and figures utilised to build the odour dispersion model.

It was concluded from the study that:

1. The proposed facility will install an odour control system capable of treating 58,800 m^3/hr of odour air to a level of less than 1,000 Ou_E/m^3 100% of the time.

2. The proposed operational facility will result in odour concentration level of less than 1.20 Ou_E/m^3 for the 98th percentile of hourly averages at all named receptors R1 to R16 – see *Table 3.1*. This is in compliance with the proposed limit of less than or equal to 3.0 Ou_E/m^3 for the 98th percentile of hourly averages for 5 yrs. of screened data.

1. Introduction and scope

1.1 Introduction

Odour Monitoring Ireland Ltd was commissioned by Killarney Waste Disposal Ltd to perform a desktop odour impact assessment of the proposed odour control system operations at the Killarney Waste Disposal Ltd processing facility located in Aughacureen, Killarney, Co. Kerry.

This document presents the materials and methods, results, discussion of results, conclusions gathered throughout this desktop study.

1.2 Scope of the work

The main aims of the study were as follows:

- Estimate the overall expected odour emission rate from the odour control system based on supplied information by the client.
- Use this odour emission data to perform an odour dispersion modelling assessment in accordance with procedures contained in EPA guidance document AG4.

2. Materials and methods

2.1 Odour emission rate calculations

The odour emission rate calculation was performed using data gathered from information supplied by the client. The odour threshold concentration limit value is based on a value which facilitates compliance with the proposed guideline limit value of less than 3.0 Ou_E/m^3 for the 98th percentile of hourly averages for a worst case meteorological year of screened data.

It is assumed in this assessment that the installed system will provide a sufficient extraction of air from the facility to prevent fugitive emissions for the building fabric which the facility is operated with closed doors.

Table 2.1 provides the basic calculations and assumptions utilised.

Table 2.1. Odour emission rate estimation for the proposed odour control system to be located in Killarney Waste Disposal, Aughacureen, Killarney, Co. Kerry.

Parameter	Value	Notes
X coordinate (m)	493554.3	-
Y coordinate (m)	593949.8	-
Stack base level (A.O.D) (m)	93.133	-
Stack height (m)	12	-
Stack tip diameter (m)	1.00	-
Stack tip area (m^2)	0.7855	-
Efflux velocity (m/s)	20.8	Based on stack tip diameter and full flow operation.
Temp (K)	293.15	Average expected temperature
Exhaust gas flow (Nm^3/hr , 293.15K, 101.3 KPa)	58,824	At full flow
Exhaust gas odour concentration (Ou_E/m^3)	1,000	Max expected odour concentration
Exhaust gas odour emission rate (Ou_E/s)	16,340	100% of the time
Building finish floor level (m)	93	-
Max building height (m)	12.331	Ridge of site buildings

2.2 Dispersion modelling

Any material discharged into the atmosphere is carried along by the wind and diluted by the turbulence, which is always present in the atmosphere. This dispersion process has the effect of producing a plume of polluted air that is roughly cone shaped with the apex towards the source and can be mathematically described by the Gaussian equation (Carney and Dodd, 1989). Atmospheric dispersion modelling has been applied to the assessment and control of odours for many years, originally using Gaussian form ISC (Industrial Source Complex) (Keddie et al., 1980) and more recently utilising advanced boundary-layer physics models such as ADMS (Atmospheric Dispersion Modelling Software) and AERMOD. Once the odour emission rate from the source is known, $Ou_E\ s^{-1}$, the impact on the vicinity can be estimated.

These models can be applied to facilities in three different ways:

1. To assess the dispersion of odours and to correlate with complaints;
2. To estimate which source is causing greatest impact;
3. In a “reverse” mode, to estimate the maximum odour emissions which can be permitted from a site in order to prevent odour complaints occurring (Zannetti, 1990; McIntyre et al., 2000; Sheridan, 2002).

In this latter mode, models can be employed to predetermine the amount of abatement required to prevent odour complaints, therefore reducing capital investment in abatement technologies (Sheridan et al., 2001).

2.3 Meteorological Data

Five years worth of hourly sequential meteorology data from Cork Airport 2011 to 2015 was used for the operation of Aermod Prime 16216r. This will allow for the determination of the worst-case scenario for the overall impact of odour emissions from the facility on the surrounding vicinity.

2.4 Terrain Data

Topography effects were accounted for within the dispersion modelling assessment using 10 m spaced OSI data. Individual sensitive receptors were also inputted into the model at their specific height in order to take account of any effects of elevation on GLC's at their specific locations. Topographical data was inputted into the model utilising the AERMAP algorithm. Each receptor was established at a normal breathing height of 1.80 m.

2.5 Dispersion models used

For this study BREEZE AERMOD Prime (16216r) was used.

2.5.1 AERMOD Prime

The AERMOD model was developed through a formal collaboration between the American Meteorological Society (AMS) and U.S. Environmental Protection Agency (U.S. EPA). AERMOD is a Gaussian plume model and replaced the ISC3 model in demonstrating compliance with the National Ambient Air Quality Standards (Porter et al., 2003) AERMIC (USEPA and AMS working group) is emphasizing development of a platform that includes air turbulence structure, scaling, and concepts; treatment of both surface and elevated sources; and simple and complex terrain. The modelling platform system has three main components: AERMOD, which is the air dispersion model; AERMET, a meteorological data pre-processor; and AERMAP, a terrain data pre-processor (Cora and Hung, 2003).

AERMOD is a Gaussian steady-state model which was developed with the main intention of superseding ISCST3 (NZME, 2002). The AERMOD modeling system is a significant departure from ISCST3 in that it is based on a theoretical understanding of the atmosphere rather than depend on empirical derived values. The dispersion environment is characterized by turbulence theory that defines convective (daytime) and stable (nocturnal) boundary layers instead of the stability categories in ISCST3. Dispersion coefficients derived from turbulence theories are not based on sampling data or a specific averaging period. AERMOD was especially designed to support the U.S. EPA's regulatory modeling programs (Porter at al., 2003)

Special features of AERMOD include its ability to treat the vertical in-homogeneity of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources, a three plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base (Curran et al., 2006). A treatment of dispersion in the presence of intermediate and complex terrain is used that improves on that currently in use in ISCST3 and other models, yet without the complexity of the Complex Terrain Dispersion Model-Plus (CTDMPLUS) (Diosey et al., 2002).

2.6 Model assumptions

The approach adopted in this assessment is considered a worst-case investigation in respect of emissions to the atmosphere from the facility. These predictions are most likely to overestimate the GLC's that may actually occur for each modelled scenario. The assumptions are summarised and include:

1. All emissions were assumed to occur at maximum potential emission concentration and mass emission rates for each scenario and were assumed to occur for 100% of an operating year, simultaneously.
2. Five years of hourly sequential meteorological data from Cork Airport 2011 to 2015 inclusive was used in the modelling screen which will provide statistical significant results in terms of the short and long term assessment. The worst case year 2015 was used for data analysis; this is in keeping with guidance presented in Environment Agency and Irish EPA publications. In addition, AERMOD incorporates a meteorological pre-processor AERMET PRO. The AERMET PRO meteorological pre-processor requires the input of surface characteristics, including surface roughness (z0), Bowen Ratio and Albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of Albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc.) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and Albedo and to a distance of 1km for surface roughness in line with USEPA recommendations.
3. AERMOD Prime (16216r) dispersion modelling was utilised throughout the assessment in order to provide the most conservative dispersion estimates;
4. All building wake affects were assessed within the dispersion model and taken into account within the assessment;
5. All receptors were established at normal breathing height of 1.8 m above ground level.

2.7 Odour impact criteria

An odour impact criterion of less than or equal 3.0 Ou_E m^{-3} at the 98th percentile for the worst case met year of 5 yrs of hourly sequential data was used for the odour impact assessment criterion in this instance. This is in keeping with recommendations contained in the EPA Guidance document AG4.

3. Results

This section will present the results obtained during the survey.

3.1 Emission point characteristics and Dispersion modelling results

Table 2.1 presents the overall source characteristics and odour emission rates used within the dispersion modelling assessment. This data is inputted into the dispersion model whereby maximum downwind ground level concentrations (GLC's) of odour are predicted for 5 years of screened hourly sequential meteorological data (Cork 2011 to 2015 inclusive). The 12.133 metre high recycling buildings throughout the site were incorporated into the dispersion model in order to take into account any building wake affects. Maximum ground level concentrations of odours are presented in tabular format in *Table 3.1*.

Table 3.1 illustrates predicted ground level concentration at the 98th percentile of hourly averages at each of the named sensitive receptors R1 to R16. As can be observed, the predicted ground level concentrations are well within the proposed limit values. In addition, *Appendix I* illustrate the odour contours generated by the dispersion model for the 98th percentile of hourly averages for the worst case year from 5 years of screened hourly sequential meteorological data.

Table 3.1. Predicted maximum ground level concentrations at each sensitive receptor (R1 to R16) using AERMOD Prime dispersion model 16216r.

Resident identity	X coordinate (m)	Y coordinate (m)	Predicted odour conc. @ 98%ile (Ou_E/m^3)
R1	493624.2	594153.6	0.43
R2	493646.8	594142.6	0.84
R3	493676.5	594137.1	1.07
R4	493693.5	594155.8	1.01
R5	493694.3	594129.4	1.07
R6	493735.1	594103.1	1.18
R7	493757.2	594089.5	1.12
R8	493788.7	594070.8	0.91
R9	493786.1	594025.8	0.99
R10	493849	594020.7	0.70
R11	493554.1	593843	0.50
R12	493597.4	593796.3	0.81
R13	493881.3	593779.3	0.64
R14	493906.8	593786.1	0.57
R15	493926.3	593809.9	0.43
R16	493954.4	593799.7	0.39
Max predicted value (Ou_E/m^3)	-	-	**1.18**
Odour limit value 98%ile (Ou_E/m^3)		-	**3.00**

In addition to *Table 3.1*, an odour contour plot is presented in *Appendix I – Figure 6.2* in order to allow visual interpretation of odour plume spread.

The odour plume spread for the 1.50 Ou_E/m^3 odour contour for the 98th percentile of hourly average for the worst case met year for 5 yrs of screened data is presented in *Figure 6.2.*

4. Discussion of results

The proposed operational facility will result in odour concentration level of less than 1.18 Ou_E/m^3 for the 98th percentile of hourly averages at all sensitive receptor locations – see *Table 3.1*. This is in compliance with the proposed limit of less than or equal to 3.0 Ou_E/m^3 for the 98th percentile of hourly averages of worst case met year for 5 yrs. of screened hourly data.

5. Conclusions

The following conclusions were drawn:

1. The proposed facility will install an odour control system capable of treating 58,800 m^3/hr of odour air to a level of less than 1,000 Ou_E/m^3 100% of the time.

2. The proposed operational facility will result in odour concentration level of less than 1.20 Ou_E/m^3 for the 98th percentile of hourly averages at all named receptors R1 to R16 – see *Table 3.1*. This is in compliance with the proposed limit of less than or equal to 3.0 Ou_E/m^3 for the 98th percentile of hourly averages for 5 yrs. of screened data.

6. *Appendix I* – Desktop Odour plume contour plots for the proposed OCU installation at Killarney Waste Disposal Ltd, Aughacureen, Killarney, Co. Kerry.

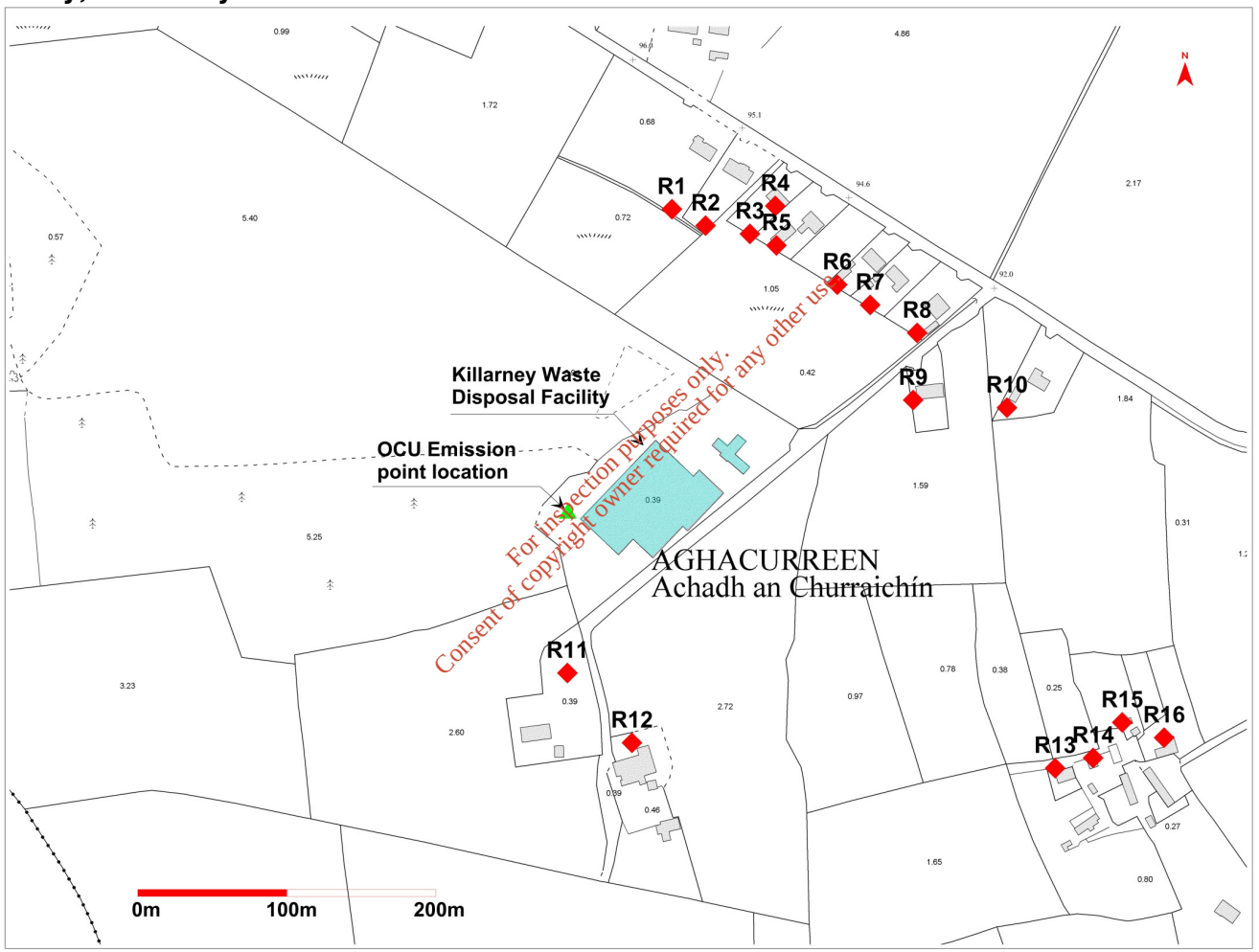

Figure 6.1. Schematic of Killarney Waste Disposal Ltd site location, facility buildings stack location (△) and receptors R1 to R16.

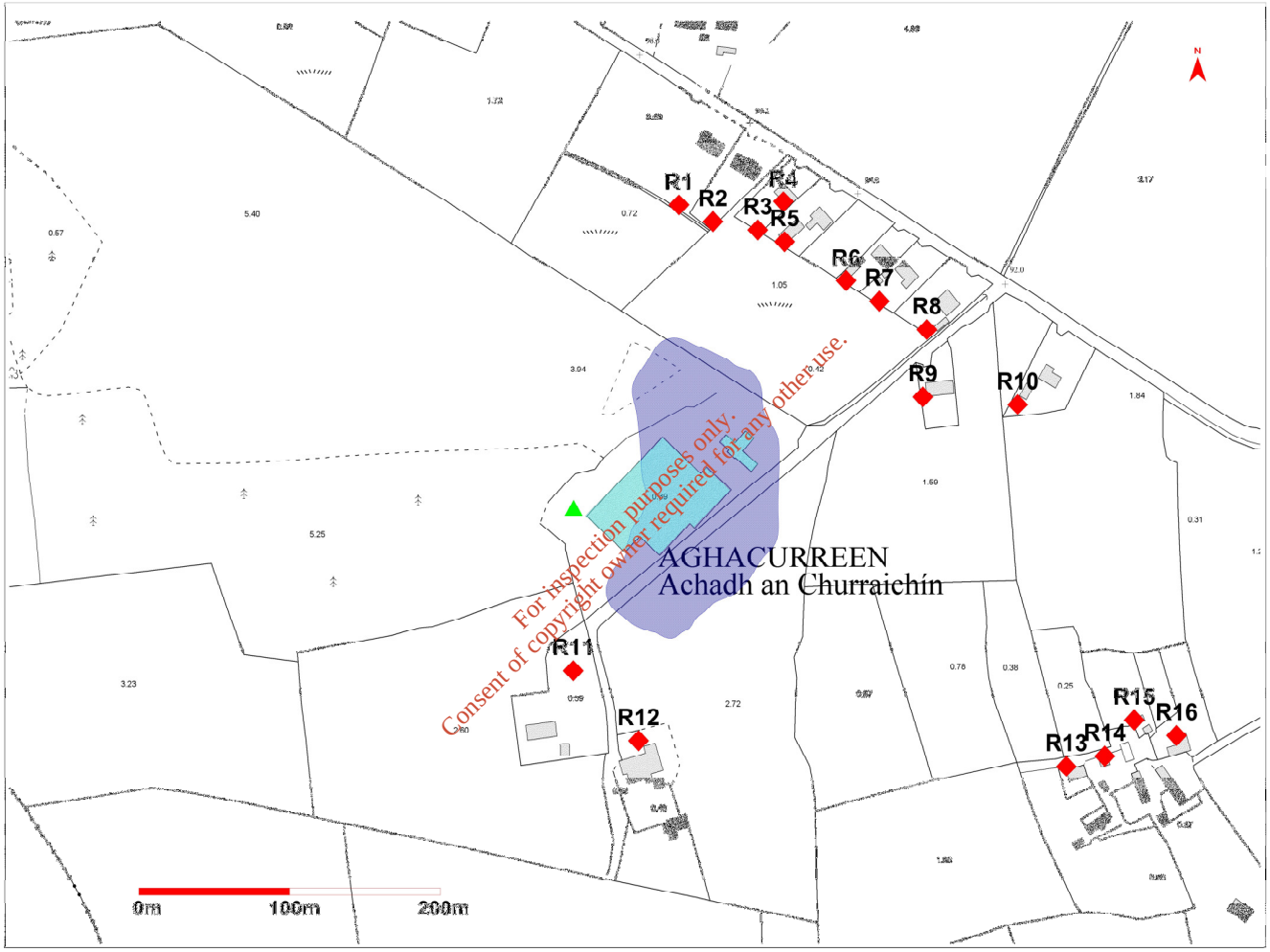

Figure 6.2. Predicted odour emission contribution of operational facility odour control unit for AERMOD Prime dispersion model for an odour concentration of less than or equal to 1.50 Ou_E/m^3 (⟶) for the 98th percentile of hourly averages of 5 years of screened hourly sequential meteorological data (Worst case year 2015).

7. *Appendix II* – Meteorological data.

Meteorological file Cork 2011 to 2015 inclusive

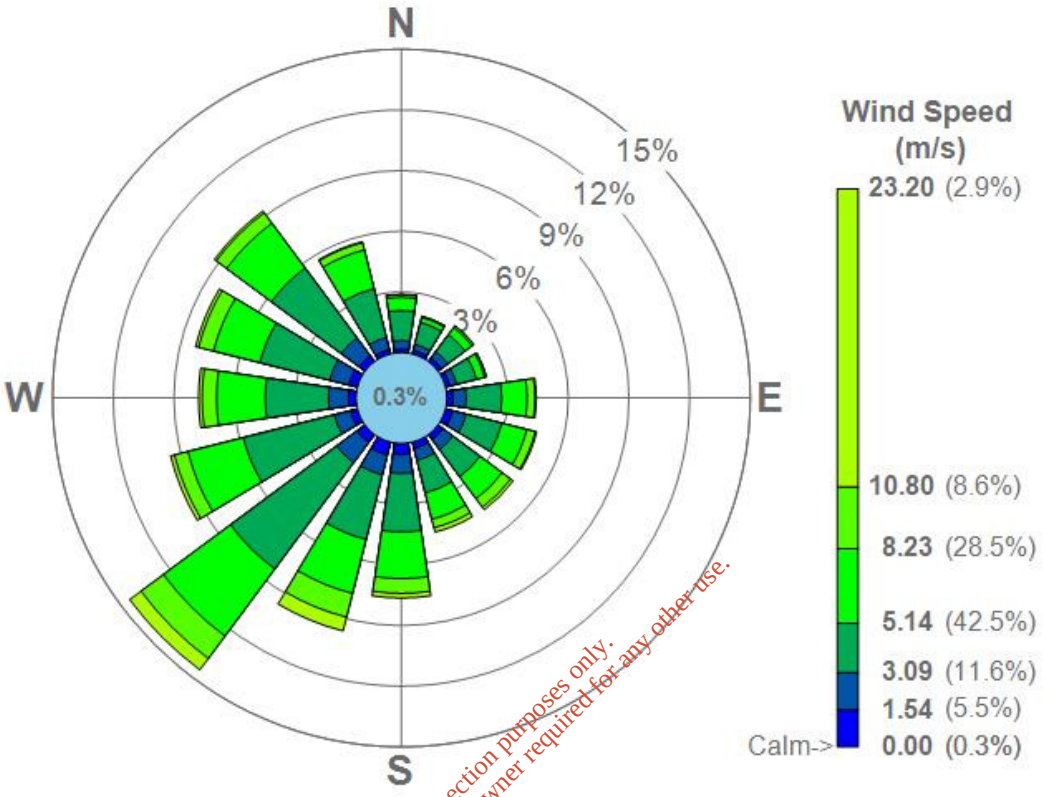

Figure 7.1. Schematic illustrating windrose for meteorological data used for atmospheric dispersion modelling, Cork Airport 2011 to 2015 inclusive.

Table 7.1. Cumulative wind speed and direction for meteorological data used for atmospheric dispersion modelling Cork 2011 to 2015 inclusive.

Cumulative Wind Speed Categories							
Relative Direction	**> 1.54**	**>3.09**	**>5.14**	**>8.23**	**> 10.80**	**< 10.80**	**Total**
0	0.18	0.42	1.49	0.66	0.12	0.03	2.89
22.5	0.18	0.31	1.12	0.26	0.05	0.02	1.93
45	0.22	0.38	1.06	0.43	0.10	0.01	2.20
67.5	0.21	0.35	1.01	0.42	0.09	0.01	2.09
90	0.29	0.66	1.76	1.25	0.40	0.06	4.42
112.5	0.37	0.68	1.82	1.28	0.43	0.07	4.65
135	0.31	0.60	1.68	1.36	0.52	0.16	4.63
157.5	0.33	0.59	1.67	1.34	0.44	0.22	4.58
180	0.54	0.94	2.89	2.31	0.73	0.23	7.64
202.5	0.65	1.01	3.29	2.75	1.21	0.70	9.62
225	0.49	1.24	6.54	4.13	1.38	0.70	14.49
247.5	0.36	0.82	4.64	2.83	0.69	0.19	9.52
270	0.38	0.98	3.13	2.41	0.72	0.18	7.79
292.5	0.44	0.97	3.56	2.36	0.76	0.16	8.25
315	0.35	1.10	4.31	2.76	0.64	0.11	9.27
337.5	0.23	0.61	2.50	1.97	0.37	0.05	5.72
Total	**5.52**	**11.65**	**42.46**	**28.50**	**8.64**	**2.89**	**99.66**
Calms	**--**	**-**	**-**	**-**	**-**	**-**	**0.32**
Missing	**-**	**-**	**-**	**-**	**-**	**-**	**0.02**
Total	**-**	**-**	**-**	**-**	**-**	**-**	**100.00**

8. *Appendix III* - Checklist for EPA requirements for air dispersion modelling reporting

Table 8.1. EPA checklist as taken from their air dispersion modelling requirements report.

Item	Yes/No	Reason for omission/Notes
Location map	Section 6	-
Site plan	Section 6	-
List of pollutants modelled and relevant air quality guidelines	Yes	-
Details of modelled scenarios	Yes	-
Model description and justification	Yes	-
Special model treatments used	Yes	-
Table of emission parameters used	Yes	-
Details of modelled domain and receptors	Yes	-
Details of meteorological data used (including origin) and justification	Yes	-
Details of terrain treatment	Yes	-
Details of building treatment	Yes	-
Details of modelled wet/dry deposition	N/A	-
Sensitivity analysis	Yes	Five years of hourly sequential data screened from nearest only valid met station-Cork 2011 to 2015 screened. Worst case year Cork 2015.
Assessment of impacts	Yes	Pollutant emissions assessment from process identified.
Model input files	No	Licensed product.