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Environmental Licensing Programme
Office of Environmental Sustainability

7th December 2023

Regulation 10(2)(b)(ii) of the EPA (Industrial Emissions) (Licensing) Regulations 2013, in respect of a licence review from Starrus Eco Holdings Limited for an installation located at Starrus Eco Holdings Limited (Munster), Sarsfieldcourt Industrial Estate, Sarsfieldcourt, Glanmire, Cork, T45 R585

Dear Sir/Madam,

I refer the Agency's letter dated 25th July 2023 in accordance with Regulation 10(2)(b)(ii) of the EPA (Industrial Emissions) (Licensing) Regulations 2013 and the outstanding Odour Dispersion Model is in Attachment A.

The information provided in the response does not impinge on the non-technical summary.

Yours Sincerely

Jim O' Callaghan

ATTACHMENT A

ODOUR MONITORING IRELAND LTD

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DESKTOP ODOUR IMPACT ASSESSMENT OF EXISTING ODOUR CONTROL SYSTEM INSTALLED IN STARRUS ECO HOLDINGS LTD, SARSFIELD COURT, GLANMIRE, CO. CORK

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF STARRUS ECO HOLDING LTD

REFERENCE NUMBER:	20231703(1)
ATTENTION:	Mr. David Tobin
PREPARED BY:	Dr. Brian Sheridan
DATE:	30th Nov 2023
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This document is submitted in response to request for additional information from the Environmental Protection Agency.

Respectively submitted,

Brian Sheridan B.Sc. M.Sc. (Agr) Ph.D (Eng).

For and on behalf of Odour Monitoring Ireland™ LTD

Document Amendment Record

Client: ***Starrus Eco Holdings Ltd***

Project: DESKTOP ODOUR IMPACT ASSESSMENT OF EXISTING ODOUR CONTROL SYSTEM INSTALLED IN STARRUS ECO HOLDINGS LTD, SARSFIELD COURT, GLANMIRE, CO. CORK

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Project Number: 20231703(1)			**Document Reference:** DESKTOP ODOUR IMPACT ASSESSMENT OF EXISTING ODOUR CONTROL SYSTEM INSTALLED IN STARRUS ECO HOLDINGS LTD, SARSFIELD COURT, GLANMIRE, CO. CORK.		
20231703(1)	Document for review	JWC	BAS	JWC	30/11/2023
Revision	**Purpose/Description**	**Originated**	**Checked**	**Authorised**	**Date**
ODOUR monitoring IRELAND					

Executive summary

Odour Monitoring Ireland Ltd was commissioned by Starrus Eco Holdings Ltd to perform a desktop odour impact assessment of the existing odour control system installed on the waste processing facility located in Starrus Eco Holdings Ltd, Sarsfield court, Glanmire, Co. Cork. The odour control system consists of a dust filtration and carbon filtration plant for the removal of dust and odours from the extracted air from the odourous part of the facility.

The main aims of the study were to assess if the existing odour control system operation parameters would comply with Irish EPA odour impact compliance limits of less than or equal to 1.50 Ou_E/m^3 for the 98^{th} percentile of hourly averages for the worst-case meteorological years over 5 years of met data at the nearest sensitive receptor.

This document will provide information on the following:

- The odour treatment levels including the odour emission concentration from the odour control system.
- Odour dispersion modelling of emissions from the stack and projected ground level concentrations as a result of operating the odour control system.

It was concluded from the study that:

1. Dispersion modelling study was carried out in accordance with EPA Guidance AG4, 2020.
2. The odour control system will treat a maximum of 90,000 Nm^3 [odourous air]/hr (293.15K, 101.3Kpa, wet gas).
3. The odour control system will achieve a maximum exhaust odour threshold concentration less than 600 Ou_E/m^3.
4. The combined odour emission rate limit for the odour control system will be no greater than 15,000 Ou_E/s. This should be defined as the Emission Limit Value for the operating site given the fact that extraction volume flow rates can be lower on occasions.
5. The system will be expected to achieve an odour removal efficiency of between 70% to 95% depending on the inlet load to the carbon filters.
6. With regards to the dispersion modelling study outcome, the predicted maximum 98^{th} percentile ground level concentration of odour at the worst-case receptor location is in compliance with the stated odour impact criterion. The predicted value will be less than or equal to 1.45 Ou_E/m^3 for the 98^{th} percentile of hourly averages for the worst-case meteorological year Cork Airport 2019.

1. Introduction and scope

1.1 Introduction

Odour Monitoring Ireland Ltd was commissioned by Starrus Eco Holdings Ltd to perform a desktop odour impact assessment of the existing odour control system located in Starrus Eco Holdings Ltd, Sarsfield court, Glanmire, Co. Cork.

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

The results conclude that the operation of the odour control system will not cause odour impact at identified sensitive receptors at or beyond the facility boundary with all predicted ground level concentrations of odour less than 1.50 Ou_E/m^3 at the 98^{th} percentile of hourly averages for 5 years of screened data.

1.2 Scope of the work

The main aims of the study were as follows:

- Provide data on the odour treatment volume and odour concentration including the guaranteed odour emission rates from the odour control system. These odour emission rates can be used as an Emission Limit Value (ELV).

- To perform an odour dispersion modelling assessment in accordance with AG4 EPA Guidance to illustrate that the odour treatment system will not result in an odour impact at identified sensitive receptors beyond the boundary of the facility.

2. Materials and methods

2.1 Odour emission rate calculation

Table 3.1 includes the odour emission rate calculation for the odour control system. The odour emission rate calculation is based on data gathered from information supplied by the client and test reports.

The total maximum volume of air to be treated in the existing odour control system is 90,000 Nm^3/hr, 293.15K, 101.3 Kpa, wet gas.

The guaranteed maximum exhaust odour threshold concentration to be achieved on the odour control system exhaust is less than or equal to 600 Ou_E/m^3.

The guaranteed maximum total odour emission rate as a result of operating the odour control system will be <15,000 Ou_E/s (Guaranteed Volume flow rate multiplied by the guaranteed odour threshold concentration).

Given that the volume flow rate can change, it is recommended that the ELV established for the Odour control system is based on the Mass odour emission rate in Ou_E/s.

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 representative of the area was used for the operation of Aermod Prime 22112. This will allow for the determination of the worst-case scenario for the overall impact of odour emissions from the odour control unit on the surrounding sensitive receptors beyond the boundary of the facility. Odour Monitoring Ireland currently has licensed met data for the existing site. Cork Airport 2018 to 2022 inclusive was used in the dispersion model.

2.4 Terrain Data

There are no topographical features in the vicinity of the facility with the surrounding terrain relatively flat and less than half the actual stack height. Based on this, simple terrain prevails and therefore no topographical data was included in the model. Building wakes affects were accounted for within the dispersion modelling assessment through the use of the Prime algorithm.

2.5 Dispersion models used

For this study BREEZE AERMOD Prime (22112) 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 existing scheduled emission point located within the operational plant. These predictions are therefore 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 inclusive was used in the modelling screen which will provide statistically significant results in terms of the short- and long-term assessment. The worst-case year was determined as Cork Airport 2019. All five years of predictions are presented for clarity. 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 (22112) 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 1.50 Ou_E/m^3 at the 98^{th} percentile was used for the odour impact assessment criterion in this instance.

2.8 Description of waste handling processes within facility

2.8.1 Waste Types & Quantities

SEHL and SPHL accept wastes on a commercial basis (Merchant Facility). The waste types include mixed residual municipal household (black bin), segregated food waste (brown bin), mixed commercial and industrial (C&I), construction and demolition (C&D), industrial non-hazardous waste and source segregated and mixed dry recyclables. A small amount (10 tonnes/year) of household hazardous waste is authorised for acceptance at the civic amenity area. Animal By-Products are not accepted. The maximum annual waste intake will be 200,000 tonnes and quantities of each waste type accepted in any given year will vary, based on market conditions.

2.8.2 Waste Acceptance Procedures

With the exception of materials dropped off at the civic amenity area by members of the public, wastes are delivered by waste collectors that have up to date Waste Collection Permits or are deemed exempt. The bulk deliveries are subject to a documented waste acceptance procedure. They arrive in fully enclosed vehicles that are weighed in at the weighbridge road and the accompanying documentation is checked. The driver is then directed to the waste intake areas in the appropriate building.

2.8.3 Waste Processes

All wastes are off-loaded and processed inside the buildings. Wastes with the potential to generate odours, for example mixed residual wastes are only handled in the main processing building which is provided with an odour control unit.

The mixed residual wastes are processed to remove organic fines, metal and wood, which are sent of site for further treatment. The remaining non-recyclable material is suitable for the manufacture of refuse derived fuel (RDF) and are baled, wrapped and stored in the open paved yards before being shipped overseas to energy recovery facilities.

The mixed commercial, industrial and construction & demolition waste are off loaded inside the main processing building where recyclables are segregated and sent off-site for further treatment, with the remaining non-recyclable materials, depending on the nature either baled as RDF or sent to licensed landfills.

The source separated dry recyclables arrive either already baled or loose. The bales are off-loaded and stored in the yard. The loose materials are off loaded inside the recycling building and then baled. The mixed dry recyclables are processed to remove non-suitable materials and separate then baled and stored.

Figure 2.1 provides an illustration of the process flow for the waste handling facility.

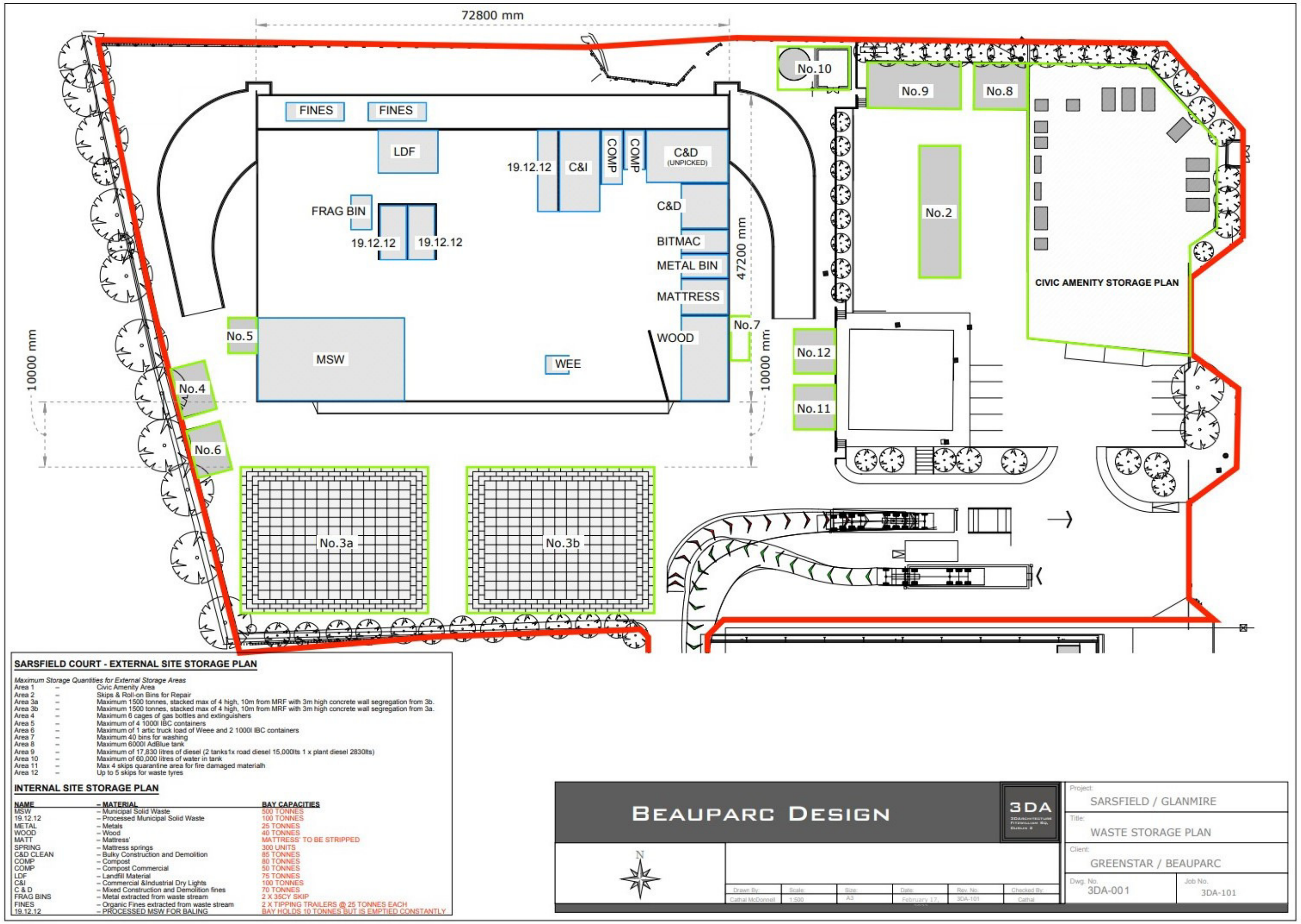

Figure 2.1. Schematic illustration of process flow within Starrus Eco Holdings Ltd facility.

3. Results

This section will present the results obtained during the survey.

3.1 Emission point source characteristics

Table 3.1 presents the overall exhaust stream and source characteristics 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 2018 to 2022 inclusive). The 12.4-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 3.2* for all modelled years and all nearby sensitive receptors.

Table 3.1. Overall exhaust stream characteristics of odour control system located in Starrus Eco Holdings Ltd and input data for dispersion model.

Parameter	A2-1 - Carbon filter 1	A2-2 - Carbon filter 2
X coordinate (m)	572098	572102
Y coordinate (m)	579090	579084
Stack tip diameter (m)	0.95	0.95
Stack tip area (m^2)	0.71	0.71
Temp (K)	293.15	293.15
Efflux velocity (m/s)	17.63	17.63
Stack height (m)	14	14
Worst case building height (m)	12.40	12.40
Volume flow rate (m3/hr)	**45,000**	**45,000**
Worst case Exhaust odour conc. (Ou_E/m^3)	**600**	**600**
Reference conditions	Nm^3/hr, 293.15K, 101.3KPa, wet gas	Nm^3/hr, 293.15K, 101.3KPa, wet gas
Odour emission rate (Ou_E/s)	**7,500**	**7,500**
Combined Odour emission rate (Ou_E/s)	**15,000**	
Receptor height (m)	2	2
Worst case building height (m)	12.4	12.4

Given that there are no other licenced emissions points within the impact area, no cumulative assessment is required in line with Figure A2 – Page 63 EPA Guidance AG4.

4. Results and Discussion

This section will describe the results obtained from the study.

4.1 Operational parameters results

- The odour control system will treat a maximum of 90,000 Nm^3 [odourous air]/hr (293.15K, 101.3Kpa, wet gas).
- The odour control system will achieve an maximum exhaust odour threshold concentration less than 600 Ou_E/m^3.
- The odour emission rate limit for the odour control system will be no greater than 15,000 Ou_E/s.
- The system will be expected to achieve an odour removal efficiency of between 70% to 95%.

4.2 Dispersion modelling results

Table 4.1 illustrates the predicted ground level concentrations for the 98^{th} percentile of hourly averages for all five screen meteorological years Cork Airport 2018 to 2022 inclusive. These predictions are made at each of the nearest sensitive receptors in the vicinity of the operational facility.

As can be observed, the predicted ground level concentrations are well within the proposed limit value of less than or equal to 1.50 Ou_E/m^3 for the 98^{th} percentile of hourly averages for worst case screen meteorological station.

In addition, *Appendix I – Figures 6.2* illustrate the odour contours generated by the dispersion model for the 98^{th} percentile of hourly averages for each of the 5 years of screened hourly sequential meteorological data.

Table 4.1. Predicted 98th percentile ground level odour concentrations at each nearby sensitive receptor in the vicinity of the facility for meteorological years Cork Airport 2018 to 2022.

Receptor ID	X coordinate (m)	Y coordinate (m)	Yr. 2018 - Predicted 98%ile odour conc. (Ou_E/m^3)	Yr. 2019 - Predicted 98%ile odour conc. (Ou_E/m^3)	Yr. 2020 - Predicted 98%ile odour conc. (Ou_E/m^3)	Yr. 2021 - Predicted 98%ile odour conc. (Ou_E/m^3)	Yr. 2022 - Predicted 98%ile odour conc. (Ou_E/m^3)
R1	572389.3	579474.5	0.35	0.35	0.30	0.33	0.32
R2	572364.3	579453.5	0.39	0.39	0.33	0.37	0.36
R3	572267.3	579443.6	0.51	0.45	0.41	0.44	0.43
R4	571940.4	579399.6	0.40	0.42	0.36	0.45	0.42
R5	571884.4	579382.6	0.40	0.42	0.31	0.38	0.36
R6	571890.4	579354.6	0.43	0.48	0.35	0.43	0.39
R7	571897.4	579330.6	0.46	0.54	0.38	0.47	0.42
R8	572190.4	579314.6	0.69	0.59	0.55	0.61	0.56
R9	571852.4	579298.6	0.35	0.41	0.31	0.34	0.34
R10	572193.3	579285.6	0.77	0.71	0.66	0.70	0.67
R11	571866.4	579269.6	0.40	0.45	0.37	0.38	0.40
R12	572203.3	579261.6	0.80	0.78	0.71	0.75	0.74
R13	571813.4	579260.6	0.40	0.46	0.39	0.34	0.45
R14	572125.4	579246.6	0.83	0.73	0.72	0.82	0.71
R15	571869.4	579241.6	0.50	0.56	0.45	0.43	0.51
R16	571869.4	579213.6	0.55	0.63	0.58	0.51	0.62
R17	571851.4	579203.6	0.52	0.57	0.52	0.47	0.56
R18	571876.4	579190.6	0.59	0.65	0.59	0.54	0.63
R19	572073.4	579188.6	0.99	0.98	0.92	1.02	1.04
R20	571900.4	579169.6	0.70	0.75	0.70	0.66	0.71
R21	571838.4	579168.6	0.51	0.54	0.55	0.52	0.54
R22	572010.4	579166.6	1.09	1.16	1.00	1.10	1.08
R23	571789.4	579156.6	0.45	0.49	0.55	0.48	0.49
R24	571727.4	579149.6	0.36	0.42	0.44	0.42	0.38
R25	572025.4	579147.6	**1.40**	**1.45**	**1.35**	**1.37**	**1.42**
R26	572093.4	579139.6	1.22	1.20	1.21	1.23	1.26
R27	571962.4	579137.6	1.07	1.08	1.07	1.05	1.06
R28	571976.4	579121.6	1.20	1.23	1.26	1.21	1.23
R29	572243.3	579080.6	0.60	0.65	0.61	0.65	0.63
R30	572264.3	579035.6	0.65	0.71	0.68	0.68	0.64
R31	572147.4	578976.7	1.12	1.12	1.08	1.13	1.14
R32	572299.3	578964.7	0.64	0.78	0.71	0.74	0.78
R33	572140.4	578923.7	0.86	0.81	0.82	0.84	0.82
R34	571860.4	578768.7	0.15	0.04	0.16	0.10	0.14
R35	571852.4	578700.7	0.15	0.03	0.15	0.06	0.11
R36	572334.3	578635.7	0.32	0.31	0.29	0.32	0.35
Max worst case predicted 98%ile odour conc. (Ou_E/m^3)	-	-	**1.40**	**1.45**	**1.35**	**1.37**	**1.42**
Limit value (98%ile Ou_E/m^3)	-	-	**<1.5**	**<1.5**	**<1.5**	**<1.5**	**<1.5**

With regards to the dispersion modelling study outcome, the predicted maximum 98th percentile ground level concentration of odour at the worst-case receptor location is in compliance with the stated odour impact criterion. The maximum predicted value was less than or equal to 1.45 Ou_E/m^3 for the 98th percentile of hourly averages for the worst-case meteorological year Cork Airport 2019.

5. Conclusions

The following conclusions were gathered from the study and include:

1. Dispersion modelling study was carried out in accordance with EPA Guidance AG4, 2020.

2. The odour control system will treat a maximum of 90,000 Nm^3 [odourous air]/hr (293.15K, 101.3Kpa, wet gas).

3. The odour control system will achieve a maximum exhaust odour threshold concentration less than 600 Ou_E/m^3.

4. The combined odour emission rate limit for the odour control system will be no greater than 15,000 Ou_E/s. This should be defined as the Emission Limit Value for the operating site given the fact that extraction volume flow rates can be lower on occasions.

5. The system will be expected to achieve an odour removal efficiency of between 70% to 95% depending on the inlet load to the carbon filters.

6. With regards to the dispersion modelling study outcome, the predicted maximum 98^{th} percentile ground level concentration of odour at the worst-case receptor location is in compliance with the stated odour impact criterion. The predicted value will be less than or equal to 1.45 Ou_E/m^3 for the 98^{th} percentile of hourly averages for the worst-case meteorological year Cork Airport 2019.

6. *Appendix I* – Desktop Odour Contour plots for modelling scenarios

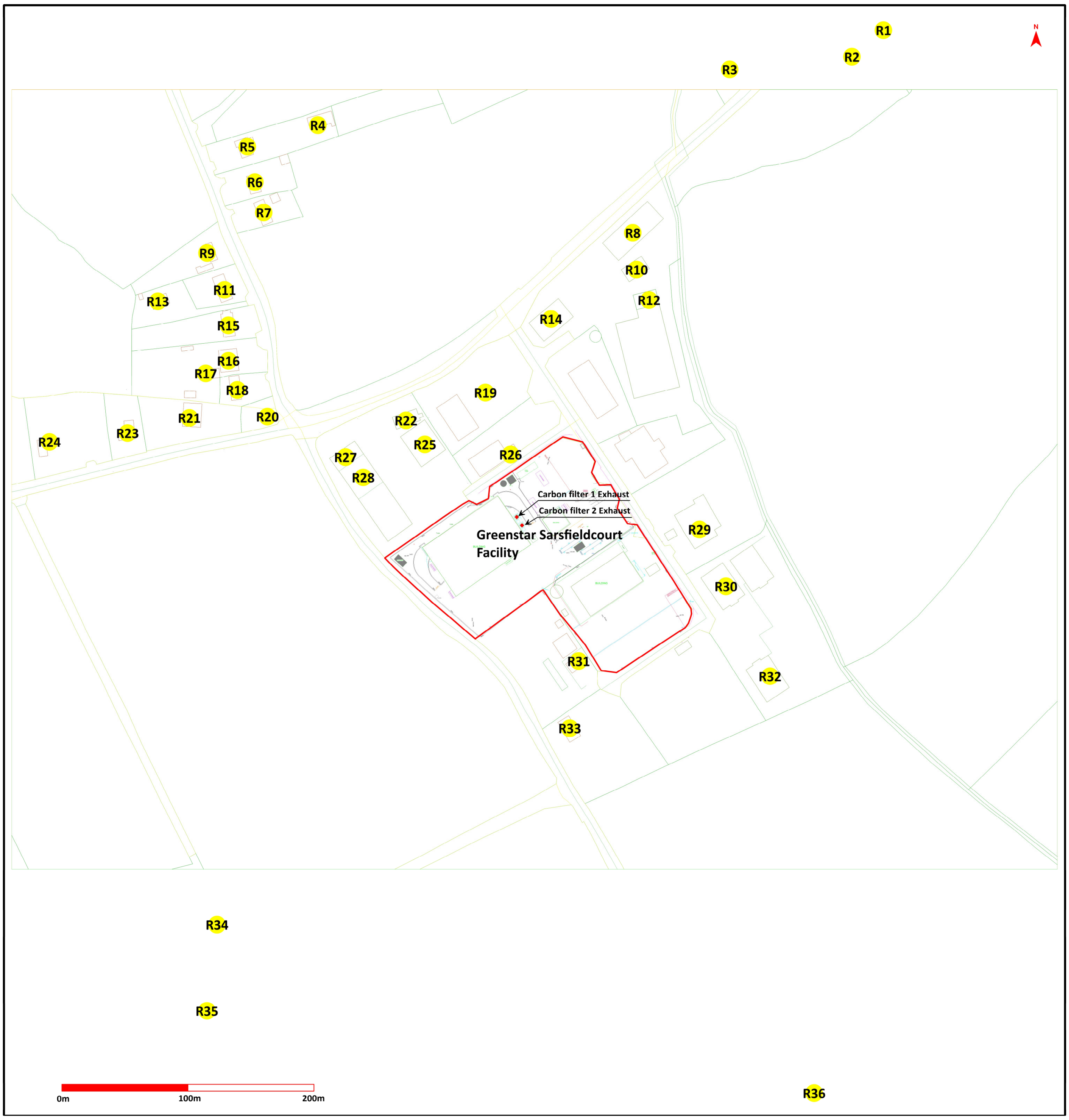

Figure 6.1. Schematic of Starrus Eco Holdings site and sensitive receptor locations and odour control stack location (•).

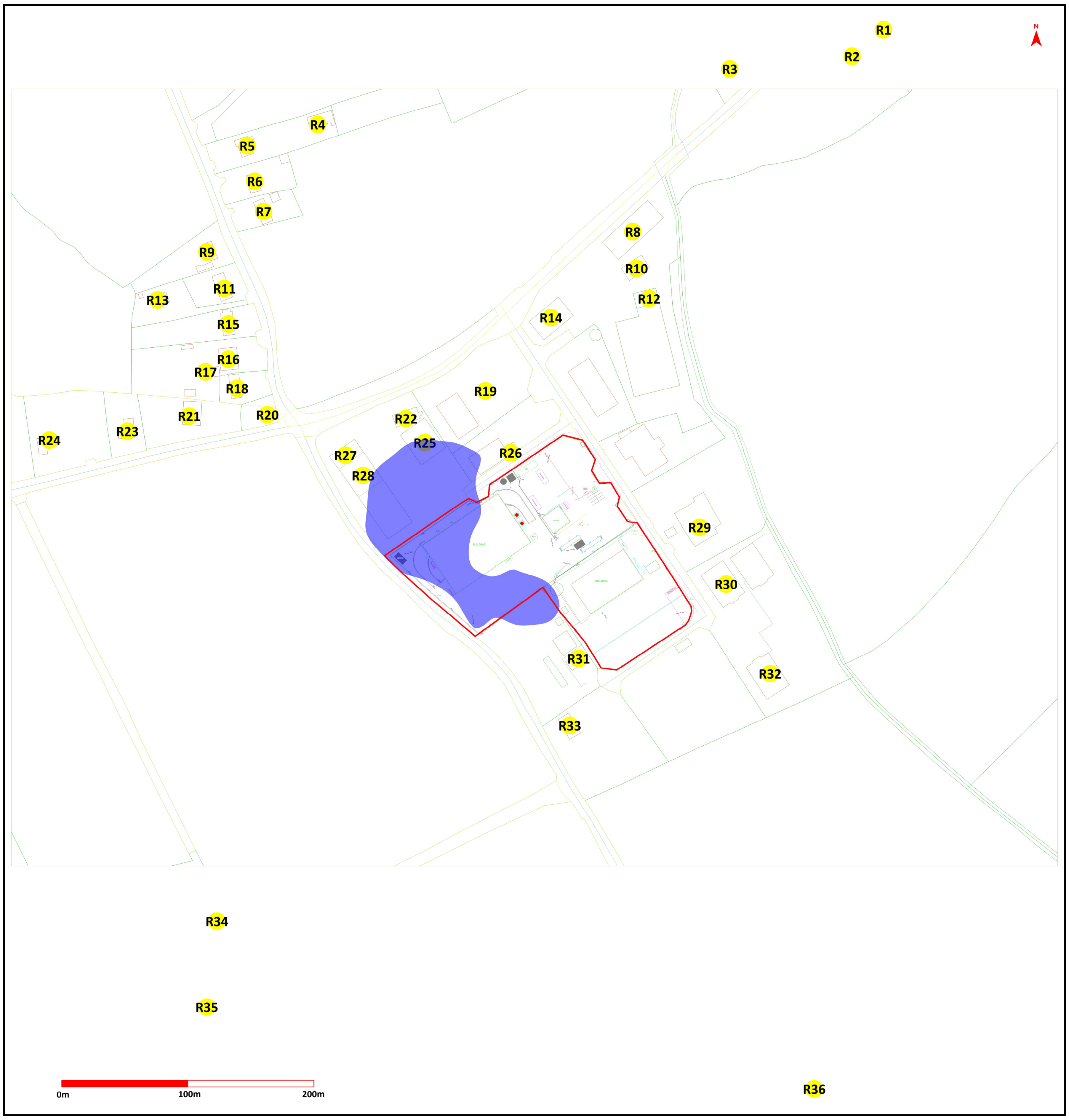

Figure 6.2. Predicted ground level odour contribution of odour control unit operation located in Starrus Eco Holdings Glanmire for an odour concentration of less than or equal to 1.30 Ou_E/m^3 (▬▬) for the 98th percentile of hourly averages for screened hourly sequential meteorological year Cork Airport 2019.

7. *Appendix II* – Gridded receptor network

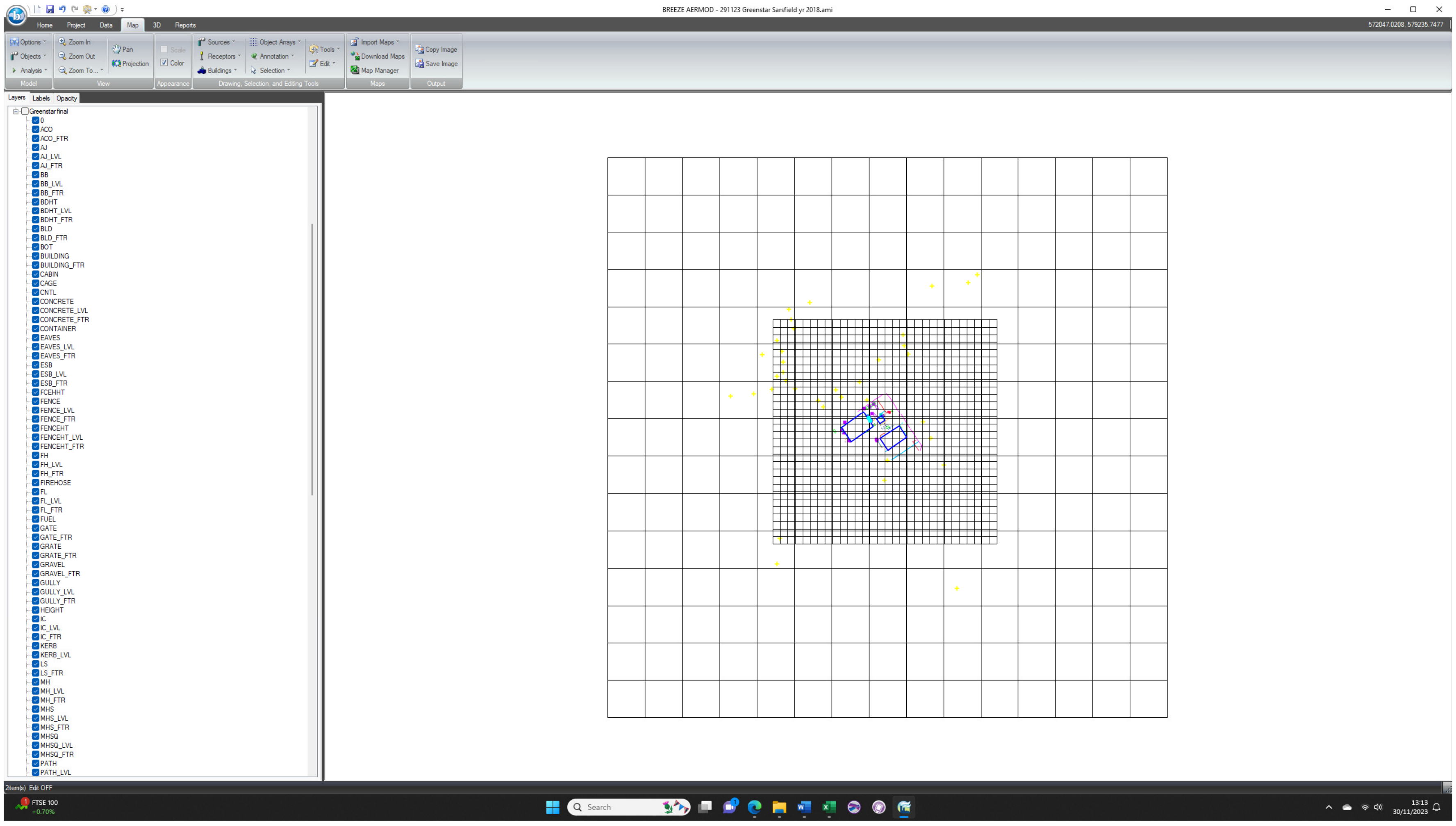

Figure 7.1. Schematic of gridded receptor network.

These computations give the odour concentration at each Cartesian grid receptor location that is predicted to be exceeded for 2% (175 hours of exceedance) over 5 years of screened hourly sequential meteorological data (Cork 2018 to 2022 inclusive). The Cartesian receptor grid was 20 m and 100 m spaced given a total receptor number of 1,255 over an area of 2.25 km².

8. *Appendix III* - Meteorological data examined and used in the dispersion modelling exercise

Table 8.1. Tabular illustration of Cork meteorological files for Years 2018 to 2022 inclusive (5 years).

5-year Meteorological file for Cork 2018 to 2022 inclusive							
Dir \ Speed	**<= 1.54 m/s**	**<= 3.09 m/s**	**<= 5.14 m/s**	**<= 8.23 m/s**	**<= 10.80 m/s**	**> 10.80 m/s**	**Total**
0.0	0.23	0.23	0.97	0.69	0.10	0.02	2.24
22.5	0.26	0.35	0.92	0.81	0.09	0.00	2.43
45.0	0.27	0.42	0.86	0.79	0.14	0.00	2.48
67.5	0.31	0.44	1.13	0.64	0.17	0.03	2.72
90.0	0.37	0.58	1.68	1.12	0.37	0.07	4.18
112.5	0.45	0.72	1.78	1.05	0.25	0.10	4.35
135.0	0.46	0.69	1.55	1.34	0.55	0.31	4.89
157.5	0.63	0.88	2.22	1.62	0.64	0.32	6.31
180.0	0.80	1.00	2.71	2.12	0.76	0.19	7.58
202.5	0.84	1.38	3.85	3.09	1.42	0.44	11.02
225.0	0.62	1.39	6.04	4.02	0.99	0.40	13.46
247.5	0.42	1.04	3.43	2.28	0.75	0.18	8.09
270.0	0.50	1.02	2.23	1.80	0.52	0.20	6.27
292.5	0.68	1.35	3.13	2.01	0.53	0.18	7.88
315.0	0.48	1.36	4.67	2.50	0.50	0.17	9.68
337.5	0.34	0.75	3.06	1.88	0.30	0.04	6.38
Total	**7.66**	**13.59**	**40.23**	**27.76**	**8.08**	**2.63**	**99.95**
Calms	**-**	**-**	**-**	**-**	**-**	**-**	**0.05**
Missing	**-**	**-**	**-**	**-**	**-**	**-**	**0.00**
Total	**-**	**-**	**-**	**-**	**-**	**-**	**100.00**

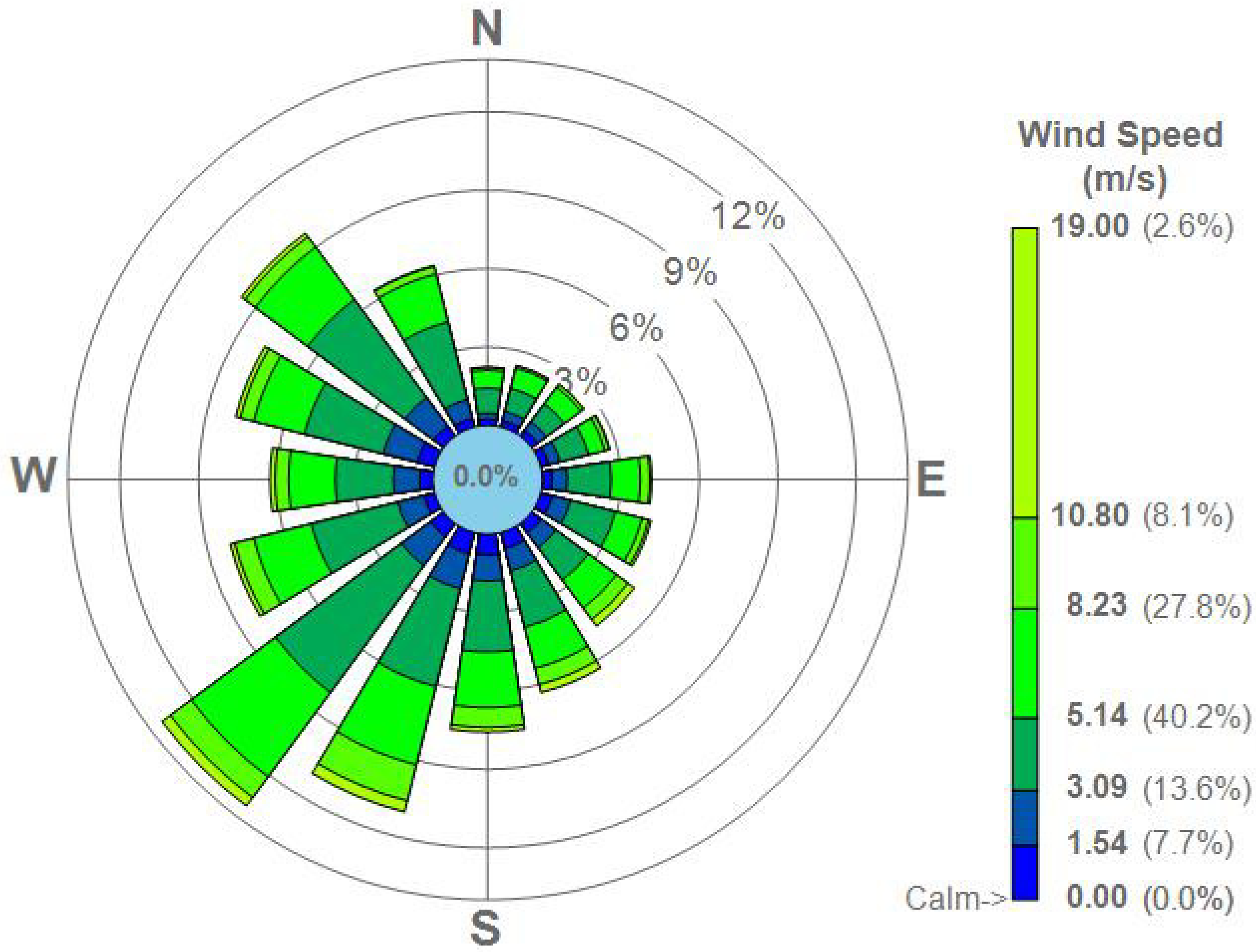

Figure 8.1. Windrose illustration of meteorological files Cork 2018 to 2022 inclusive.