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Technical Note

Response to EPA request for further information regarding the Knockharley Landfill odour impact assessment

1. Scope

Beauparc have requested Olfasense UK Ltd to provide a technical commentary on the request for information issued by the Environmental Protection Agency (EPA) in relation to the Odour Impact assessment conducted as part of the EIAR for Knockharley landfill.

The commentary is presented below.

2. Information requested

The relevant section of the information request issued by the EPA which mentions the odour impact assessment is presented in full below:

2. *It is noted from the odour impact assessment in Appendix 7.1 of the EIAR that odour emissions from landfilling activities were modelled and assessed separately from odour emissions from the biological treatment plant. In order to assess the odour impact from the proposed activities, you are required to model all potential sources of odour together within the modelled scenarios and to revise the model/report to take account of the following [Regulation 9(2)(k)]:*

   (a) *All additional potential odour sources including the current leachate lagoon and the three additional proposed leachate lagoons, the landfill gas compound and the entrance and exit doors to the biological treatment plant considering the potential frequency of odour emissions during waste unloading and finished compost removal.*

   (b) *Compare the results of the odour impact assessment to an odour impact criterion of 1.5 OU_E/m^3 as a 98^{th}%ile of one hour averaging periods.*

   (c) *Utilise data from an inland meteorological station which may be more reflective of the location of the installation.*

(d) *Provide all required details in relation to the model as set out in section 6.12 of EPA Guidance Note (AG4) on Air Dispersion Modelling from Industrial Installations, and in particular a site plan showing buildings, sources, boundary and receptor grid and the model data inputs.*

(e) *Clarify whether the odour emission measurements, carried out in October 2010 and March 2018, are considered representative of the site taking account of seasonal variations and the years in which the monitoring was conducted.*

(f) *Confirm whether the maximum odour concentration at the outlet of the biofilter, as outlined in section 4.2.3, is based on a design which includes the operation of the scrubber.*

(g) *Clarify if the results of the year 4 and year 6 scenarios are considered worst case relative to all other future years.*

3. Response

3.1 Question 2 and (b). Combined modelling of the landfill and BWTF using the most stringent odour impact criterion.

Modelling of the odour emissions from the landfilling and the biological waste treatment facilities was conducted separately due to the differences in the character and perceived offensiveness of the odours released from each area.

This approach adopted was consistent with best practice at the time the assessment was undertaken. Furthermore, it recognises that odours with different character and offensiveness are generally not considered to be 'additive' in terms of impact risk development, since higher offensiveness odours tend to dominate perception at receptor level.

It should also be recognised that the use of the most stringent criterion of $C_{98,\ 1\text{-hour}}$ = 1.5 ou_E/m^3 98th percentile criterion for landfill type odours already includes a margin of safety since this criterion is generally considered to be precautionary in nature, particularly when applied to landfills. This point is illustrated by research conducted by Sniffer on landfill odours which was co funded by the EPA that 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'.

The assessment of the landfill odours therefore already has a considerable margin of safety built in.

In Olfasense's view, the request to undertake modelling of the emissions from the landfill and biowaste facility assuming they are additive and have the same 'high' offensiveness' is unreasonable and would lead to an excessively stringent assessment of the impact risk of the facility.

3.2 Question 2 point (a). Inclusion of all odour sources.

The modelling was designed to consider all of the potentially significant sources of odour at the site. The additional sources mentioned in the EPA request were not included in the model for the following reasons:

1. **Leachate lagoons.** As stated in the EIAR, the leachate lagoons are fully covered, and the air displaced from loading of leachate tankers is and will be treated using a carbon filter prior to release to atmosphere. Inspection of the existing covers indicates they provide a high degree of containment of leachate odours and no odours were detected around the lagoon during the 2018 survey. Loading of tankers with leachate was not directly witnessed during the survey. However, Olfasense experience indicates that carbon filtration is highly effective at removing leachate odours and can achieve odour removal efficiencies of up to 99%. The emissions from the leachate area are therefore minimal and are not insignificant in terms of offsite impact.

2. **Gas compound.** In Olfasense' experience, flare and gas utilisation engines are not significant sources of odour if they are operated correctly. Any residual odours from gas engines tend to be related to the release of combustion products, which disperse rapidly and are rarely detectable more than a few meters downwind. This was confirmed during the monitoring survey conducted in May 2018.

3. **Biological Waste Treatment Facility**. The facility is designed to be self-contained and will be continually extracted at a rate of 3 air changes per hour to an odour treatment system comprising a biofilter. The entry and exit doors will be fitted with fast closing doors and it is also understood that air curtains will be included as part of the design to provide an additional barrier to minimise the escape of any odorous air during the short time interval that doors are open. These measures are likely to result in a high degree of containment of odour and hence significant emissions are not expected to occur under normal operating conditions.

At this basis, we consider that the model captures the key odour sources associated with the development which are likely to be relevant in terms of offsite odour impact risk.

3.2 Question 2 (c) Meteorological data

Dublin airport was selected as a suitable source of the meteorological data for the dispersion model on the basis of the procedure recommended by the UK Atmospheric Dispersion Modelling Liaison Committee (ADMLC), after they concluded that the most important factor in the selection of meteorological station was annual windspeed. This procedure, as outlined in the EPA guidance note AG4, is as follows:

- Estimate the mean annual wind speed in the region of the installation using a wind map (available from the Met Eireann website https://www.met.ie/climate/what-we-measure/wind).

- Calculate the ratio of the mean annual wind speed for the source and the mean annual wind speed for the nearby meteorological sites (as shown in Table 6.1 in AG4).

- Choose a meteorological station with the mean annual wind speed ratio between 0.9 to 1.1. to estimate the dispersion from the site.

Application of the procedure in this case indicated that the annual mean windspeed at the study site is likely to fall between 5 and 6 m/s and is estimated at 5.2 m/s based on the wind speed contours presented on the Met Eireann website. This compared favourably with Dublin airport where the annual mean windspeed stated in AG4 is 5.3 m/s, giving a ratio of 0.98 and within the 0.9 to 1.1 limits detailed in AG4.

Dublin airport also appeared to be a good choice based on the similarities in topography, surface roughness and elevation in comparison to the study site; the availability of a full set of meteorological data including cloud cover measurements; and the fact that the station had been used for other impact assessments in the area historically including previous odour modelling studies at Knockharley landfill.

In comparison, the nearest inland stations at Dunsany and Mullingar have average windspeeds of 4.1 and 4.3 m/s respectively, which is not within the recommended range based on the ADMLC approach. Casement Aerodrome is an appropriate choice in terms of wind speed but is noted in AG4 as being in proximity to complex terrain and is therefore unlikely to provide a suitable representation of conditions at Knockharley Landfill.

There therefore appears to be little benefit in rerunning the model with meteorological data which is likely to be less representative than the meteorological dataset that has already applied.

3.3 Question 2 (d) Model data

The majority of the data has already been provided in the EIAR AQ chapter and OIA report. Additional information is provided in the Annex and attached model files.

3.4 Question 2 (e) Monitoring

As stated in section 4.2.1 of the odour impact assessment report, the odour emission estimates applied in the model for municipal solid waste handling were derived from odour measurements conducted in 2010 and 2018. This data compares well with data collected by Olfasense (and formerly Odournet) from landfills across the UK and Ireland and is considered to be representative of the emissions that are likely to occur from municipal solid waste received at the site under current and foreseeable future operational conditions, across the year.

3.5 Question 2 (f) Maximum odour concentration from the biofilter

The maximum odour concentration from the biofilter was provided by a third party and is based on a design which includes an acid scrubber upstream of the biofilter.

3.6 Question 2 (g) Worst case scenarios

Year 6 in the OIA is considered to be the worst case year for the proposed development in terms of odour emissions from waste deposition and landfill. This reflects the forecast situation during completion of the final cells of the landfill. Year 4 was provided as a reference point to the final year of the ‘do nothing’ (existing licence conditions) scenario.

Annex A: Model data

A.1 Model parameters for Sc0

Figure 1: Model input image for Sc0 showing receptor grid, discrete receptors (yellow crosses), volume sources (red squares), area sources (green polygons) and buildings (blue)

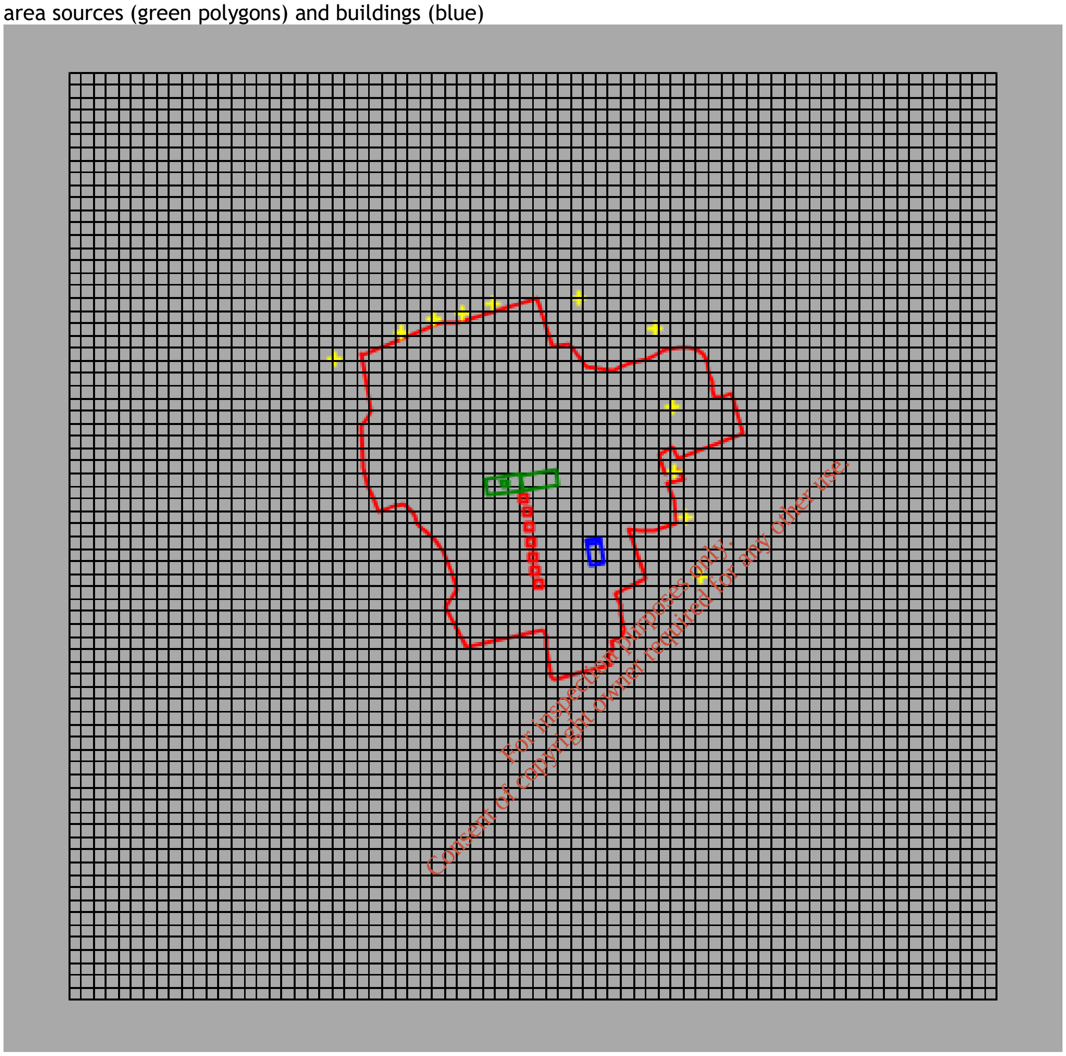


Table 1: Dispersion modelling parameters – area sources

Source location (UTM)			Source parameters					
Name	X	Y	Elevation	Emission rate (ou$_E$/m^2/s)	Release height	X length	Y length	Angle
Freshly deposited waste	663240.5	5947060.2	64	28.4	10	5	5	81
Active face	663225.0	5947069.9	64	10	10	25	25	81
Cell 21 (filling)	663160.4	5947075.3	64	1	10	62.5	142	81
Cell 21 (filling)	663298.7	5947095.1	64	1	10	62.5	142	81

Table 2: DispersiFulln modelling parameters – volume sources

Source location (UTM)			Source parameters				
Name	X	Y	Elevation	Emission rate ($ou_E/m^2/s$)	Release height	Initial lateral dimensions	Initial vertical dimensions
CEL13&14	663313.7	5947004.1	64	32784	10	31	0.05
CEL11&12	663324.2	5946949.5	64	32784	10	31	0.05
CEL9&10	663336.6	5946885.9	64	3200	10	31	0.05
CELL7&8	663343.1	5946830.0	64	1770	10	31	0.05
CELL5&6	663351.9	5946765.0	64	1348	10	31	0.05
CELL3&4	663360.6	5946714.5	64	914	10	31	0.05
CELL1&2	663373.4	5946662.5	64	624	10	31	0.05

A.2 Model parameters for Sc1

Figure 2: Model input image for Sc1 showing receptor grid, discrete receptors (yellow crosses), volume sources (red squares) and area sources (green polygons)

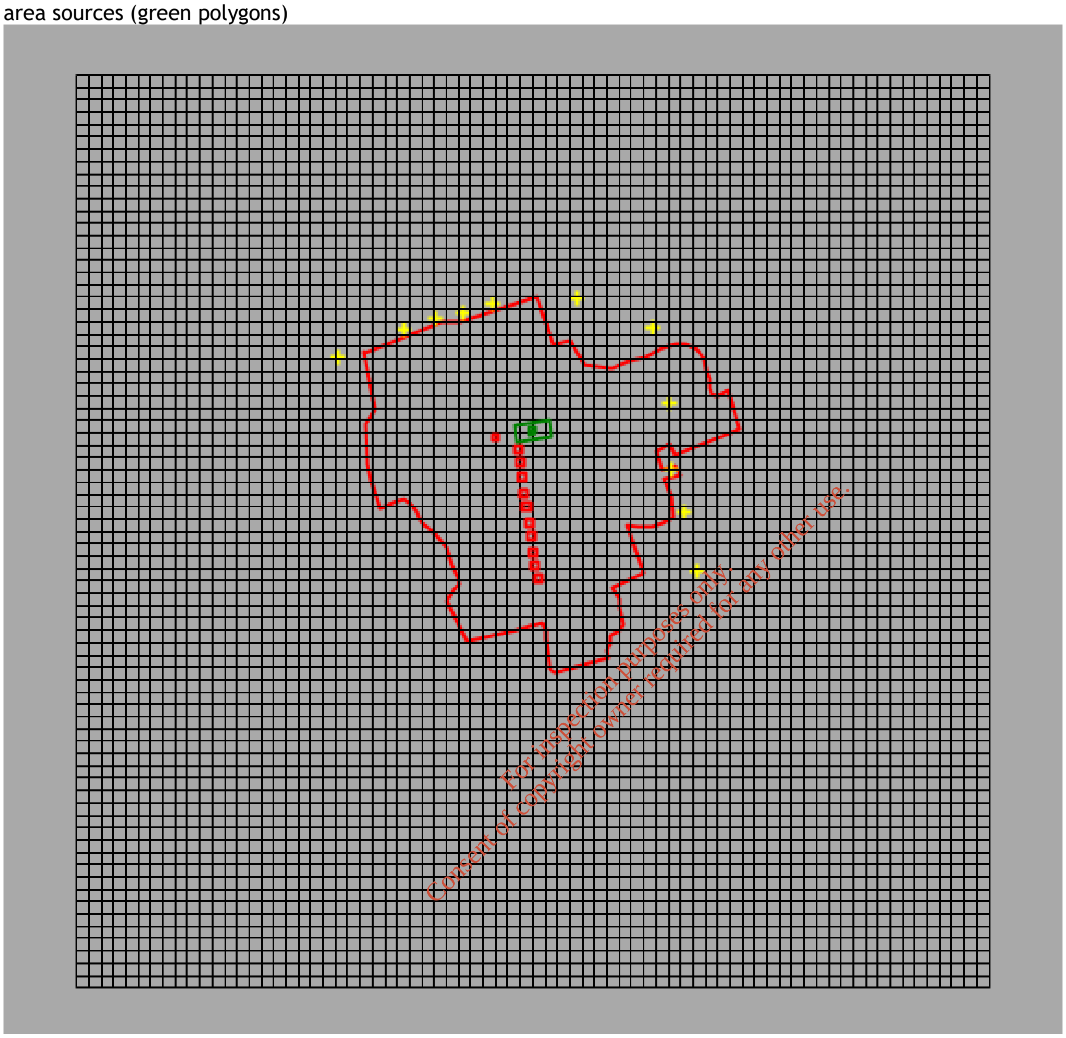


Table 3: Dispersion modelling parameters – area sources

Source location (UTM)			Source parameters					
Name	X	Y	Elevation	Emission rate ($ou_E/m^2/s$)	Release height	X length	Y length	Angle
freshly deposited waste	663343.9	5947260.5	60.16	28.4	10	5	5	81
active face	663332.7	5947269.7	60.21	10	10	25	25	81
Cell 21 (filling)	663274.8	5947277.1	60.9	1	10	62.5	142	81

Table 4: Dispersion modelling parameters – volume sources

Source location (UTM)			Source parameters				
Name	X	Y	Elevation	Emission rate ($ou_E/m^2/s$)	Release height	Initial lateral dimensions	Initial vertical dimensions
CEL19&20	663291.4	5947185.5	64	23247	10	31	0.05
CEL17&18	663306.3	5947072.0	64	2203	10	31	0.05
CEL15&16	663299.5	5947131.5	64	1663	10	31	0.05
CEL13&14	663313.7	5947004.1	64	634	10	31	0.05
CEL11&12	663324.2	5946949.5	64	356	10	31	0.05
CEL9&10	663336.6	5946885.9	64	201	10	31	0.05
CELL7&8	663343.1	5946830.0	64	186	10	31	0.05
CELL5&6	663351.9	5946765.0	64	130	10	31	0.05
CELL3&4	663360.6	5946714.5	64	90	10	31	0.05
CELL1&2	663373.4	5946662.5	64	65	10	31	0.05
CELL21	663198.4	5947232.4	64	33593	10	22	0.05

A.3 Model parameters for Sc2

Figure 1: Model input image for Sc2 showing receptor grid, discrete receptors (yellow crosses), volume sources (red squares), area sources (green polygons), buildings (blue) and OCU stack (sky blue dot)

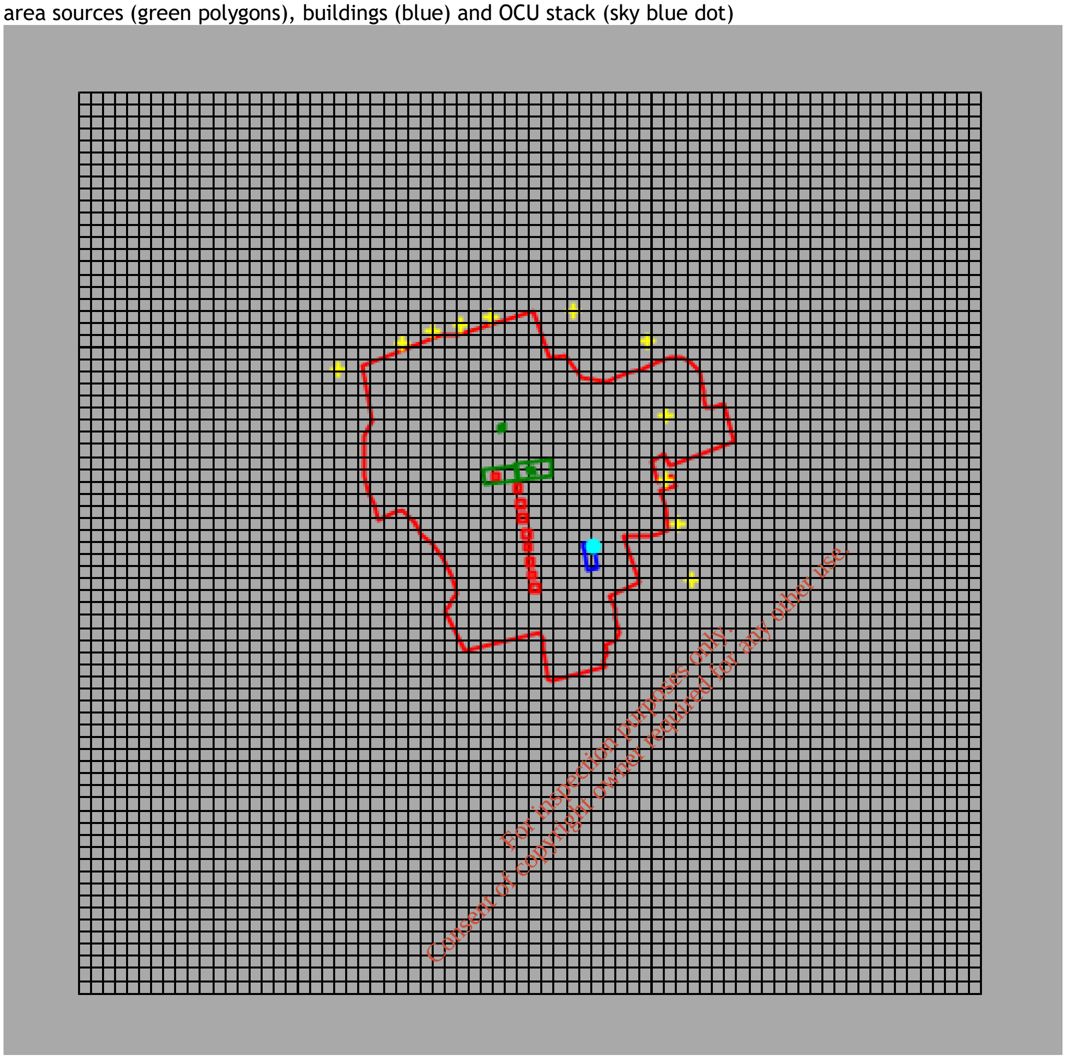


Table 5: Dispersion modelling parameters – area sources

Source location (UTM)			Source parameters					
Name	X	Y	Elevation	Emission rate (ou$_E$/m^2/s)	Release height	X length	Y length	Angle
freshly deposited waste	663356.6	5947143.1	64	46.2	10	5	5	81
active face	663341.0	5947151.5	64	10	10	25	25	81
Cell 22 (filling)	663293.0	5947168.4	64	1	10	62.5	142	83
Cell 22 (filling)	663155.7	5947147.5	64	1	10	62.5	142	83
active face	663221.6	5947332	64	1	10	25	25	81

Table 6: Dispersion modelling parameters – volume sources

Source location (UTM)			Source parameters				
Name	X	Y	Elevation	Emission rate ($ou_E/m^2/s$)	Release height	Initial lateral dimensions	Initial vertical dimensions
CEL15&16	663302.9	5947070.2	64	13865	10	31	0.05
CEL11&12	663324.2	5946949.5	64	5321	10	31	0.05
CEL9&10	663336.6	5946885.9	64	2193	10	31	0.05
CELL7&8	663343.1	5946830.0	64	938	10	31	0.05
CELL5&6	663351.9	5946765.0	64	510	10	31	0.05
CELL3&4	663360.6	5946714.5	64	553	10	31	0.05
CELL1&2	663373.4	5946662.5	64	200	10	31	0.05
CELL17	663213.4	5947119.3	64	10424	10	22	0.05
CEL13&14	663313.7	5947004.1	64	5205	10	31	0.05

A.4 Model parameters for Sc3

Figure 1: Model input image for Sc3 showing receptor grid, discrete receptors (yellow crosses), volume sources (red squares), area sources (green polygons), buildings (blue) and OCU stack (sky blue dot)

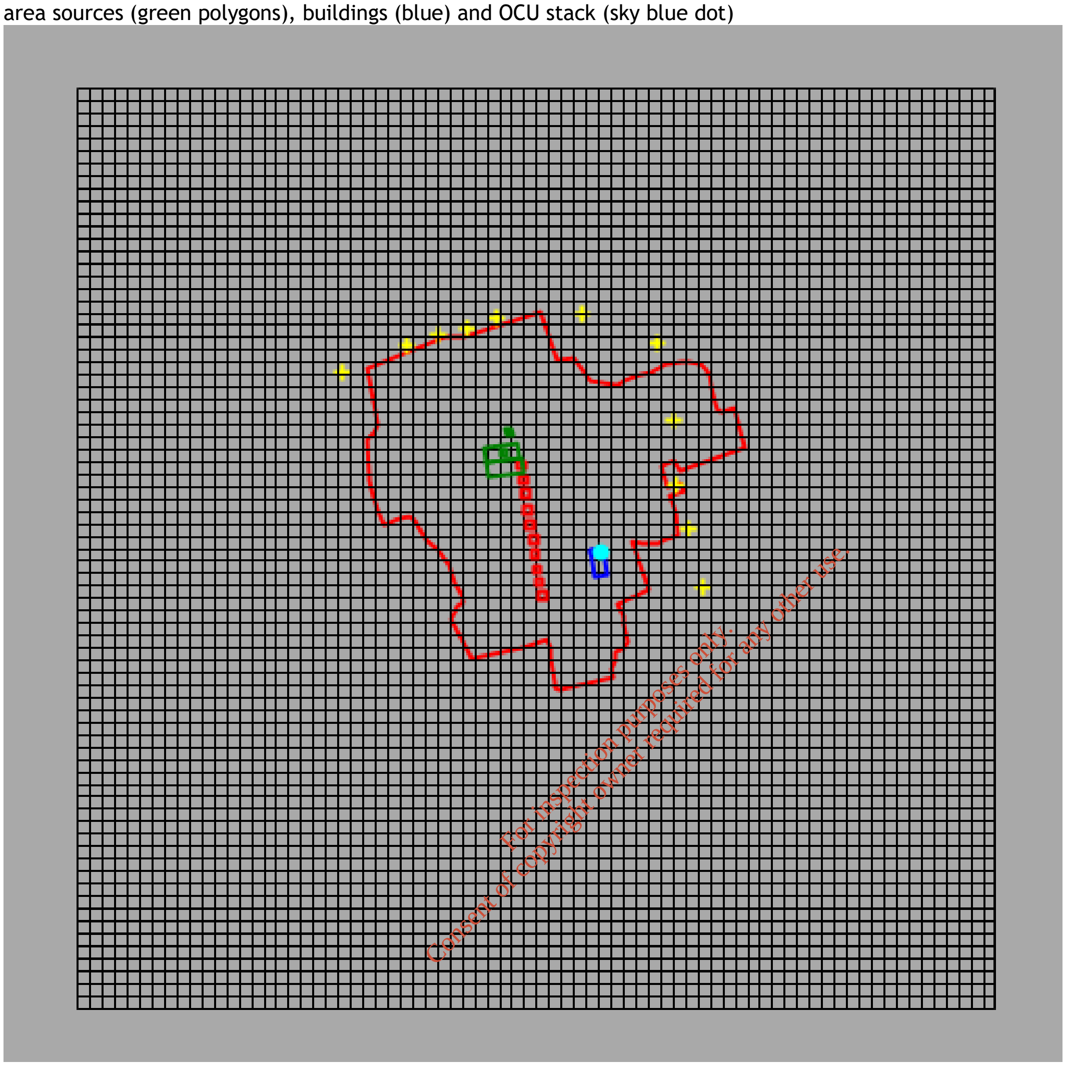


Table 7: Dispersion modelling parameters – area sources

Source location (UTM)			Source parameters					
Name	X	Y	Elevation	Emission rate ($ou_E/m^2/s$)	Release height	X length	Y length	Angle
freshly deposited waste	663209.0	5947239.3	64	46.2	10	5	5	81
active face	663201.4	5947249.0	64	10	10	25	25	81
Cell 21 (filling)	663133.8	5947260.6	64	1	10	62.5	142	83
active face	663221.6	5947332	64	1	10	25	25	81

stabilised depo	663234.5	5947323.6	64	8	10	5	5	81
Cell 21 (filling)	663144.2	5947198.9	64	1	10	62.5	142	83

Table 8: Dispersion modelling parameters – volume sources

Source location (UTM)			Source parameters				
Name	X	Y	Elevation	Emission rate $(ou_E/m^2/s)$	Release height	Initial lateral dimensions	Initial vertical dimensions
CEL19&20	663287.0	5947185.4	64	23446	10	31	0.05
CEL17&18	663304.0	5947073.9	64	6108	10	31	0.05
CEL15&16	663296.6	5947126.6	64	4153	10	31	0.05
CEL13&14	663313.7	5947004.1	64	2857	10	31	0.05
CEL11&12	663324.2	5946949.5	64	2920	10	31	0.05
CEL9&10	663336.6	5946885.9	64	1204	10	31	0.05
CELL7&8	663343.1	5946830	64	515	10	31	0.05
CELL5&6	663351.9	5946765	64	280	10	31	0.05
CELL3&4	663360.6	5946714.5	64	304	10	31	0.05
CELL1&2	663373.4	5946662.5	64	110	10	31	0.05

Table 9: Dispersion modelling parameters – stack sources

Source location (UTM)			Stack parameters				
Name	X	Y	Stack Height (m)	Stack Diameter (m)	Temperature (°C)	Actual Volume flow rate (m^3/s)	Velocity (m/s)
Bio-treatment facility	663612	5946830	20	2.4	10	67	14.8

A.5 Discrete receptors included in model

Table 10: Details of discrete receptors included in the model

Receptor ID	X coordinate (UTM)	Y coordinate (UTM)	Elevation	Hill height scale	Flagpole height
1	663914.1	5947101.1	57.80	57.80	1.5
5	663964.4	5946922.6	53.82	53.82	1.5
6	664021.9	5946689.8	54.57	54.57	1.5
11	662565.7	5947552.2	69.71	69.71	1.5
12	662829	5947661.9	67.90	67.90	1.5
15	662957.9	5947708.5	66.43	66.43	1.5
16	663070.3	5947736	65.53	65.53	1.5
18	663190.9	5947771.6	62.95	62.95	1.5

22	663536.5	5947793.5	59.78	59.78	1.5
40	663838.1	5947672.9	55.85	55.85	1.5
42	663909.4	5947365.8	60.31	60.31	1.5

A.6 Meteorological data parameters

Table 11: Pre-processing values applied to meteorological processing

Sector[degrees]	Surface roughness [m]	Albedo / Bowen Ratio
111-158	0.05	0.245/1.056
158-352	0.111	
352-111	0.083	

Figure 3: Surface file wind rose 2012

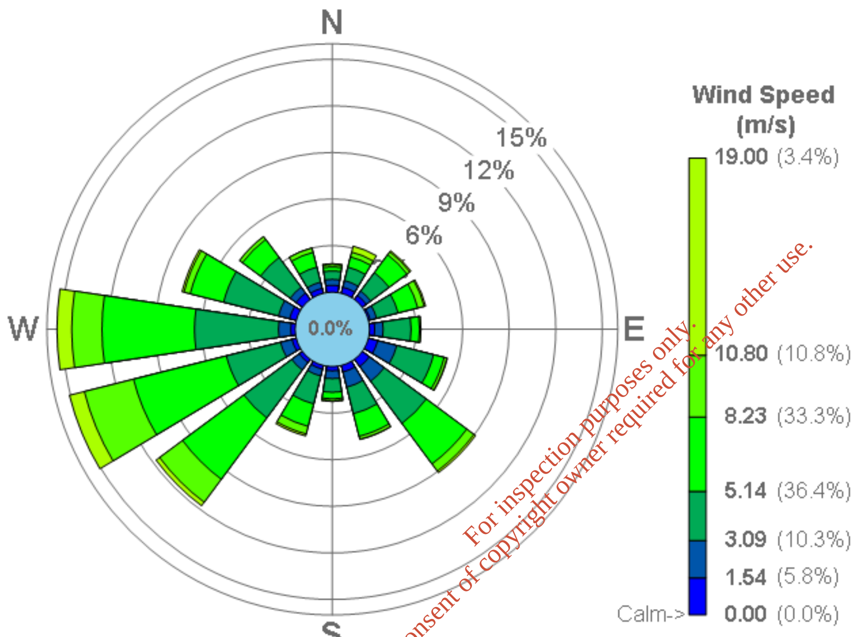


Figure 3: Surface file wind rose 2013

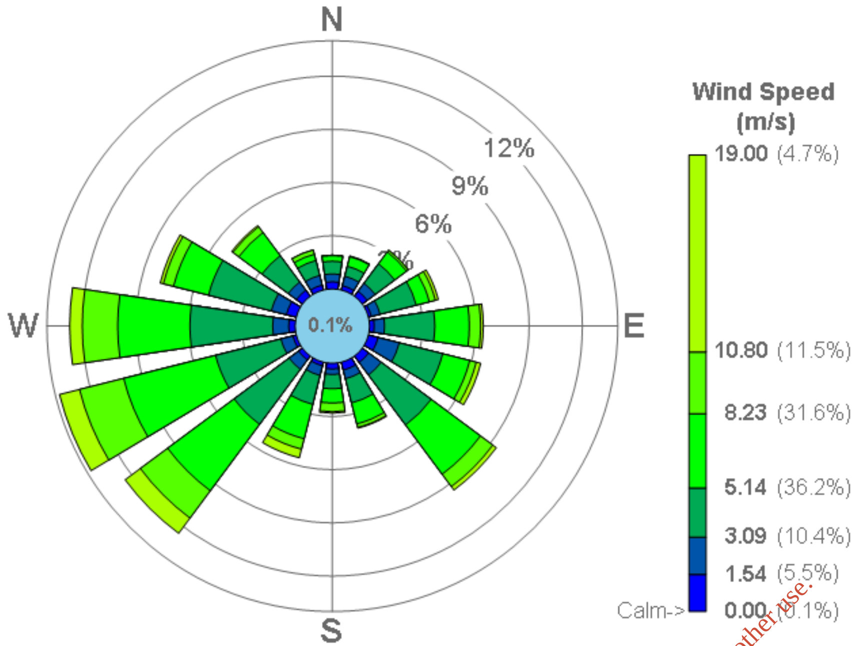


Figure 4: Surface file wind rose 2014

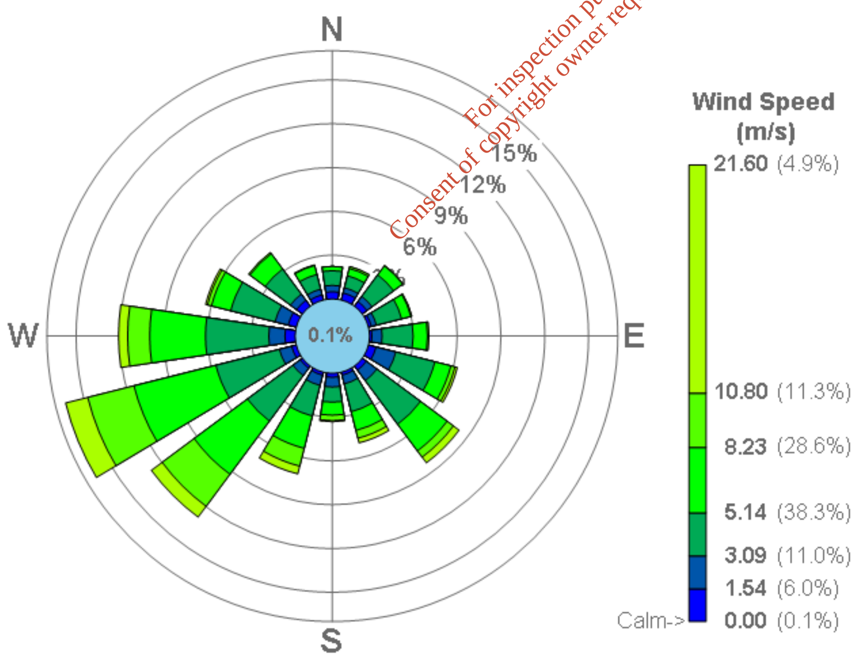


Figure 5: Surface file wind rose 2015

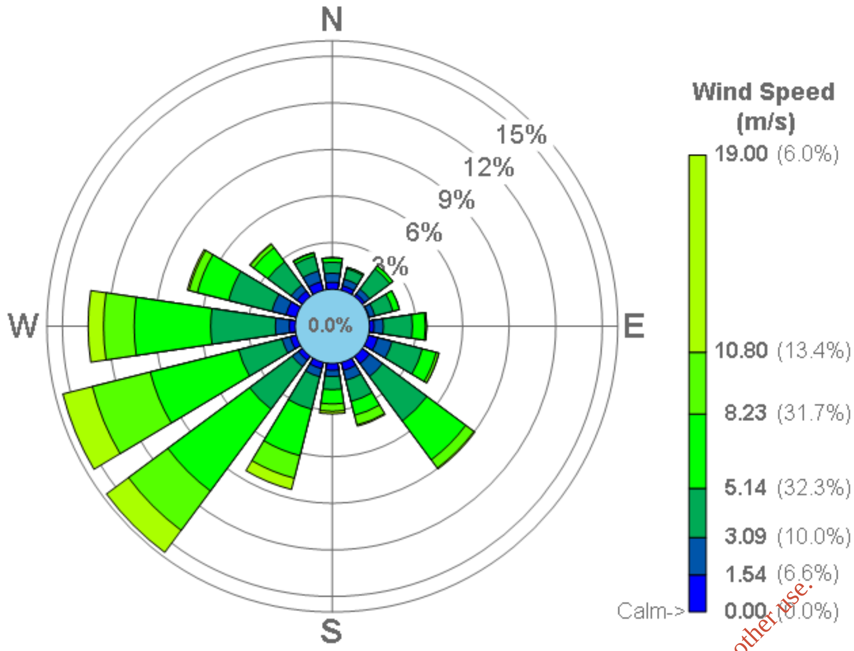
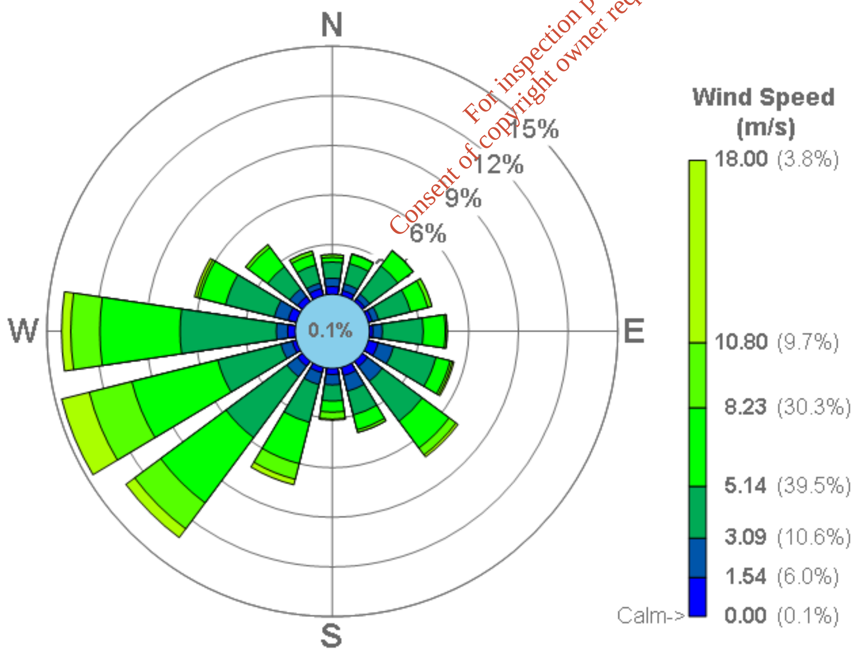


Figure 6: Surface file wind rose 2016



A.7 Dispersion modelling results for discrete receptors

Table 12: Modelled odour exposure levels at discrete receptors (2012)

Receptor ID	X coordinate (UTM)	Y coordinate (UTM)	Predicted odour exposure $C_{98,\ 1\text{-hour}}$			
			Sc0	Sc1	Sc2	Sc3
1	663914.1	5947101.1	2.15	1.77	1.37	1.46
5	663964.4	5946922.6	2.14	1.32	1.30	1.19
6	664021.9	5946689.8	1.68	0.81	0.89	0.77
11	662565.7	5947552.2	1.74	1.81	1.29	1.56
12	662829	5947661.9	1.91	2.46	1.43	1.76
15	662957.9	5947708.5	2.07	2.58	1.65	2.03
16	663070.3	5947736	1.49	2.22	1.27	1.55
18	663190.9	5947771.6	1.09	1.20	0.76	0.81
22	663536.5	5947793.5	0.93	1.14	0.67	0.88
40	663838.1	5947672.9	0.98	1.33	0.78	0.95
42	663909.4	5947365.8	2.00	1.57	1.27	1.31

Table 13: Modelled odour exposure levels at discrete receptors (Sc0)

Receptor ID	X coordinate (UTM)	Y coordinate (UTM)	Predicted odour exposure $C_{98,\ 1\text{-hour}}$			
			2012	2013	2014	2015
1	663914.1	5947101.1	2.15	2.13	2.80	2.15
5	663964.4	5946922.6	2.14	2.37	2.76	2.32
6	664021.9	5946689.8	1.68	1.74	1.80	1.82
11	662565.7	5947552.2	1.74	1.41	1.52	1.34
12	662829	5947661.9	1.91	1.53	1.56	1.75
15	662957.9	5947708.5	2.07	1.29	1.28	1.34
16	663070.3	5947736	1.49	0.84	0.98	0.97
18	663190.9	5947771.6	1.09	0.74	1.05	0.88
22	663536.5	5947793.5	0.93	0.94	1.03	1.04
40	663838.1	5947672.9	0.98	1.01	1.12	1.03
42	663909.4	5947365.8	2.00	1.79	2.04	1.63

Table 14: Modelled odour exposure levels at discrete receptors (Sc1)

Receptor ID	X coordinate (UTM)	Y coordinate (UTM)	Predicted odour exposure $C_{98,\ 1\text{-hour}}$			
			2012	2013	2014	2015
1	663914.1	5947101.1	1.77	2.05	2.15	1.91
5	663964.4	5946922.6	1.32	1.37	1.41	1.41
6	664021.9	5946689.8	0.81	0.81	0.90	0.85
11	662565.7	5947552.2	1.81	1.80	1.83	1.35
12	662829	5947661.9	2.46	2.00	1.96	2.23
15	662957.9	5947708.5	2.58	1.94	1.91	2.12
16	663070.3	5947736	2.22	1.27	1.45	1.52
18	663190.9	5947771.6	1.20	0.82	1.12	1.12
22	663536.5	5947793.5	1.14	1.12	1.27	1.36
40	663838.1	5947672.9	1.33	1.15	1.23	1.07
42	663909.4	5947365.8	1.57	1.45	1.99	1.46

Table 15: Modelled odour exposure levels at discrete receptors (Sc2)

Receptor ID	X coordinate (UTM)	Y coordinate (UTM)	Predicted odour exposure $C_{98,\ 1\text{-hour}}$			
			2012	2013	2014	2015
1	663914.1	5947101.1	1.37	1.47	1.84	1.68
5	663964.4	5946922.6	1.30	1.37	1.56	1.43
6	664021.9	5946689.8	0.89	0.87	1.02	0.90
11	662565.7	5947552.2	1.29	1.08	1.17	0.95
12	662829	5947661.9	1.43	1.29	1.21	1.43
15	662957.9	5947708.5	1.65	1.06	1.05	1.25
16	663070.3	5947736	1.27	0.69	0.81	0.90
18	663190.9	5947771.6	0.76	0.53	0.67	0.68
22	663536.5	5947793.5	0.67	0.69	0.83	0.84
40	663838.1	5947672.9	0.78	0.79	0.79	0.72
42	663909.4	5947365.8	1.27	1.15	1.44	1.11

Table 16: Modelled odour exposure levels at discrete receptors (Sc3)

Receptor ID	X coordinate (UTM)	Y coordinate (UTM)	Predicted odour exposure $C_{98,\ 1\text{-hour}}$			
			2012	2013	2014	2015
1	663914.1	5947101.1	1.46	1.61	1.87	1.60
5	663964.4	5946922.6	1.19	1.23	1.40	1.39
6	664021.9	5946689.8	0.77	0.78	0.92	0.82
11	662565.7	5947552.2	1.56	1.27	1.41	1.09
12	662829	5947661.9	1.76	1.61	1.47	1.72
15	662957.9	5947708.5	2.03	1.43	1.41	1.61
16	663070.3	5947736	1.55	0.93	1.04	1.00
18	663190.9	5947771.6	0.81	0.60	0.79	0.80
22	663536.5	5947793.5	0.88	0.82	0.96	1.03
40	663838.1	5947672.9	0.95	0.87	0.91	0.83
42	663909.4	5947365.8	1.31	1.17	1.62	1.17

Table 17: Modelled odour exposure levels at discrete receptors (Bio-treatment)

Receptor ID	X coordinate (UTM)	Y coordinate (UTM)	Predicted odour exposure $C_{98,\ 1\text{-hour}}$			
			2012	2013	2014	2015
1	663914.1	5947101.1	1.54	1.58	1.55	1.47
5	663964.4	5946922.6	1.14	1.15	1.16	1.06
6	664021.9	5946689.8	1.14	1.22	1.11	1.03
11	662565.7	5947552.2	0.37	0.35	0.34	0.31
12	662829	5947661.9	0.42	0.45	0.39	0.50
15	662957.9	5947708.5	0.46	0.50	0.51	0.46
16	663070.3	5947736	0.47	0.46	0.44	0.40
18	663190.9	5947771.6	0.43	0.35	0.36	0.32
22	663536.5	5947793.5	0.15	0.17	0.21	0.20
40	663838.1	5947672.9	0.35	0.39	0.46	0.53
42	663909.4	5947365.8	0.78	0.85	0.87	1.03