POWERFUEL

Portland energy recovery facility

Environmental statement
Addendum
Appendices

8.1

Plume visibility modelling results

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Plume Visibility Modelling Results

1 Introduction

When waste is combusted, the flue gases released from the stack contain water vapour. This partly comes from the moisture in the waste and partly comes from hydrogen in waste which becomes water when combusted.

The flue gases are released at around 140°C, which means that the water is gaseous. As the flue gases mix with the air, the water vapour cools and condenses. It also disperses in the atmosphere. Under some circumstances, the liquid water content of the exhaust gases can be high enough for the plume to become visible. This normally happens on cold, still mornings. If it is cold, the flue gases cool more quickly and if there is little wind, the flue gases disperse more slowly.

The ADMS dispersion model, which is an industry-leading model used across the country and approved by the Environment Agency, includes a function to model when the plume is visible, based on the water content of the plume and the meteorological conditions. We have used this model and five years of hourly weather data to assess how frequently the plume would be visible.

2 Results

The results of the modelling are presented in the table overleaf. For each year of weather data, we have shown the following figures.

1. The number of daylight hours which have been modelled. (It is not relevant whether the plume is visible at night.)
2. The number of daylight hours when the plume is predicted to be visible.
3. The number of daylight hours when the plume is predicted to be visible when the cloud cover was not high (7 or 8 oktas), as the plume would be obscured by cloud on cloudy days.
4. The percentage of daylight hours when the plume is predicted to be visible on non-cloudy days.
5. The number of daylight hours when the length of the visible plume on non-cloudy days was 0-20m, 20-50m, 50-100m or 100-200m.
6. The length of the longest visible plume.

2018 was an unusual year, in weather terms. This is because there were two periods when the temperature remained at or below 0°C for extended daylight periods – the Beast from the East and Storm Emma from 26 February to 2 March and a follow-up on 17 to 19 March. In contrast, the recorded temperature was above 0°C for the whole of 2014-2017. Given that the visibility of the plume would probably not be a concern during such periods, we have also presented figures for 2018 excluding these periods.

Table 1: Plume Visibility Results

Year	2014	2015	2016	2017	2018	Total	2018 (adjusted)	Total (adjusted)	Average (adjusted)
Daylight hours modelled	4,371	4,435	4,409	4,358	4,312	21,885	4,230	21,803	4,361
Daylight hours with visible plume	18	29	28	34	96	205	60	169	33.8
Non-Cloudy daylight hours with visible plume	11	17	22	19	52	121	42	111	22.2
Percentage of daylight hours with visible plume, non-cloudy	0.25%	0.38%	0.50%	0.44%	1.21%	0.55%	0.99%	0.51%	0.51%
Non-cloudy daylight hours with visible plume length:									
0-20m	2	10	8	4	8	32	7	31	6.2
20-50m	1	4	9	9	14	37	10	33	6.6
50-100m	5	2	1	4	20	32	17	29	5.8
100-200m	3	1	4	2	10	20	8	18	3.6
Maximum length of visible plume, daylight hours, non-cloudy	123.38	124.49	187.89	171.90	168.06	187.89	156.88	187.89	187.89

Over the five years of weather data considered, the plume was expected to be visible for only 205 daylight hours. However, 84 of those hours had high levels of cloud cover and 10 further hours took place during the unusual weather conditions in 2018, so only 111 hours, or 0.51%, would have been genuinely visible.

The distribution of those visible plumes through the year is illustrated in Figures 1 to 5 overleaf. In Figure 5, for 2018, the visible plumes during the unusual weather conditions are shown in red. It can be seen that virtually all of the visible plumes occurred in January to April, with a few in December but none in the summer months.

Figure 6 shows the number of visible plumes predicted in each direction from the stack over the five years considered.

Figure 1: 2014 Visible Plumes

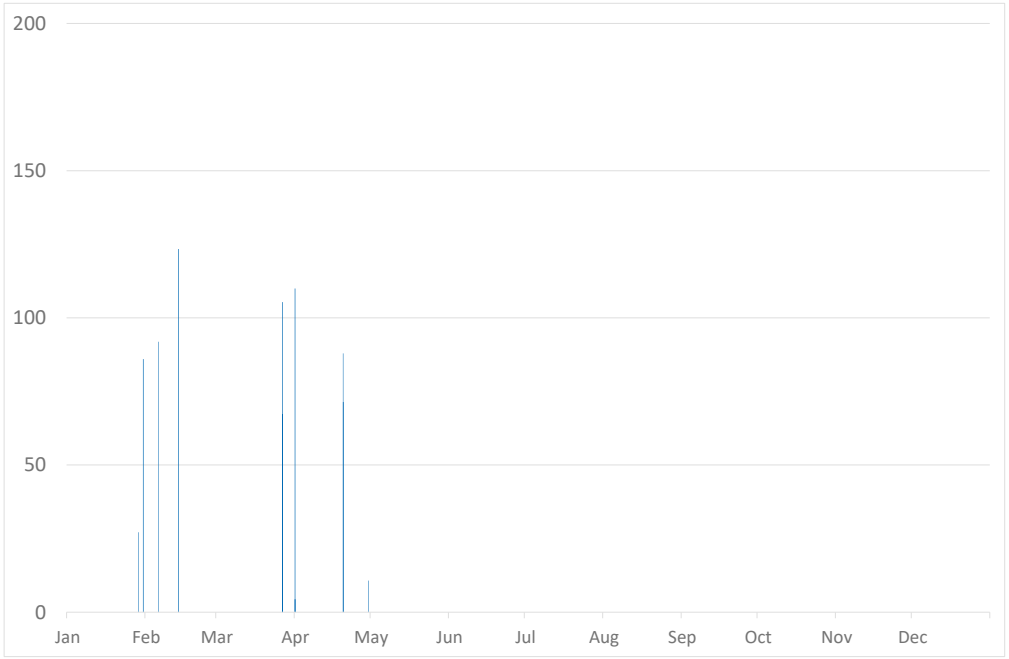

Figure 2: 2015 visible plumes

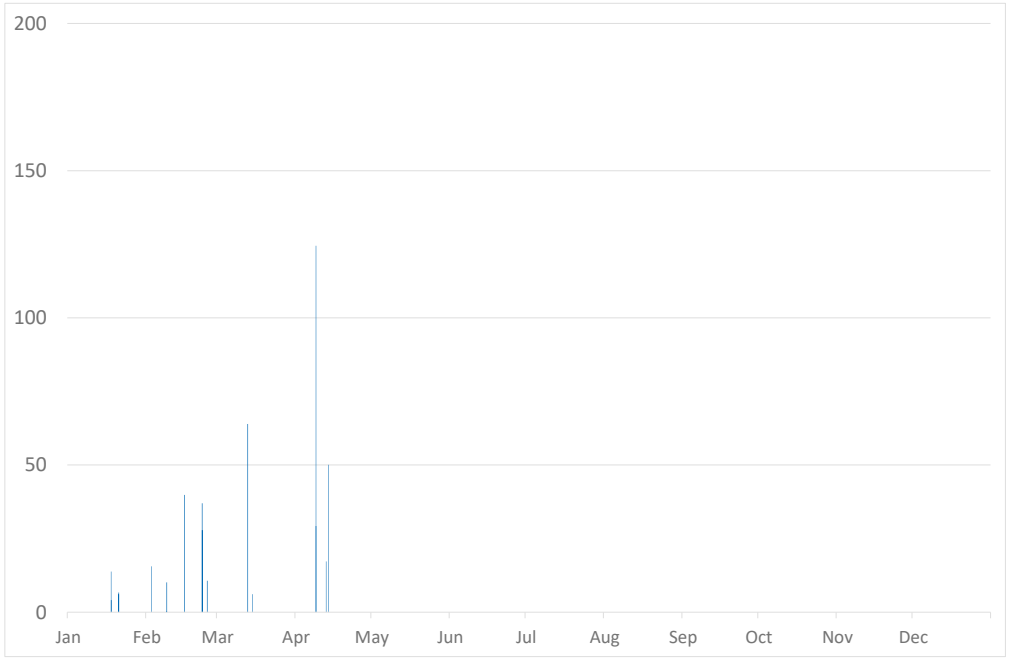

Figure 3: 2016 Visible Plumes

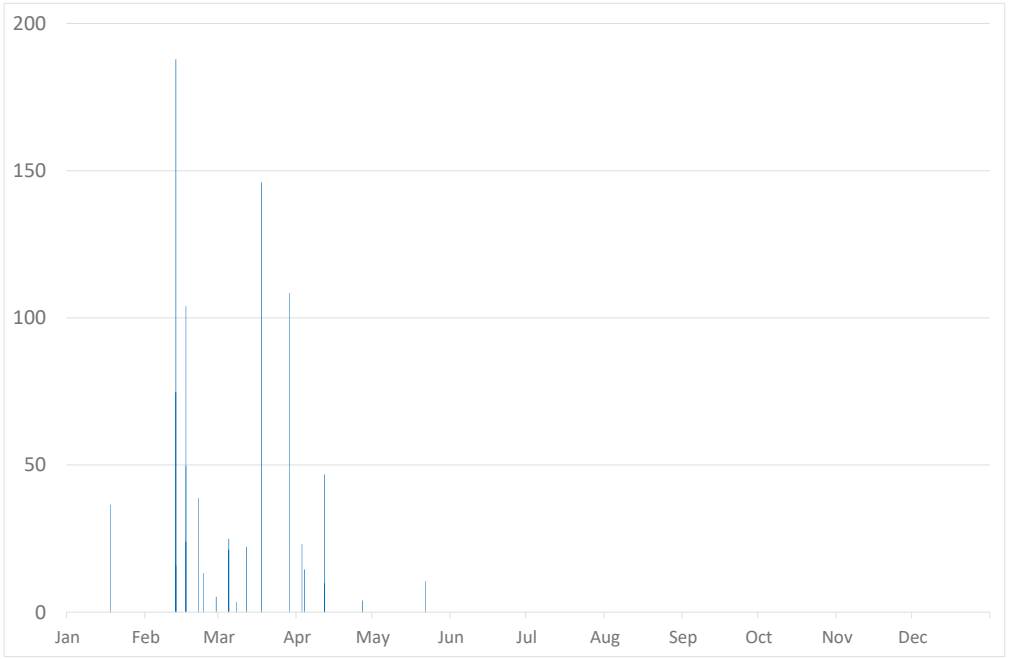

Figure 4: 2017 Visible Plumes

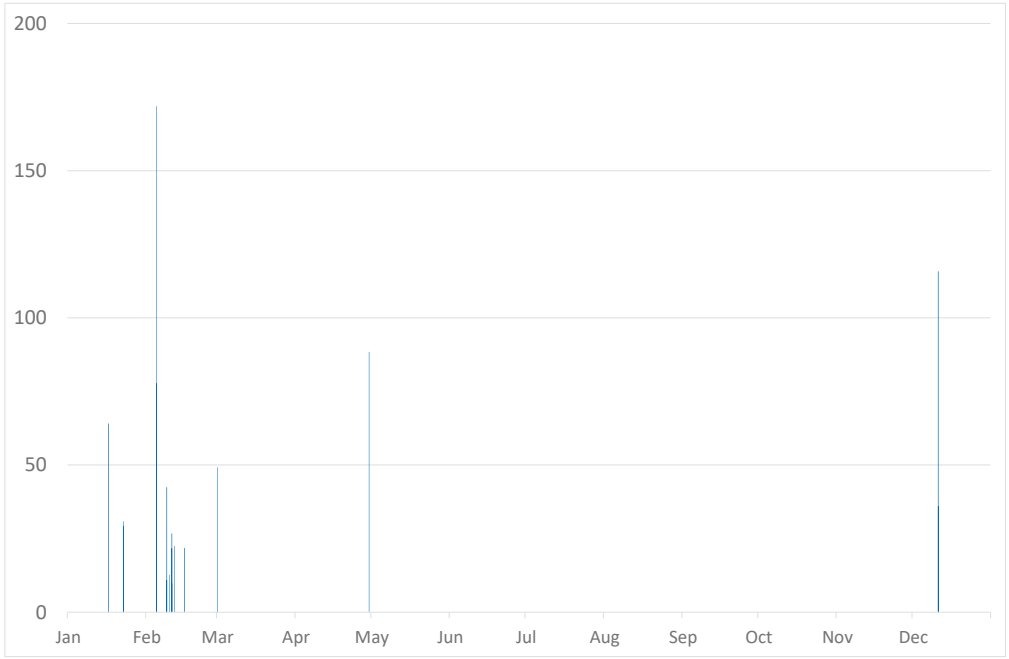

Figure 5: 2018 Visible Plumes

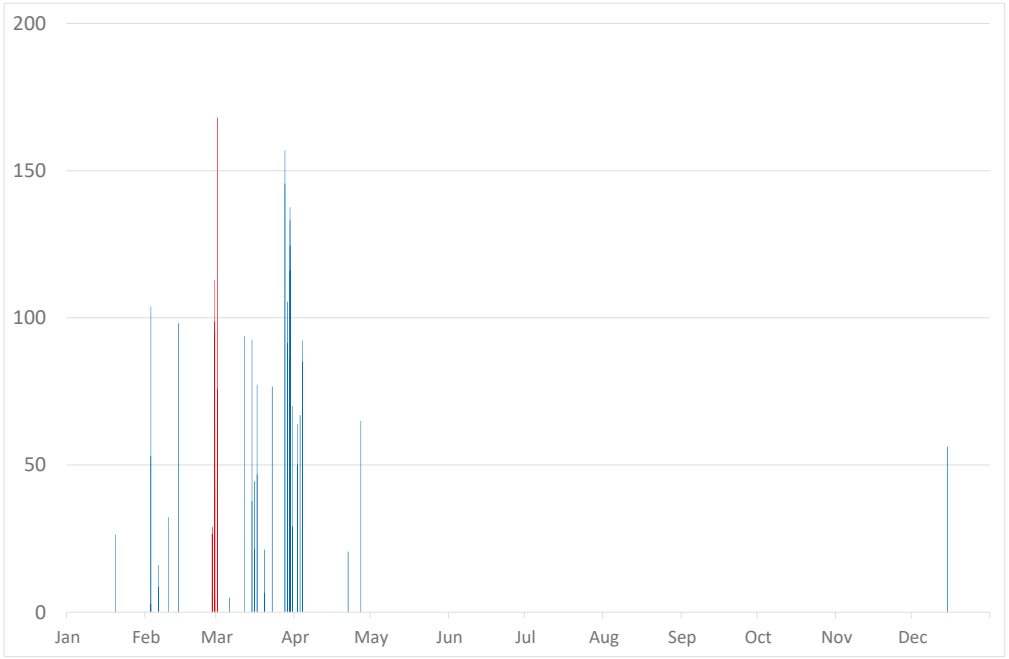

Figure 6: Direction of visible plumes