



UK Health  
Security  
Agency

## **Health Risk Assessment of air quality monitoring results from March to August 2021: Walleys Quarry Landfill Site, Silverdale Newcastle-under-Lyme**

### **Regarding ongoing response to odours and health concerns associated with the site**

On 1 October 2021, Public Health England (PHE) transitioned to the newly established UK Health Security Agency (UKHSA)<sup>a</sup>. From 1 October, PHE's Category 1 functions under the Civil Contingencies Act 2004 transferred to the UKHSA. The UKHSA West Midlands Health Protection Team will continue to provide senior representation at Local Resilience Forum (LRF) meetings and events. They will provide the expert health protection advice to local authority Directors of Public Health, the local NHS and to LRF structures and programmes. UKHSA, as a Category 1 Responder, will be the point of contact for public health incidents and will be responsible for establishing Scientific and Technical Advisory Cells (STACs) during relevant responses.

### **Non-Technical Summary**

The site is owned by Walleys Quarry Limited (formerly Red industries), who operate the site as an active landfill which accepts non-hazardous waste, and a cell which accepts stable non-reactive hazardous waste (gypsum and asbestos). Activities at the site are regulated by the Environment Agency (EA) under an Environmental Permit first issued in 2016.

In response to increased community concern of odours within Silverdale and the surrounding areas, from March 2021 the EA installed air quality Mobile Monitoring Facility (MMF) units which are to remain in place until at least March 2022 to collect monitoring data to continuously assess air quality.

Data, provided to UKHSA by the EA, have been compared to available health-based air quality guidelines and standards or assessment levels for hydrogen sulphide, particulate matter, nitrogen dioxide, sulphur dioxide, methane and volatile organic compounds (VOCs comprising benzene, toluene, ethylbenzene and xylene (BTEX)). In addition, for hydrogen sulphide and toluene the concentrations have been compared to the odour annoyance guideline and odour detection thresholds respectively. Air concentrations of particulate matter, nitrogen dioxide, sulphur dioxide, methane and VOCs are lower than appropriate

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<sup>a</sup> All reference to Public Health England has now been changed to UKHSA in this report

health-based and odour standards, guidelines or assessment levels, and therefore, the risk to health from these substances is minimal.

The short term 24-hour average guideline value for hydrogen sulphide was exceeded at MMF9 on two days during the monitoring period: 7 and 8 March 2021. Exposure to concentrations of hydrogen sulphide above this guideline does not necessarily mean eye irritation or other health effects will occur, but it reduces the margin of safety that is considered desirable to protect health.

**The hydrogen sulphide data up to the end of August 2021 shows continuing exposure to the population around the site, albeit concentrations in August continue to decrease compared to those seen from March to July (Figure 4). Additionally, at three of the monitoring sites concentrations are now below the long-term (lifetime) health-based guidance value.** Currently any risk to long-term (lifetime) physical health is likely to be small, however, we cannot completely exclude a risk to health from pollutants in the area, where exposure continues above the long-term health-based guidance values. Short-term health effects may be experienced such as irritation to the eyes, nose and throat. People who have health conditions that affect breathing, such as asthma, may experience increased frequency and/or severity of symptoms. With continuing exposure these effects may be prolonged but are not anticipated to continue long-term, once exposure has decreased to acceptable levels.

Hydrogen sulphide is an odorous chemical and the human nose is very sensitive to odours. While substances that are perceived as odorous are commonly present at levels below which there is a direct physical health effect of the substance itself, odours can cause nuisance and temporary symptoms. Such effects include headache, nausea, dizziness, watery eyes, stuffy nose, irritated throat, cough or wheeze, sleep problems and stress. The concentrations of hydrogen sulphide continue to be above the WHO odour annoyance guideline value for a considerable percentage of the time at one of the monitoring sites, which is undesirable due to the effects on people's wellbeing and the symptoms they are experiencing. Even at hydrogen sulphide concentrations below the WHO odour annoyance guideline value odour may still be present, however as concentrations fall to even lower levels it is anticipated that the strength of any odour should also reduce.

Therefore, UKHSA continues to strongly recommend that all measures are taken to reduce the off-site odours from the landfill site.

## Scope

The EA has shared with UKHSA monitoring data from MMF Stations MMF2 and MMF9 from which there is rectified<sup>b</sup> data from the 5 March – 31 August 2021 (181 days) and 6 March – 31 August 2021 (180 days) respectively). In April two additional monitors were deployed MMF1 from which there is rectified data from the 14 April – 31 August 2021 (140 days) and MMF 6 from which there is rectified data from the 24 April – 31 August 2021 (130 days).

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<sup>b</sup> Rectified data - Data is collected by the Environment Agency (EA) from four of the EA's Mobile Monitoring Facilities (MMF) located adjacent to the Walley's Quarry and Landfill Site in Newcastle-under-Lyme. There may be gaps in data as a result of power supply failure, hardware failure, communication loss or software updates. In some cases, it may be possible to retrospectively include this information. The EA call this data, 'rectified data' as it has undergone a basic quality assurance check and has been subjected to calibration where possible. However, as the calibration dates don't directly match the data collection period, this is not 'final data' and it is likely that this rectified data set may be updated following further quality assurance.

UKHSA has reviewed the available data from the MMF stations, listed below, and shown on a map in Figure 1:

**MMF 1 Location** – Silverdale cemetery, Newcastle under Lyme

**MMF 2 Location** – Silverdale Road, Newcastle under Lyme

**MMF 6 Location** – Newcastle community Fire Station, Newcastle under Lyme

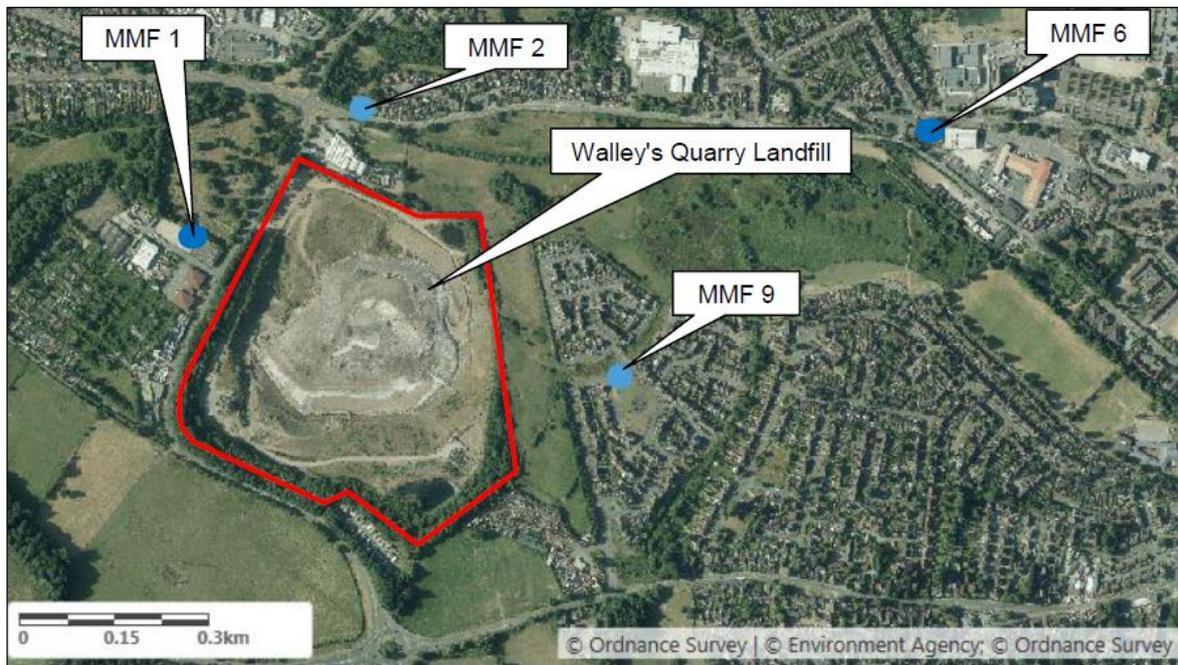
**MMF 9 Location** – Severn Trent Pumping Station off Galingale View, Newcastle-under-Lyme

The contaminants monitored at each MMF are provided in Table 1.

**Table 1 Monitoring stations and the contaminants they are monitoring**

Monitoring station	Hydrogen sulphide (H <sub>2</sub> S)	Methane (CH <sub>4</sub> )	Nitrogen dioxide (NO <sub>2</sub> )	Sulphur dioxide (SO <sub>2</sub> )	Particulate matter (PM <sub>10</sub> , PM <sub>2.5</sub> )	Benzene, toluene, ethylbenzene and xylene
MMF1	✓	✓		✓	✓	
MMF2	✓	✓	✓		✓	✓
MMF6	✓	✓		✓	✓	
MMF9	✓	✓	✓	✓	✓	✓

Figure 1. Map showing the location of the four monitoring sites



## Methodology

### Air quality guidelines, standards and assessment levels

The data provided to UKHSA have been compared to available health-based air quality guidelines, standards or assessment levels. There are a variety of health-based standards and assessment levels that have been derived by a number of organisations shown below:

- UK health-based guidance values
- UK air quality standards
- World Health Organization (WHO) air quality guidelines
- European air quality standards
- Other UK air quality assessment levels
- National air quality assessment levels or health-based guidance values (other than UK)

### Hydrogen sulphide

The health-based guidance values used by UKHSA for the risk assessment for acute, intermediate and lifetime exposure to hydrogen sulphide are summarised in Table 2.

**Table 2: Health based guidance values used for this risk assessment**

WHO air quality guidelines	ATSDR- MRL**	US EPA RfC***
<b>30-minute (average)*</b> 7 µg/m <sup>3</sup> (5 ppb) Based on odour annoyance	<b>Intermediate (up to 1 year)</b> 30 µg/m <sup>3</sup> (20 ppb) Based on lesions of the nasal olfactory epithelium in rats.	<b>For assessment of lifetime exposure</b> 2 µg/m <sup>3</sup> (1 ppb) Based on lesions of the nasal olfactory epithelium in rats.
<b>24-hour (average)</b> 150 µg/m <sup>3</sup> (107 ppb) Based on eye irritation in humans.		

\*The WHO guideline value of 7 µg/m<sup>3</sup> (5 ppb) over a 30-minute averaging period is a short-term odour value protective of odour annoyance<sup>1</sup>.

\*\* An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure. They are derived for acute (>1, ≤14 days), intermediate (>14, <364 days), and chronic (365 days and longer) exposure durations<sup>2</sup>.

\*\*\* An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime<sup>3</sup>.

### Hydrogen sulphide acute (short term) exposure

#### WHO 30-minute (average) guideline

The EA monitoring data were used to identify the percentage of time across the whole monitoring period when hydrogen sulphide concentrations were above the WHO odour annoyance guideline level (7 µg/m<sup>3</sup>, 30-minute average):

MMF1 (14/04/2021 to 31/08/2021): 7%

MMF2 (05/03/2021 to 31/08/2021): 7%

MMF6 (24/04/2021 to 31/08/2021): 4%  
 MMF9 (06/03/2021 to 31/08/2021): 23%

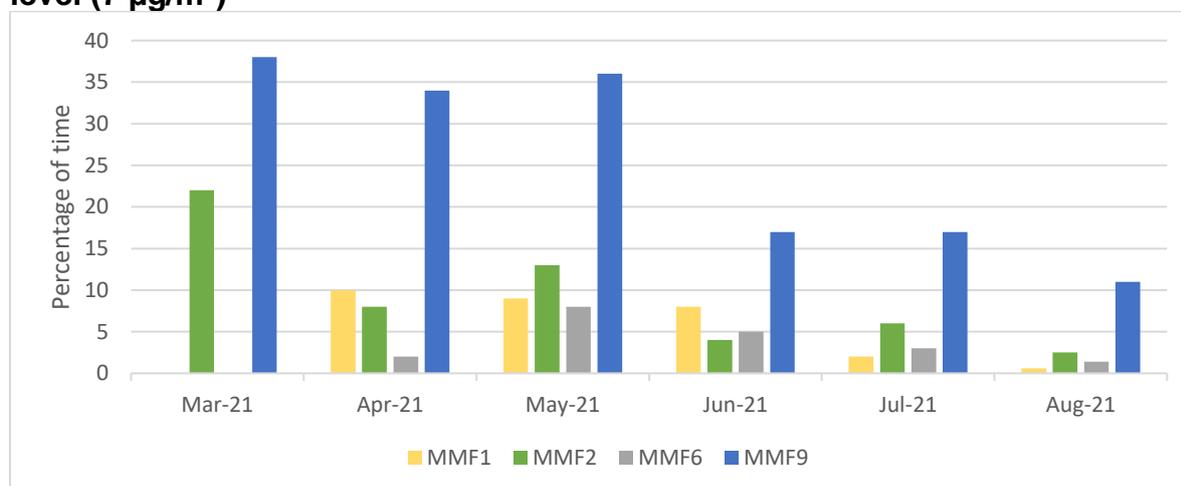
As such, there was potential for significant odour complaints to occur over these periods (see Table 3 and Figure 2).

**Table 3: Monthly percentage of time that each monitoring station location has recorded hydrogen sulphide concentrations above WHO odour annoyance guideline level (7 µg/m<sup>3</sup>)**

Monitoring Station	March 2021 (%)	April 2021 (%)	May 2021 (%)	June 2021 (%)	July 2021 (%)	August 2021 (%)
MMF1	NS	10***	9	8	2	0.6
MMF2	22*	8	13	4	6	2.5
MMF6	NS	2****	8	5	3	1.4
MMF9	38**	34	36	17	17	11

NS = hydrogen sulphide not sampled  
 \*Data from 5th March 2021 to 31st March 2021  
 \*\*Data from 6th March 2021 to 31st March 2021  
 \*\*\*Data from 14th April 2021 to 30th April 2021  
 \*\*\*\*Data from 24th April 2021 to 30th April 2021

**Figure 2: Monthly percentage of time that each monitoring station location has recorded hydrogen sulphide concentrations above WHO odour annoyance level (7 µg/m<sup>3</sup>)**



Odours can become a nuisance and start to affect people, causing temporary symptoms including headache, nausea, dizziness, watery eyes, stuffy nose, irritated throat, cough or wheeze particularly if a person has a pre-existing respiratory condition, sleep problems and stress. Individuals will react differently to the odour of hydrogen sulphide. Some people may be more sensitive to hydrogen sulphide odour than others. As the hydrogen sulphide concentration increases more people would be expected to have symptoms, particularly when the concentration exceeds the WHO 30-minute odour annoyance level of 7 µg/m<sup>3</sup> on a regular basis. This is reflected in the impacts on the effects on people's wellbeing and the

symptoms they are experiencing, as reported to Staffordshire County Council’s Smell and Symptom Tracker ([link](#)).

Even at hydrogen sulphide concentrations below the WHO odour annoyance guideline value odour may still be present, however as concentrations fall to even lower levels it is anticipated that the strength of any odour should also reduce.

UKHSA strongly continues to recommend that all measures are taken to reduce the off-site odours from the landfill site.

### WHO 24-hour (average) guideline

The monitoring data has been converted to 24-hour averages for each of the monitoring days. At MMF1, MMF2 and MMF6 24-hour average values were significantly below the WHO 24-hour average guideline value of 150 µg/m<sup>3</sup>.

At MMF9, the 24-hour average guideline value was exceeded on two days during the monitoring period: 7 and 8 March 2021, with 24-hour average concentrations of 163 µg/m<sup>3</sup> (7 March 2021) and 202 µg/m<sup>3</sup> (8 March 2021). No further exceedances have occurred, and subsequent 24-hour average values were significantly below the WHO 24-hour average guideline value of 150 µg/m<sup>3</sup>.

Exposure to concentrations of hydrogen sulphide above the WHO 24-hour guideline value does not necessarily mean eye irritation or other health effects will occur, but it reduces the margin of safety that is considered desirable to protect health.

### Peak exposures

**Table 4: US Environmental Protection Agency (US EPA) Acute Exposure Guideline Levels (AEGs) for hydrogen sulphide**

	10 min	30 min	60 min	4 hour	8 hour
<b>AEG-1<sup>†</sup></b> ppb µg/m <sup>3</sup>	750 (1045)	600 (836)	510 (711)	360 (502)	330 (460)
<b>AEG-2<sup>††</sup></b> ppb µg/m <sup>3</sup>	41000 (57150)	32000 (44600)	27000 (37660)	20000 (27880)	17000 (23700)
<b>AEG-3<sup>†††</sup></b> ppb µg/m <sup>3</sup>	76000 (105900)	59000 (82240)	50000 (69690)	37000 (51570)	31000 (43210)

<sup>†</sup> The level of the chemical in air at or above which the general population could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

<sup>††</sup> The level of the chemical in air at or above which there may be irreversible or other serious long-lasting effects or impaired ability to escape.

<sup>†††</sup> The level of the chemical in air at or above which the general population could experience life-threatening health effects or death<sup>4</sup>.

Short-term peaks in hydrogen sulphide concentration have been compared against the US Environmental Protection Agency (US EPA) Acute Exposure Guideline Levels (AEGs) (see Table 4).

AEGLs are expressed as specific concentrations of airborne chemicals at which health effects may occur and used to assess peaks of exposure. They are designed to protect the elderly and children, and other individuals who may be susceptible.

The monitoring data from MMF1, MMF2, MMF6 and MMF9 were compared with AEGL-1 10-minute, 30-minute, 60-minute, 4-hour and 8-hour levels for hydrogen sulphide (Figures 1-4 in the Appendix). At MMF1, MMF2 and MMF6, all concentrations were significantly below the AEGL-1 values.

At MMF9, the AEGL-1 level was exceeded across the AEGL time frames between the 7 and 8 of March as set out in Table 1. No further exceedances have occurred, and all later concentrations were significantly below the AEGL-1 values.

Exposure to concentrations above the AEGL-1 values may cause notable discomfort, irritation or certain asymptomatic, non-sensory effects. However, the effects are not disabling, and are transient and reversible upon cessation of exposure.

**Table 1: AEGL-1 timeframes**

	<b>Acute Exposure Guideline Levels (AEGLs)</b>				
	<b>10 min</b>	<b>30 min</b>	<b>60 min</b>	<b>4 hour</b>	<b>8 hour</b>
<b>Timeframe of Exceedances of AEGL-1 at MMF9</b>	0615 - 0650 hrs (8 <sup>th</sup> March)	0550 - 0655 hrs (8 <sup>th</sup> March)	0415 - 0650 hrs (8 <sup>th</sup> March)	0210 - 0550hrs (8 <sup>th</sup> March)	2245 hrs (7 <sup>th</sup> March) – 0230 hrs (8 <sup>th</sup> March)

Note that exceedances of AEGLs occur when rolling-average concentrations over a given AEGL duration (ie, 10 min, 30min, 60min, 4 hour and 8hour) exceed the corresponding AEGL concentration.

### **Hydrogen sulphide medium term exposure**

To assess medium term exposure to hydrogen sulphide during 2021, the calculated average of the daily exposure concentrations from the March - August data have been compared against the Agency for Toxic Substances and Disease Registry (ATSDR) Intermediate Minimal Risk Level (MRL) of 30 µg/m<sup>3</sup>, which applies cumulatively to up to 1 year. The average daily hydrogen sulphide concentrations across the whole monitoring period were:

MMF1 (14/04/2021 to 31/08/2021): 1.8 µg/m<sup>3</sup>  
 MMF2 (05/03/2021 to 31/08/2021): 2.7 µg/m<sup>3</sup>  
 MMF6 (24/04/2021 to 31/08/2021): 2.2 µg/m<sup>3</sup>  
 MMF9 (06/03/2021 to 31/08/2021): 13.8 µg/m<sup>3</sup>

At all the monitoring stations, the average daily hydrogen sulphide concentrations over the period March to August 2021 are below the ATSDR Intermediate MRL. This means that the concentrations experienced so far in 2021 are unlikely to cause a lasting impact to physical health, and as such, any risk to long term (lifetime) physical health is likely to be small.

The monthly average and cumulative-monthly average hydrogen sulphide concentrations for MMF 9 (the monitoring station with the highest recorded concentrations of hydrogen sulphide) are shown in Figure 3 below. Monthly average hydrogen sulphide concentrations for complete months data is represented in Table 5 and Figure 4 below.

**Table 5: Monthly average concentrations for hydrogen sulphide**

Monitoring Station	March 2021 ( $\mu\text{g}/\text{m}^3$ )	April 2021 ( $\mu\text{g}/\text{m}^3$ )	May 2021 ( $\mu\text{g}/\text{m}^3$ )	June 2021 ( $\mu\text{g}/\text{m}^3$ )	July 2021 ( $\mu\text{g}/\text{m}^3$ )	August 2021 ( $\mu\text{g}/\text{m}^3$ )
MMF1	NS	3.0***	2.4	1.9	1.3	0.8
MMF2	5.8*	2.7	3.1	2.0	1.9	1.3
MMF6	NS	1.4****	3.6	2.4	1.5	1.2
MMF9	27.9**	26.5	15.7	7.2	5.7	4.1

NS = hydrogen sulphide not sampled

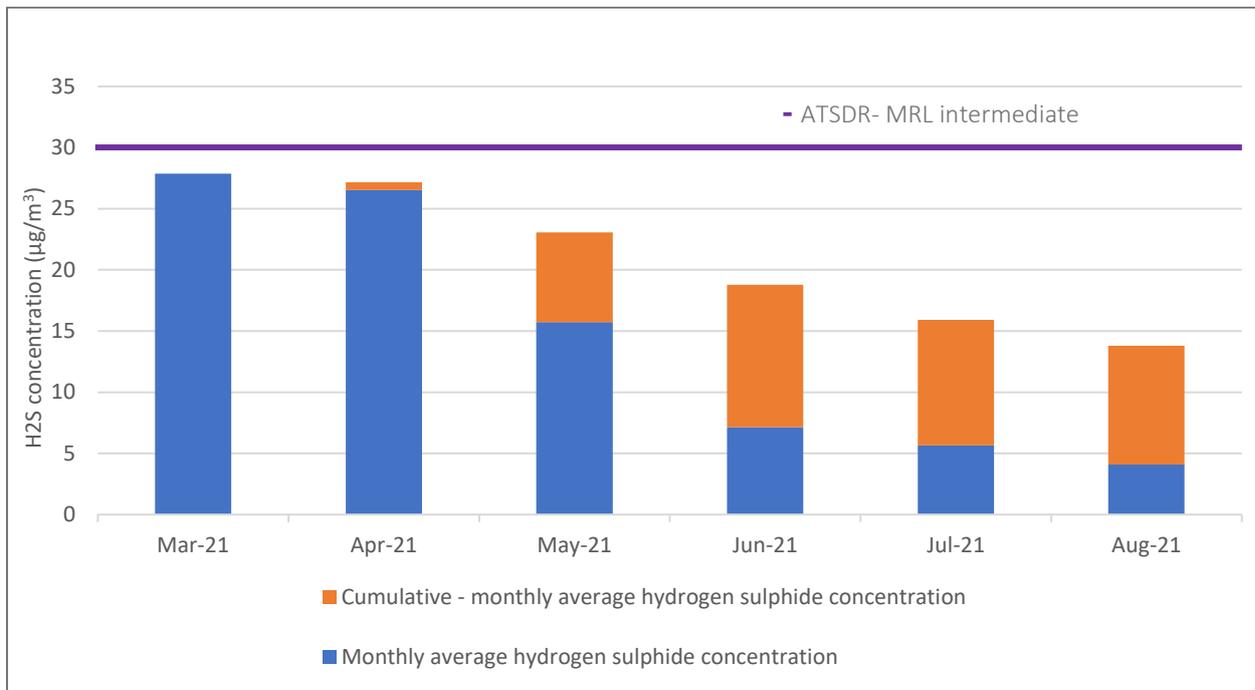
\*Data from 5th March 2021 to 31st March 2021

\*\*Data from 6th March 2021 to 31st March 2021

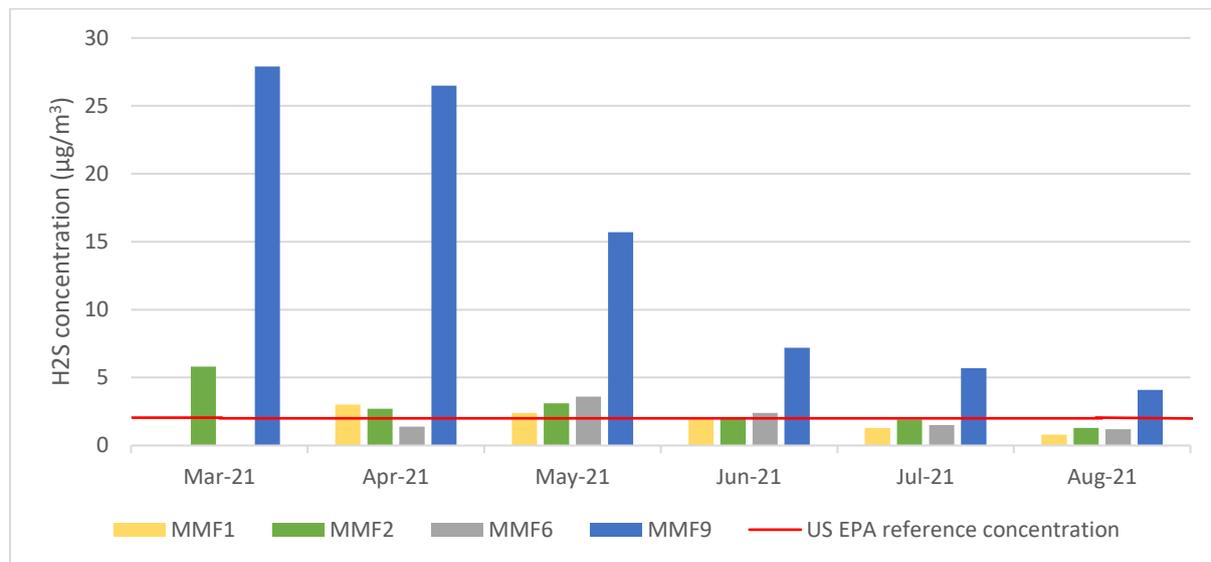
\*\*\*Data from 14th April 2021 to 30th April 2021

\*\*\*\*Data from 24th April 2021 to 30th April 2021

**Figure 3: MMF9 monthly average and cumulative-monthly average hydrogen sulphide concentrations**



**Figure 4: Monthly average hydrogen sulphide concentrations at each monitoring station**



### Hydrogen sulphide long-term exposure

To assess long term exposure to hydrogen sulphide, data has been compared against the US EPA Reference Concentration (RfC) shown in Table 2. The RfC is an estimate of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Exposure to concentrations of hydrogen sulphide above the US EPA RfC does not necessarily mean health effects will occur, but it reduces the margin of safety<sup>c</sup> that is considered desirable to protect health.

At MMF1, the monthly average concentrations since June 2021 have been below the US EPA RfC of 2 µg/m<sup>3</sup>. At MMF2 and MMF6, the monthly average concentrations since July 2021 have been below the US EPA RfC of 2 µg/m<sup>3</sup> (Figure 4). If these concentrations continue, the risk to long term (lifetime) health would be minimal.

At MMF9, the monthly average concentrations are reducing but they continue to be above the US EPA RfC (Figure 4). Currently, as the concentrations are below the ATSDR Intermediate MRL (see above), the risk to long term (lifetime) health is likely to be small, but it cannot be completely excluded if the monthly average concentrations continue to be above the US EPA RfC. The lower the concentrations become, the smaller any risk will be.

### Assessment of previous monitoring data for hydrogen sulphide

In considering, long term exposure to hydrogen sulphide, the previous monitoring data from 6/7/2017 to 14/2/2018 and 15/1/2019 to 25/6/2019 monitoring periods should also be taken into account in the assessment against the US EPA RfC shown in Table 2.

<sup>c</sup> Health-based guidance values are derived from animal or human data with a margin of safety applied to account for uncertainties in the data including potential differences in human response compared to that of an animal species and the variability in response in the human population due to factors such as genetic profile, age, and health status.

For the 2017/18 monitoring period the average 24-hour concentration was 0.85 µg/m<sup>3</sup> and for the 2019 the average 24-hour concentration was 0.95 µg/m<sup>3</sup>. These previous concentrations are below the US EPA value, therefore they would not be expected to contribute to any significant effects on health.

## Particulate matter

**Table 5: Particulate matter UK Air Quality Objectives**

Substance	UK limit values
PM <sub>10</sub>	50 µg/m <sup>3</sup> not to be exceeded more than 35 times a year 24 hour mean
	40 µg/m <sup>3</sup> Annual mean
PM <sub>2.5</sub>	25 µg/m <sup>3</sup> Annual mean

### PM<sub>10</sub>:

Average for MMF1 (12/04/2021 to 31/08/2021): 17.6 µg/m<sup>3</sup>

Average for MMF2 (04/03/2021 to 31/08/2021): 15.8 µg/m<sup>3</sup>

Average for MMF6 (29/04/2021 to 31/08/2021): 11.8 µg/m<sup>3</sup>

Average for MMF9 (05/03/2021 to 31/08/2021): 12.3 µg/m<sup>3</sup>

### PM<sub>2.5</sub>:

Average for MMF1 (14/04/2021 to 31/08/2021): 8.5 µg/m<sup>3</sup>

Average for MMF2 (04/03/2021 to 31/08/2021): 8.6 µg/m<sup>3</sup>

Average for MMF6 (24/04/2021 to 31/08/2021): 7.6 µg/m<sup>3</sup>

Average for MMF9 (05/03/2021 to 31/08/2021): 7.8 µg/m<sup>3</sup>

These results are all below the relevant annual air quality objectives.

## Nitrogen dioxide

**Table 6: Nitrogen dioxide (NO<sub>2</sub>) UK Air Quality Objectives**

Substance	UK limit values
NO <sub>2</sub>	200 µg/m <sup>3</sup> not to be exceeded more than 18 times a year 24-hour mean
	40 µg/m <sup>3</sup> Annual mean

Average for MMF2 (04/03/2021 to 31/08/2021): 13.7 µg/m<sup>3</sup>

Average for MMF9 (04/03/2021 to 31/08/2021): 8.8 µg/m<sup>3</sup>

These results are all well below the relevant annual air quality objectives in the UK Air Quality Strategy.

## Sulphur dioxide

**Table 7: Sulphur dioxide (SO<sub>2</sub>) UK Air Quality Objectives**

Substance	UK limit values
SO <sub>2</sub>	266 µg/m <sup>3</sup> not to be exceeded more than 35 times a year 15 min mean
	350 µg/m <sup>3</sup> not to be exceeded more than 24 times a year 1 hour mean
	125 µg/m <sup>3</sup> not to be exceeded more than 3 times a year 24 hour mean

Average for MMF1 (24/06/2021 to 31/08/2021): 1.1 µg/m<sup>3</sup>

Average for MMF6 (24/06/2021 to 31/08/2021): 1.1 µg/m<sup>3</sup>

Average for MMF9 (28/05/2021 to 31/08/2021): 3.8 µg/m<sup>3</sup>

The SO<sub>2</sub> data for the period averaged are all well below the respective limit values for SO<sub>2</sub> in the UK Air Quality Strategy. Therefore, no significant risks to health from SO<sub>2</sub> are expected during this monitoring period.

## Methane

Methane (CH<sub>4</sub>) is generally considered to be an asphyxiant rather than a toxic gas. It is typically only a risk to health in high concentrations in enclosed spaces. There are no ambient air quality standards. However, levels greater than 80% methane may cause asphyxia (1% methane is equivalent to 6,556 mg/m<sup>3</sup>) and the Lower Explosive Limit is 32,781 mg/m<sup>3</sup>.

The average concentration of methane recorded were:

MMF1 (14/04/2021 to 31/08/2021): 2.3 mg/m<sup>3</sup>

MMF2 (05/03/2021 to 31/08/2021): 2.6 mg/m<sup>3</sup>

MMF6 (24/04/2021 to 31/08/2021): 1.7 mg/m<sup>3</sup>

MMF9 (06/03/2021 to 31/08/2021): 4.2 mg/m<sup>3</sup>

All the maximum concentrations of methane were significantly below the values discussed above.

## Benzene, toluene, ethylbenzene and xylene (BTEX)

### Benzene

**Table 8: Benzene UK Air Quality Objective and health-based guidance value**

Substance	UK Air Quality Objective and health-based guidance value
Benzene	UK Air Quality Objective: 5 µg/m <sup>3</sup> (annual mean)
	Short-term Environmental Assessment Level (EAL)*: 30 µg/m <sup>3</sup> (24-hour mean)

\* EALs represent a pollutant concentration in ambient air at which no significant risks to public health are expected<sup>5</sup>.

Average for MMF2 (10/03/2021 to 11/08/2021): 0.21 µg/m<sup>3</sup>

Average for MMF9 (10/03/2021 to 11/08/2021): 0.25 µg/m<sup>3</sup>

Maximum 30-minute concentration for MMF2: 8.01 µg/m<sup>3</sup>  
Maximum 30-minute concentration for MMF9: 2.42 µg/m<sup>3</sup>

The calculated averages for the monitoring period are below the UK Air Quality Objective and the maximum 30-minute concentrations are below the short-term EAL therefore there would not be expected to be any significant risks to health at these levels of exposure.

## Toluene

**Table 9: Toluene health-based guidance values**

Substance	Health-based guidance values
Toluene	PHE indoor air quality guideline (long-term)*: 2300 µg/m <sup>3</sup> (24-hour average)
	PHE indoor air quality guideline value (short-term)*: 15,000 µg/m <sup>3</sup> (8-hour average)
	WHO odour detection threshold level**: 1000 µg/m <sup>3</sup> (30-minute average)

\*An estimate of a level human exposure to a chemical in air at which no significant risks to health are expected. Whilst these values have been set to assess indoor exposure, they are also relevant for assessment of outdoor exposure<sup>6</sup>.

\*\* The WHO recommends that the peak concentrations of toluene in air should be kept below the odour detection threshold level of 1000 µg/m<sup>3</sup> as a 30-minute average<sup>7</sup>.

Average for MMF2 (10/03/2021 to 11/08/2021): 1.94 µg/m<sup>3</sup>  
Average for MMF9 (10/03/2021 to 11/08/2021): 3.10 µg/m<sup>3</sup>

Maximum 30-minute concentration for MMF2: 51.45 µg/m<sup>3</sup>  
Maximum 30-minute concentration for MMF9: 26.71 µg/m<sup>3</sup>

The calculated averages and maximum 30-minute concentrations are below the health-based guidance values. Therefore, there would not be expected to be any significant risk to health at these levels of exposure.

## Ethylbenzene

**Table 10: Ethylbenzene health-based guidance values**

Substance	Health-based guidance values
Ethylbenzene	ATSDR chronic MRL*: 260 µg/m <sup>3</sup>
	ATSDR acute MRL*: 27,700 µg/m <sup>3</sup>

\*An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure. They are derived for acute (>1, ≤14 days), intermediate (>14, <364 days), and chronic (365 days and longer) exposure durations<sup>8</sup>.

Average for MMF2 (10/03/2021 to 11/08/2021): 0.77 µg/m<sup>3</sup>  
Average for MMF9 (10/03/2021 to 11/08/2021): 0.61 µg/m<sup>3</sup>

Maximum 30-minute concentration for MMF2: 121.56 µg/m<sup>3</sup>  
Maximum 30-minute concentration for MMF9: 88.58 µg/m<sup>3</sup>

The calculated averages and maximum 30-minute concentrations are below the health-based guidance values. Therefore, there would not be expected to be any significant risk to health at these levels of exposure.

## Xylene

**Table 11: Xylene health-based guidance values**

Substance	Health-based guidance values
Xylene	PHE indoor air quality guideline value (long-term)*: 100 µg/m <sup>3</sup>
	ATSDR acute MRL**: 9000 µg/m <sup>3</sup>

\*An estimate of a level human exposure to a chemical in air at which no significant risks to health are expected. Whilst these values have been set to assess indoor exposure, they are also relevant for assessment of outdoor exposure<sup>6</sup>.

\*\*An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure. They are derived for acute (>1, ≤14 days), intermediate (>14, <364 days), and chronic (365 days and longer) exposure durations<sup>9</sup>

Average for MMF2 (10/03/2021 to 11/08/2021): 2.28 µg/m<sup>3</sup>

Average for MMF9 (10/03/2021 to 11/08/2021): 1.63 µg/m<sup>3</sup>

Maximum 30-minute concentration for MMF2: 58.59 µg/m<sup>3</sup>

Maximum 30-minute concentration for MMF9: 140.28 µg/m<sup>3</sup>

The calculated averages for the monitoring period are below the PHE indoor air quality guideline value and the maximum 30-minute concentrations are below the ATSDR acute MRL therefore there would not be expected to be any significant risks to health at these levels of exposure.

## Conclusions

The monitoring results for particulate matter, nitrogen dioxide and sulphur dioxide were below UK air quality objectives. Levels of volatile organic compounds (VOCs) (namely benzene, toluene, ethylbenzene and xylene (BTEX)) were below health-based guidance values. Therefore, there would be minimal risks to health at these levels of exposure.

The results for hydrogen sulphide continue to be above the WHO odour annoyance guideline value for a considerable percentage of the time at one of the monitoring sites, which is undesirable due to the effects on people's wellbeing and the symptoms they are experiencing.

For the majority of the monitoring period from March to August 2021 the concentrations of hydrogen sulphide were below the short term WHO 24-hour health-based guideline value and AEGL values. The WHO 24-hour value and the AEGLs values were exceeded over a 2-day period on 7 and 8 March 2021. Exposure to concentrations above these values could potentially cause notable discomfort and irritation. Exceedances of these values does not necessarily mean health effects will occur, but it reduces the margin of safety that is generally considered to be desirable to protect health.

The hydrogen sulphide data up to the end of August 2021 shows continuing exposure to the population around the site, albeit concentrations in August continue to decrease compared to those seen from March to July. At three of the monitoring sites concentrations are now below the US EPA (RfC) long-term (lifetime) health-based guidance value. To assess the risk from the monitored concentrations in 2021, the concentrations have been compared to the ATSDR intermediate MRL for exposure between 14 - 364 days, and the MRL has not been exceeded. As a result, currently any risk to long term physical health is likely to be

small, however we cannot completely exclude a risk to health from pollutants in the area, where exposure continues above the long-term health-based guidance values. Short term transient health effects may be experienced such as irritation to the eyes, nose and throat, in addition to effects resulting from odour such as headache, nausea, dizziness, watery eyes, stuffy nose, irritated throat, cough or wheeze, sleep problems and stress. Individuals with pre-existing respiratory conditions may be more susceptible to these effects. With continuing exposure these effects may be prolonged, but are not anticipated to continue long term, once exposure has decreased to acceptable levels.

The EA and multi-agency partners will also be assessing additional factors such as meteorological conditions, complaints, and distance to receptors from the monitoring stations. UKHSA will continue supporting the other agencies with this work.

Overall, UKHSA continues to strongly recommend that all measures are taken to reduce the off-site odours from the landfill site, as early as possible, and reduce the concentrations in the local area to levels below those health-based guidance values used to assess long term exposure.

## References

- 1 World Health Organization (WHO) air quality guideline [Microsoft Word - 6.6-hydrogen sulfide.doc \(who.int\)](#)
- 2 U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological profile for Hydrogen Sulphide, 2006. <http://www.atsdr.cdc.gov/ToxProfiles/tp114.pdf>
- 3 U.S. Environmental Protection Agency Reference Concentration for Hydrogen Sulphide. [https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance\\_nmbr=61](https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=61)
- 4 Hydrogen Sulphide Acute Exposure Guideline Levels (AEGs) [Acute Exposure Guideline Levels for Airborne Chemicals | US EPA](#)
- 5 Environment Agency Environmental Assessment Levels (EALs) <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>
- 6 Public Health England. Indoor Air Quality Guidelines for selected Volatile Organic Compounds (VOCs) in the UK, 2019. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/831319/VO\\_statement\\_Final\\_12092019\\_CS\\_1\\_.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/831319/VO_statement_Final_12092019_CS_1_.pdf)
- 7 World Health Organization (WHO) air quality guideline, Toluene.

[https://www.euro.who.int/\\_data/assets/pdf\\_file/0005/74732/E71922.pdf](https://www.euro.who.int/_data/assets/pdf_file/0005/74732/E71922.pdf)

8 U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological profile for ethylbenzene, 2010.

<https://www.atsdr.cdc.gov/ToxProfiles/tp110.pdf>

9 U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological profile for xylene, 2007.

<https://www.atsdr.cdc.gov/toxprofiles/tp71.pdf>

# Appendix

## Figure 1: MMF1 Hydrogen sulphide

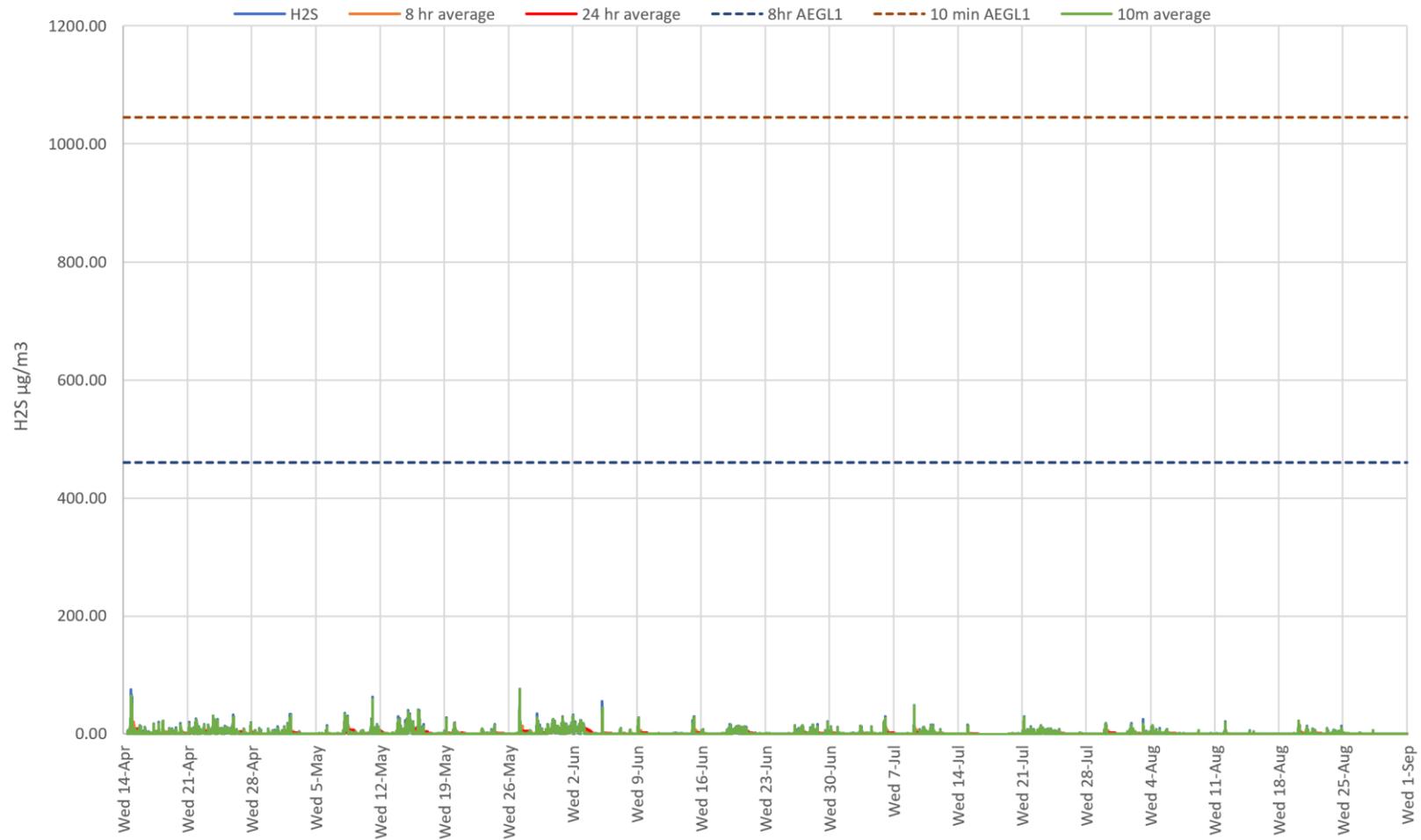


Figure 2: MMF2 Hydrogen sulphide

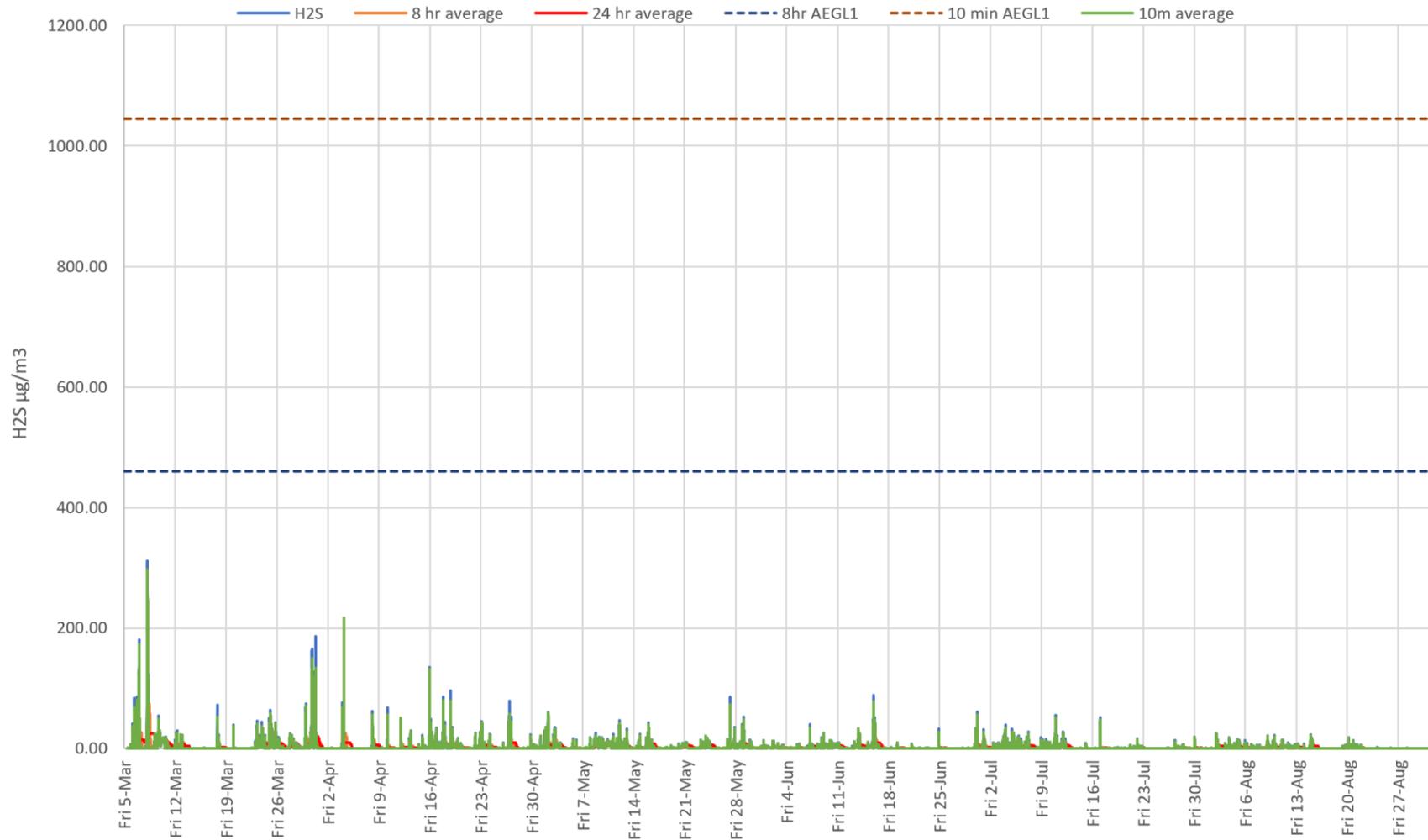


Figure 3: MMF6 Hydrogen sulphide

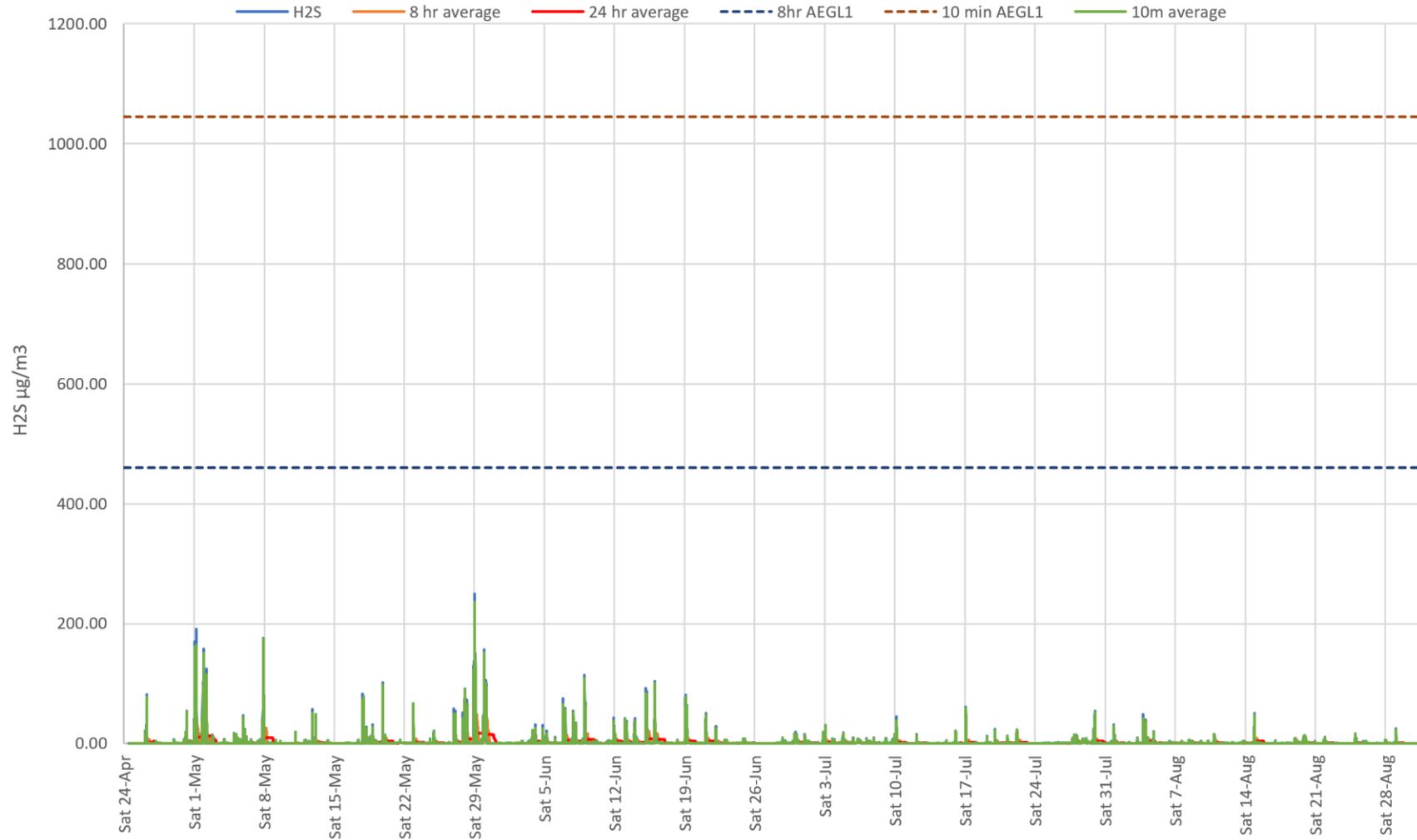


Figure 4: MMF9 Hydrogen sulphide

