Air Quality in Helsby

2020 Annual Report

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Executive summary

This report provides details and results of the air quality monitoring programme that took place at Helsby, Cheshire from 1st January to 31st December 2020.

The work was carried out by Ricardo Energy and Environment on behalf of Peel NRE Limited. The monitoring programme includes measurements of particulates (PM_{10} and $PM_{2.5}$), heavy metals, and Toxic Organic Micro Pollutants (dioxins, furans, dioxin like polychlorinated biphenyls, and polycyclic aromatic hydrocarbons), to assess their concentrations against the relevant air quality objectives.

Hourly PM_{10} and $PM_{2.5}$ monitoring was carried out using a Fine Dust Analysis System (FIDAS). The data capture rate for PM in 2020 was 90%. The annual means measured in 2020 for PM_{10} and $PM_{2.5}$ were 11.2 μgm^{-3} and 6.7 μgm^{-3}, respectively. The annual mean AQS objectives are >40 μgm^{-3} for PM_{10} and >25 μgm^{-3} for $PM_{2.5}$, therefore, the annual means are below the limit values. The 24-hour mean PM_{10} limit is 50 μgm^{-3} which may not be exceeded more than 35 times per year to meet the objective. There were no exceedances of this limit in 2020, therefore the objective was met.

Monthly collated filter samples of PM_{10} were analysed for a number of heavy metals. The mean values were compared to the UK AQS Objective for lead and Ambient Air Directive target values or Environment Assessment Levels for other compounds where applicable. All heavy metal concentrations were below the target values in 2020.

Dioxins, furans, dioxin like polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) were extracted from samples collected and collated every three months from a High-Volume sampler. Benzo(a)pyrene (B[a]P) is used as a marker for PAHs in ambient air. The mean concentrations of B[a]P in 2020 was 0.071 ngm^{-3}, which is well below the annual mean European target value of 1 ngm^{-3} and the UK objective of 0.25 ngm^{-3}.

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Tables

1 Introduction

This report produced on behalf of Peel NRE Limited, relates to the period 1st January 2020 to 31st December 2020 during which time air quality monitoring of dioxins, furans, particulates, PAHs and heavy metals were undertaken in Helsby, Cheshire.

The monitoring, commissioned on behalf of Peel NRE, followed on from an original contract with the Bioenergy Infrastructure Group (B.I.G) acting on behalf of Ince Bio Power Ltd. The original contract, which was completed in July 2020, was to monitor pollutants prior to and post construction and commissioning of a new biomass renewable energy power plant in Cheshire (Plot 9, Ince Resource Recovery Park). Further information on the air quality monitoring which took place during this initial survey can be found in a report located on the Protos website.[1]

Monitoring continued without a break following the initial survey and will be ongoing to provide members of the local and wider community with air quality data on an annual basis. It will also provide monitoring required by businesses operating at Protos to ensure compliance with planning conditions.

During the period 1st January 2020 to 31st December 2020, activity on site at Protos included the operational biomass renewable energy power plant, ground preparation works, construction of two sub-stations, and ongoing estate management.

2 Monitoring Site and Methods

2.1 Monitoring Station

The monitoring station was set up in 2016 on land owned by Helsby Parish Council adjacent to an office building accessed from Mountain View, Helsby. The site was previously used by Ince Bio Power Ltd and will continue to be used for the purposes of ongoing monitoring for current and future facilities located at Protos.

Protos is an energy and resource site of 54ha, currently under development by Peel NRE. During 2020 two plots within Protos were occupied at the site. Figure 1 shows the location of the monitoring station (blue marker) with respect to the Protos development (as shown by the red line), and the operational Ince Bio Power Plant and Ince Park Renewables Ltd (orange markers).

This plan will be updated each year to show facilities at Protos which have been under construction, under commissioning, or operational during the reporting year.

[1] https://www.protos.co.uk/media-centre/community-downloads/#air-quality-documents.

Figure 1: Location of Helsby monitoring station (blue marker) and the Protos development. Details on current operational facilities within the Protos development (orange markers) are shown in the insert.

2.2 Pollutants Monitored

The monitoring station set up in Helsby is shown in Figure 2. The following sections provide an overview of the pollutants that Ricardo Energy & Environment were contracted to measure at the site in Helsby throughout 2020, firstly by B.I.G., then since July 3rd 2020, by Peel NRE. In addition, hourly meteorological data from Liverpool John Lennon Airport (located 9 km NW of the monitoring station) were sourced from the NOAA Integrated Surface Databased (NOAA, 2020) and accessed using the worldmet R package (Carslaw, 2020).

Figure 2: Monitoring station located on land adjacent to RSK offices accessed from Mountain View in Helsby.

2.2.1 Particulate Matter

Airborne particulate matter varies widely in its physical and chemical composition, source and particle size. The terms PM_{10} and $PM_{2.5}$ are used to describe particles with an effective size with a median aerodynamic diameter of 10 and 2.5 µm respectively. These are of greatest concern with regard to human health, as they are small enough to penetrate deep into the lungs. They can cause inflammation and a worsening of the condition of people with heart and lung diseases. In addition, they may carry surface absorbed carcinogenic compounds into the lungs. Particles with a median aerodynamic diameter greater than 10 µm are less likely to travel as far into the respiratory system. These larger particles are also removed more readily from the air by sedimentation.

The main source of airborne particulate matter in the UK is combustion (industrial, commercial and residential fuel use). Other large sources include production processes, agriculture and road transport. PM and its precursors can also be transported long distances, and transboundary pollution from the continent can result in increased PM in the UK.

PM_{10} and $PM_{2.5}$ were measured using an MCERTS approved Fine Dust Analysis System (FIDAS). The FIDAS analyser utilises an LED to determine particle numbers and particle size distribution through light scattering of individual particles.

The output is recorded and stored every 10 seconds and averaged to 15 minute average values by an on-site data logger. This logger is connected to a modem to download the data to Ricardo Energy & Environment. The data are then converted to concentration units and averaged to hourly mean concentrations. Data were processed according to the rigorous quality assurance and quality control procedures used by Ricardo Energy & Environment, and ratified every six months, to produce the final dataset reported here.

2.2.2 Heavy Metals

Heavy metals are toxic metallic elements that can result in adverse health effects. Anthropogenic sources of heavy metals include emissions from industrial processes and fuel combustion.

An annual mean limit value of 0.5 μgm^{-3} for lead in the PM_{10} particulate fraction of ambient air was defined in the Air Quality Directive (2008/50/EC). Following this, target values for arsenic (6 ngm^{-3}), cadmium (5 ngm^{-3}), and nickel (20 ngm^{-3}), were set out in the Fourth Daughter Directive (2004/107/EC).

A Partisol 2025 sampler was used to collect particulates in the PM_{10} fraction on a weekly schedule. The weekly filters were collated into monthly samples and sent to an analytical laboratory to be analysed for heavy metals using including: Arsenic, Cadmium, Cobalt, Chromium, Mercury, Manganese, Nickel, Lead, Antimony, Thallium, Vanadium, Zinc, via UKAS accredited procedures, and Chromium VI (not accredited).

2.2.3 Toxic Organic Micro Pollutants (TOMPs)

Toxic Organic Micro Pollutants include a range of persistent organic pollutants (POPs), such as polychlorinated-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). Exposure to POPs can have an adverse impact on human health and the environment. The main source of POPs in recent years in the UK are unintentional by-products from the incomplete combustion of fuels.

A High Volume sampler was used to collect samples for analysis of dioxins, furans, dioxin like PCBs and PAHs. Samples were collected every 2 weeks and collated into 3 monthly samples (Table 1). The method used for the analytical measurement complies with BS EN 1948-3:2006 for dioxins and BS EN 1948-4:2006 for dioxin like PCBs.

Table 1: Start and end dates of 3-monthly periods for TOMPs sampling in 2020.

Period	Start Date	End Date
Period 1	02/01/2020	08/04/2020
Period 2	08/04/2020	18/06/2020
Period 3	18/06/2020	22/09/2020
Period 4	22/09/2020	30/12/2020

2.3 Air Quality Limit Values

Table 2 shows the current UK objectives (included in the Air Quality Regulations and subsequent Amendments for the purpose of Local Air Quality Management), and European air quality objectives, for the pollutants monitored at Helsby for this report. Where target analytes do not have a limit UK objective limit value, Ambient Air Directive (AAD) target values or Environmental Assessment Levels (EALS) used for Environmental Permit Risk assessments (Defra, Air emissions risk assessment for your environmental permit, 2016) were adopted for the purpose of this study, as shown in Table 3.

Table 2: UK and European air quality objectives for pollutants measured at Helsby.

Pollutant	UK Objective	European Objective	Measured as
PM_{10}	50 μgm^{-3} not to be exceeded more than 35 times a year	50 μgm^{-3} not to be exceeded more than 35 times a year	24 hour mean
PM_{10}	40 μgm^{-3}	40 μgm^{-3}	annual mean
$PM_{2.5}$	25 μgm^{-3}	25 μgm^{-3}	annual mean
Polycyclic Aromatic Hydrocarbons (PAH)	0.25 ngm^{-3} B[a]P	1 ngm^{-3} B[a]P	annual mean
Lead	0.25 μgm^{-3}	0.5 μgm^{-3}	annual mean

Table 3: UK and European air quality objectives for pollutants measured at Helsby.

Pollutant	Adopted limit (ngm^{-3})	Standard	Measured as
Arsenic (As)	6	AAD Target Value	annual mean
Cadmium (Cd)	5	AAD Target Value	annual mean
Copper (Cu)	10000	Environmental Assessment levels	annual mean
Mercury (Hg)	250	Environmental Assessment levels	annual mean
Manganese (Mn)	150	Environmental Assessment levels	annual mean
Nickel (Ni)	20	AAD Target Value	annual mean
Antimony (Sb)	5000	Environmental Assessment levels	annual mean

3 Results and Discussion

The pollutant data measured at Helsby during 2020 have been analysed and where applicable, measurements have also been assessed with respect to current Air Quality Objectives.

3.1 Meteorological Conditions

Figure 3 shows the distribution of wind speed and wind direction (wind rose) for each month at Liverpool John Lennon Airport. The “spokes” show the direction the wind is coming from, a longer spoke means a higher frequency of wind from that direction and the colours represent the wind speed (purple= high winds, yellow = calm winds). February 2020 was a particularly windy month, with strong winds arriving from the west. February was when Storm Ciara and Storm Dennis arrived at the UK. On the other hand, during April, there were a high proportion of winds arriving from the East. Easterly winds can often bring polluted air from the continent, which may result in elevated levels of pollutants observed in the UK.

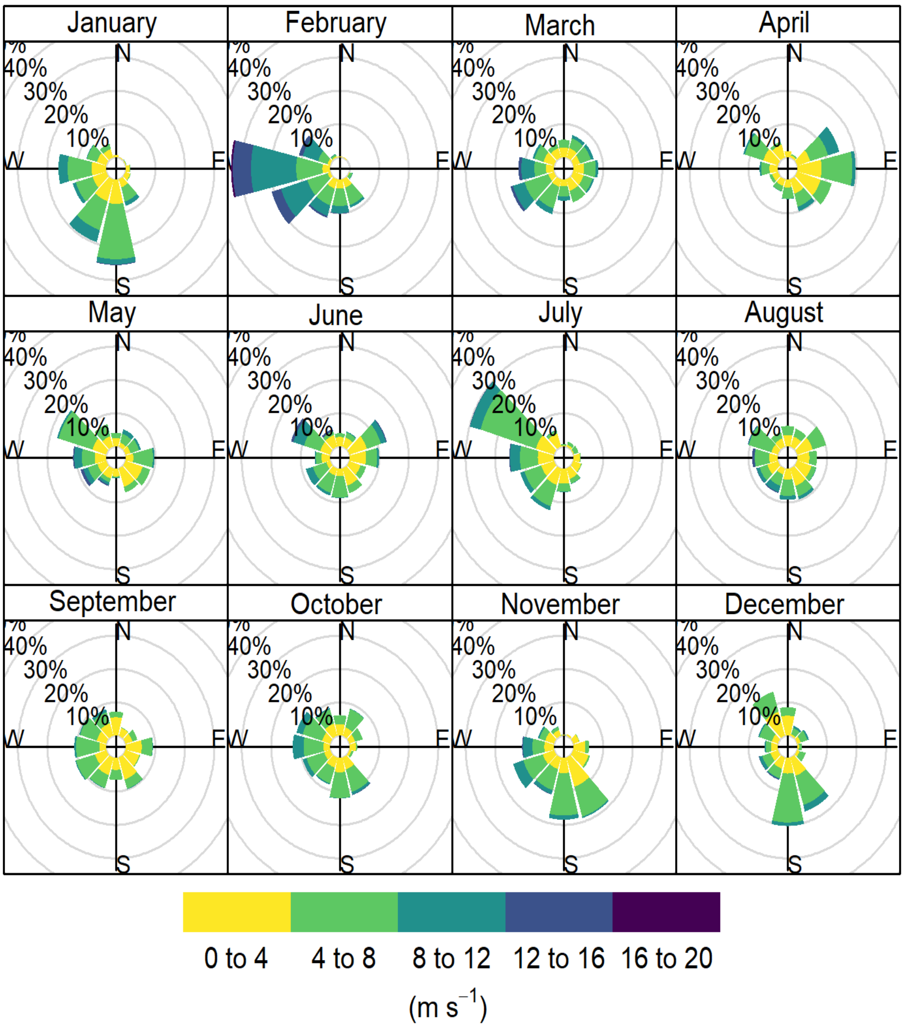

Figure 3: Monthly wind roses for Liverpool John Lennon Airport. Data source: NOAA Integrated Surface Database (ISD) (NOAA, 2020).

3.2 PM Data Analysis

3.2.1 Summary Statistics

Table 4 shows a summary of the PM data for 2020. The period mean concentrations are below the annual mean air quality objectives for PM_{10} and $PM_{2.5}$. There were no exceedances of the PM_{10} daily mean objective during 2020, therefore the objective was met. The data capture rates in 2020 for both PM fractions is 90%.

Table 4: Summary statistics and exceedances for particulate matter measured at Helsby in 2020.

Statistic	PM_{10}	$PM_{2.5}$
Annual Mean (μgm^{-3})	11.2	6.7
Hourly Maximum (μgm^{-3})	91.6	81.8
Daily Maximum (μgm^{-3})	44	35.9
Data Capture rate (%)	90.3	90.3
Period mean > annual mean objective	No	No
Exceedances (daily mean > 50 μgm^{-3})	0	0

3.2.2 AQ Index Distribution

The plots below illustrate the distribution of AQ index values for Helsby for PM_{10} and $PM_{2.5}$. The AQIs are based on the daily mean for PM and each plot shows the number of days that concentrations measured are in each index. The index ranges from 1 to 10 and separated into four different bands: 1-3 = Low, 4-6 = Moderate, 7-9 = High, and 10 = Very High. Further information on the AQ Index is available in Appendix A1 and from UK-Air[2]. During 2020, there were no days recorded when the PM_{10} AQI went above the "Low" banding (Index 1-3). For $PM_{2.5}$ there was one day in 2020 when the AQI was in the "Moderate" banding (Index 4), with the rest recorded as "Low".

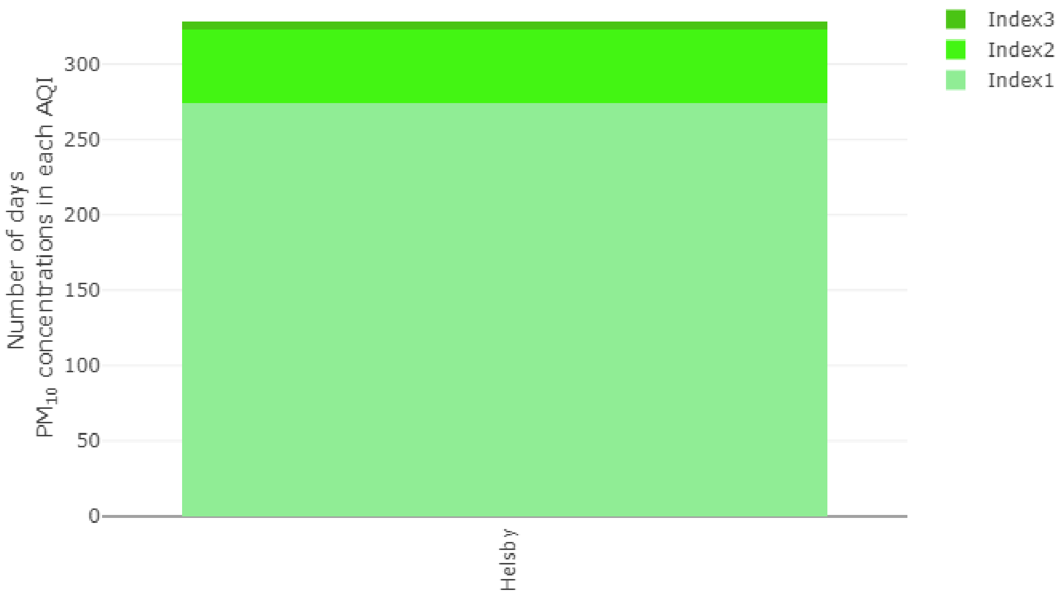

Figure 4: Distribution of AQI for PM_{10}.

[2] Defra "Daily Air Quality Index". https://uk-air.defra.gov.uk/air-pollution/daqi

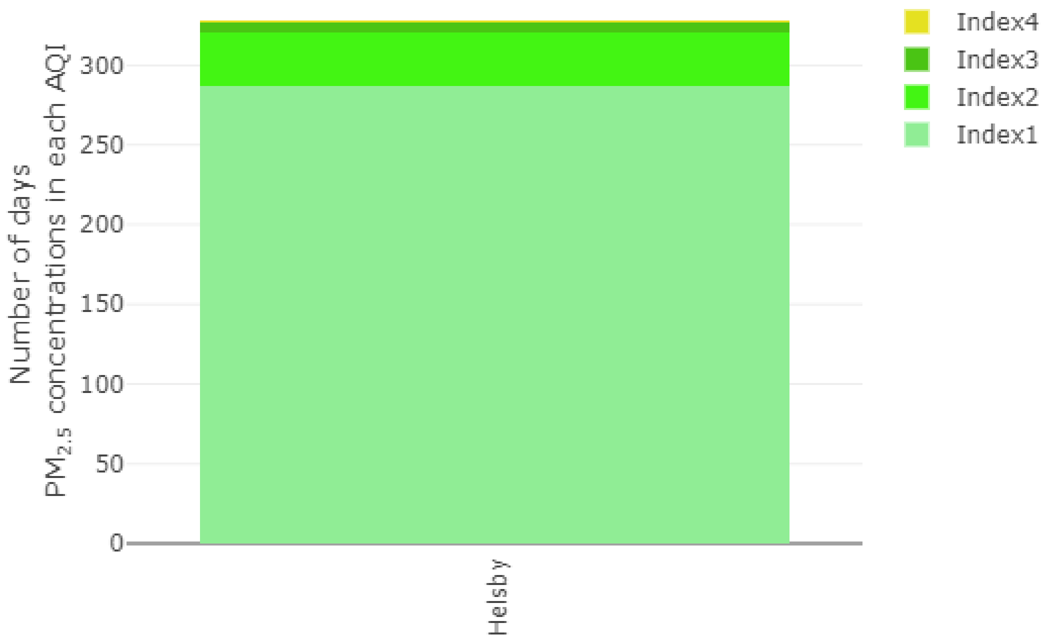

Figure 5: Distribution of AQI for $PM_{2.5}$.

3.2.3 Time Series

Figure 6 shows 24 hour averaged time series of PM_{10} and $PM_{2.5}$ measured at Helsby during 2020.

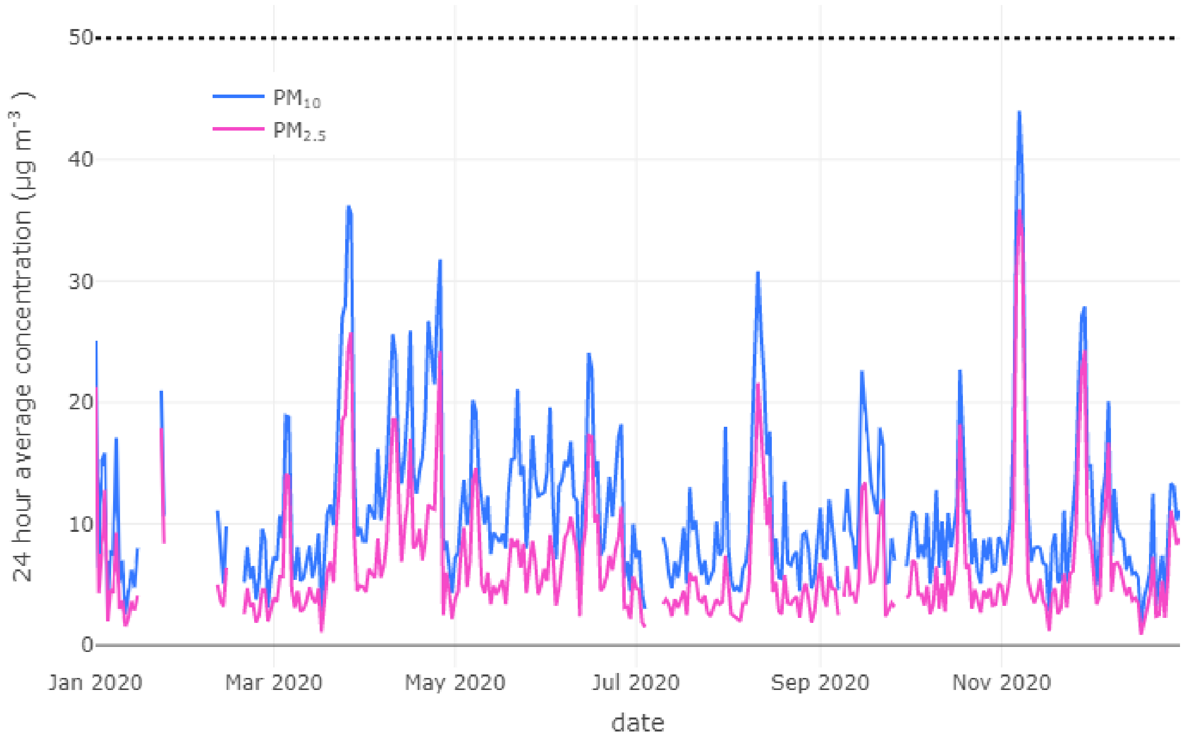

Figure 6: 24 hour average PM_{10} and $PM_{2.5}$ concentrations measured at Helsby during 2020. The dashed line represents the PM_{10} 24 hour objective.

3.2.4 Time Variations

As PM_{10} and $PM_{2.5}$ are continuously measured on an hourly time period, the variability over short and long time periods can be assessed. Figure 7 shows the daily, weekly, and monthly variability in concentrations for 2020.

Seasonal: Variations in the PM concentrations across seasons can be seen in the "month" plot in Figure 7. PM concentrations were elevated over winter/spring during 2020. There is likely to be an increase in emissions from residential heating during these colder months. This coupled with low dispersion under cold/stable conditions can result in elevated levels of PM. Long range transport of pollutants can also result in an increase in PM in the UK. Despite the national lockdown being in place, the highest PM levels were still observed in April 2020. As shown in (Figure 3) there were a high proportion of easterly winds measured at the nearby Liverpool John Lennon Airport during April. Air masses arriving from the east can transport pollutants from the continent resulting in an increase in PM.

Weekly: The weekly cycles for PM_{10} and $PM_{2.5}$ are very similar with the lowest concentrations typically observed on a Saturday, which may be related to local traffic.

Diurnal: The diurnal cycle, as seen in the "hour" plot in Figure 7, shows a minimum in PM_{10} and $PM_{2.5}$ around noon, and peaks in the morning and evening.

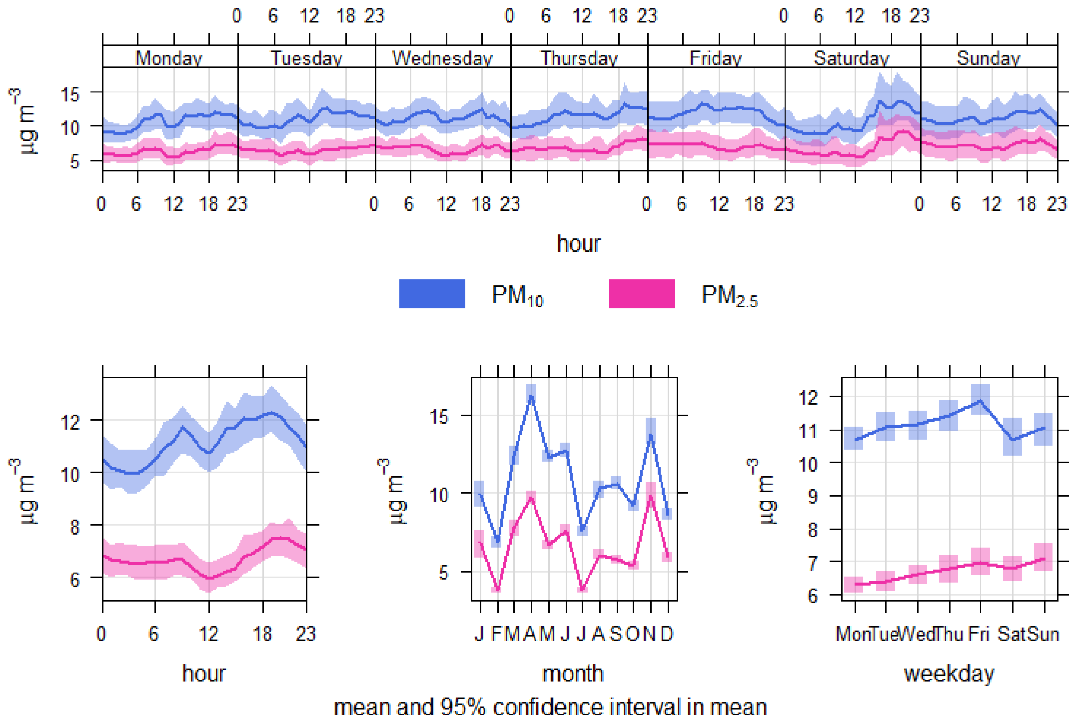

Figure 7: Temporal variations in PM_{10} and $PM_{2.5}$ concentrations measured at Helsby during 2020.

3.2.5 Calendar Plots

The plots below show daily variation in concentrations by pollutant for each month in 2020. The colours shown for each day relate to the concentration. The highest daily mean PM_{10} and $PM_{2.5}$ concentrations were observed from 6th to 8th November.

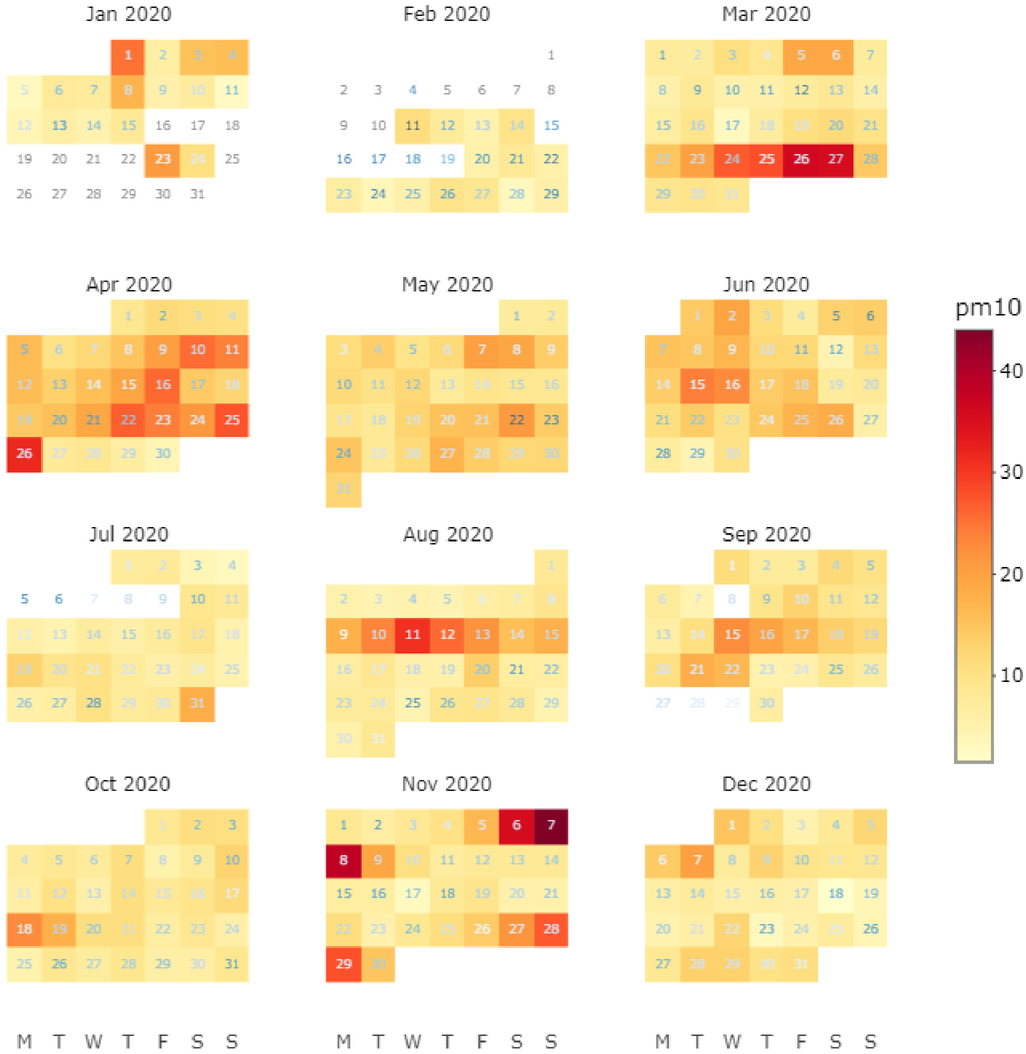

Figure 8: Calendar plot for PM_{10} measured at Helsby during 2020.

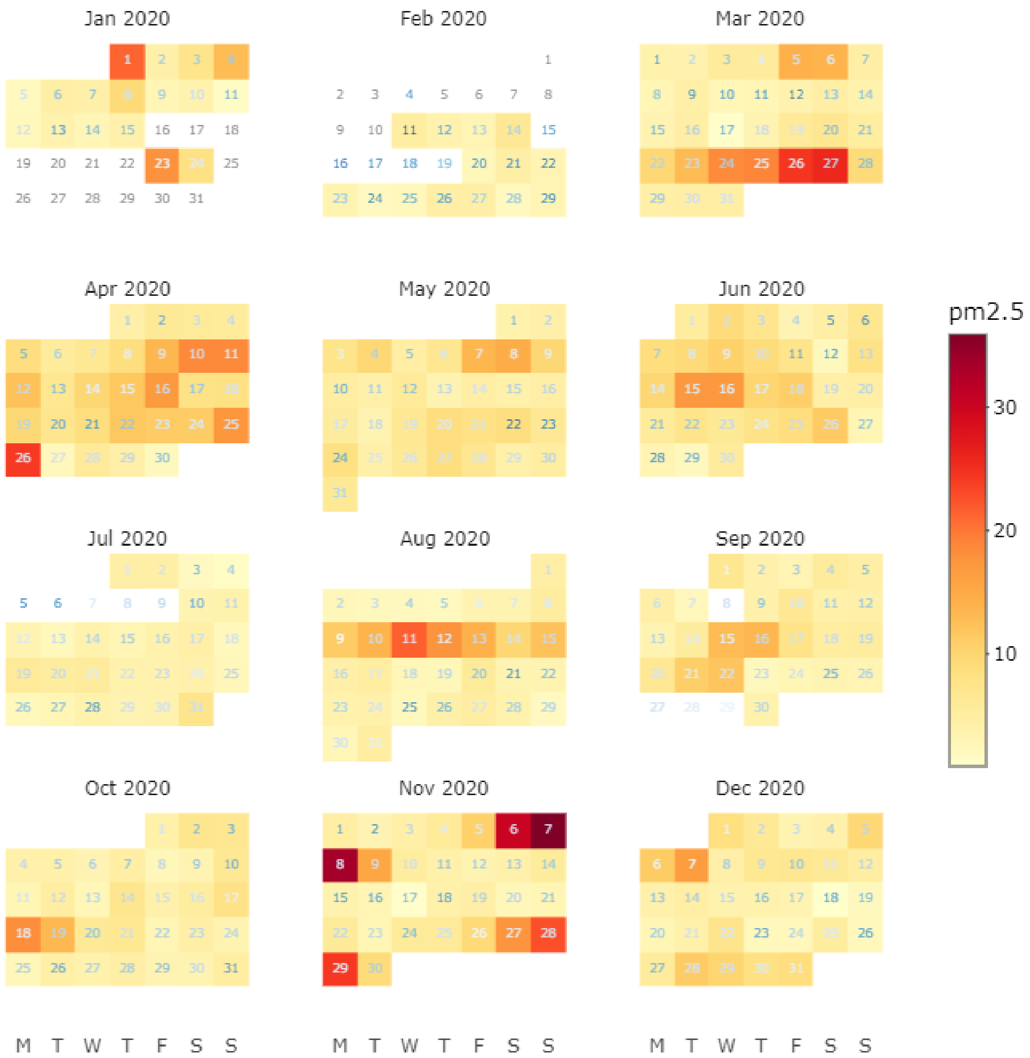

Figure 9: Calendar plot for $PM_{2.5}$ measured at Helsby during 2020.

3.2.6 Polar Plots

To investigate possible sources of PM in 2020, meteorological data measured at Liverpool John Lennon Airport was used to assess the hourly mean PM_{10} and $PM_{2.5}$ concentrations with wind speed and wind direction.

Figure 10 and Figure 11 show bivariate polar plots or “pollution roses” of PM_{10} and $PM_{2.5}$, respectively. The plots indicate how the PM concentration varies with wind direction and wind speed, with blue colours representing low PM levels, and red colours high PM levels.

PM_{10}: In 2020, the highest concentrations of PM_{10} were observed when the wind was from the South West under high (>10 ms^{-1}) wind speeds.

$PM_{2.5}$: Similar to PM_{10} higher concentrations were observed from the south west at high wind speeds, however, the highest $PM2_5$ concentrations were observed under low wind speeds and in all directions in 2020, which may be related to a more local source.

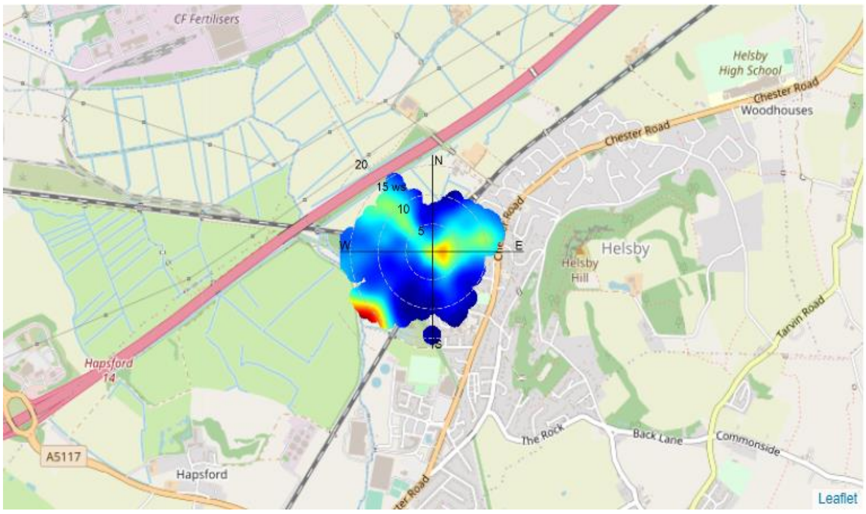

Figure 10: Bivariate polar plot of PM_{10} for 2020.

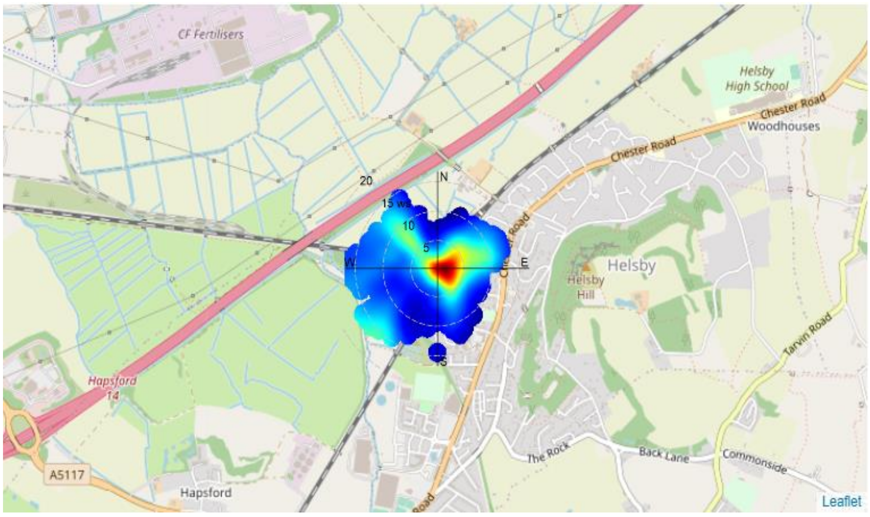

Figure 11: Bivariate polar plot of $PM_{2.5}$ for 2020

3.3 Heavy Metals Analysis

Annual averages for heavy metal concentrations measured during 2020 are given in Table 5. Where no regulations apply, Ambient Air Directive target values or Environment Assessment Levels outlined in Table 3 have been used where available. Annual averages with and without measurements below detectable limits are provided. During 2020, all heavy metal concentrations measured were below the target values.

Table 5: Summary statistics for heavy metals during 2020.

Adopted limits ng.m^{-3}	As 6	Cd 5	Co -	Cr -	Cu 10000	Hg 250	Mn 150	Ni 20	Pb 250	Sb 5000	Tl -	V -	Zn -	Cr VI -
Annual Average	3.4	3.8	1.5	11	13	3.8	6.9	3.6	11	3.6	7.5	2.7	6.2	1.3
% of limit	57	75			0.13	1.5	4.6	18	4.6	0.073				
Annual Average (without < LOD)	2.3			11	13		6.6	3.7	11	3.3		2.3	14	
% of limit (without < LOD)	38				0.13		4.4	19	4.5	0.065				

Figure 12 shows a time series of the metal concentrations for each month, during 2020. Data from the analysis of the monthly samples are provided in Table C1 in Appendix A3.

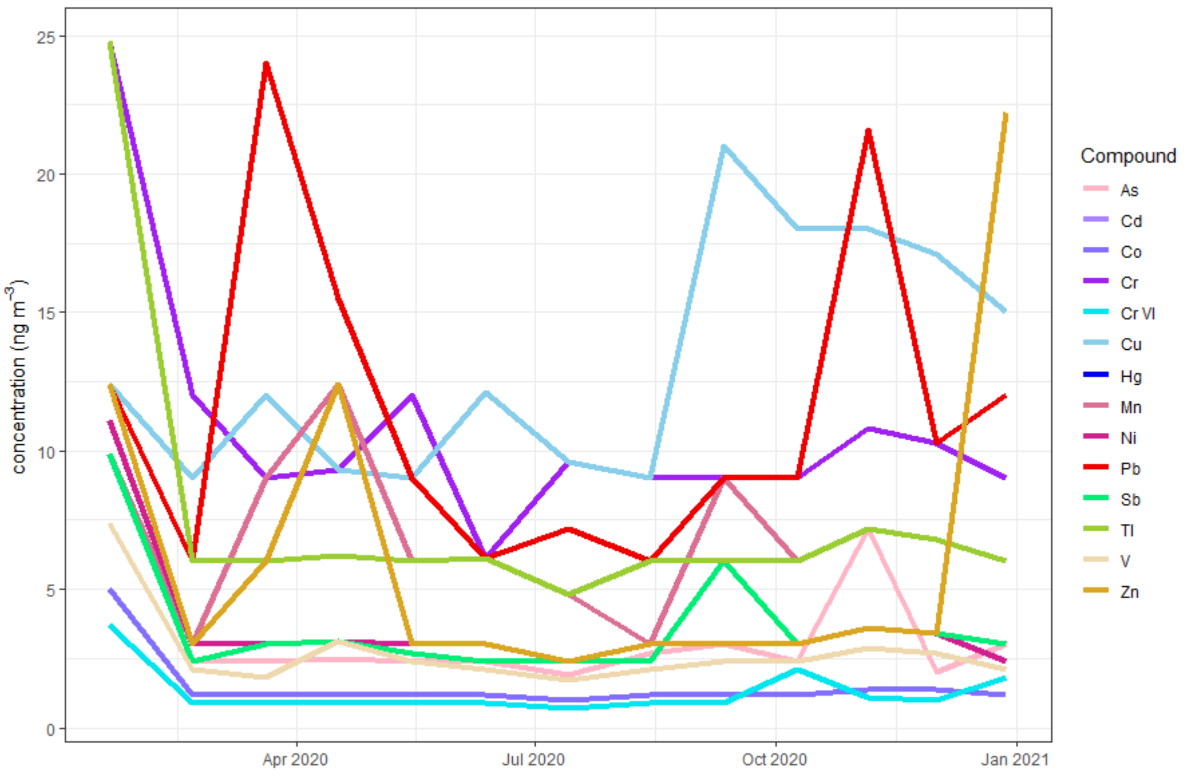

Figure 12: Heavy metal concentrations measured at Helsby during 2020. Points shown at mid-point of 4-week period.

3.4 PAH Analysis

Table 6 shows the period mean of the measured PAHs in PM_{10} calculated from the 3-monthly samples in 2020. All compounds sampled were above the LOD. Benzo(a)pyrene (B[a]P) is used as a marker for assessment of PAHs against UK and European objectives. The annual mean concentration of B[a]P in 2020 was 0.071 ngm^{-3}, which is well below the European target value of 1 ngm^{-3} and below the stricter UK objective of 0.25 ngm^{-3}. To assess the use of B[a]P as a marker for PAHs, additional PAHs are required to be measured as per the Fourth Daughter Directive (DD4). These additional compounds should include at a minimum: benz[a]anthracene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-cd]pyrene and dibenz[a,h]anthracene. All these compounds were measured at Helsby, along with other PAHs.

Table 6: Summary statistics for PAHs during 2020 2. Benzo(a)pyrene is used for assessment of PAHs against air quality objectives.

Compound	Annual Mean (ngm^{-3})
Napthalene	0.085
Acenapthylene	0.16
Acenapthene	0.35
Fluorene	0.41
Phenanthrene	1.4

Compound	Annual Mean (ngm^{-3})
Anthracene	0.11
Fluoranthene	0.87
Pyrene	0.78
Benzo(a)anthracene	0.12
Chrysene	0.11
Benzo(b+j)fluoranthene	0.031
Benzo(k)fluoranthene	0.034
Benzo(a)pyrene	0.071
Indeno(1,2,3-cd)pyrene	0.049
Dibenzo(ah/ac)anthracene	0.0038
Benzo(ghi)perylene	0.038

Concentrations of PAHs for each of the four periods in 2020 are shown in Figure 13. The data for each period are provided in Table C2 in Appendix A3.

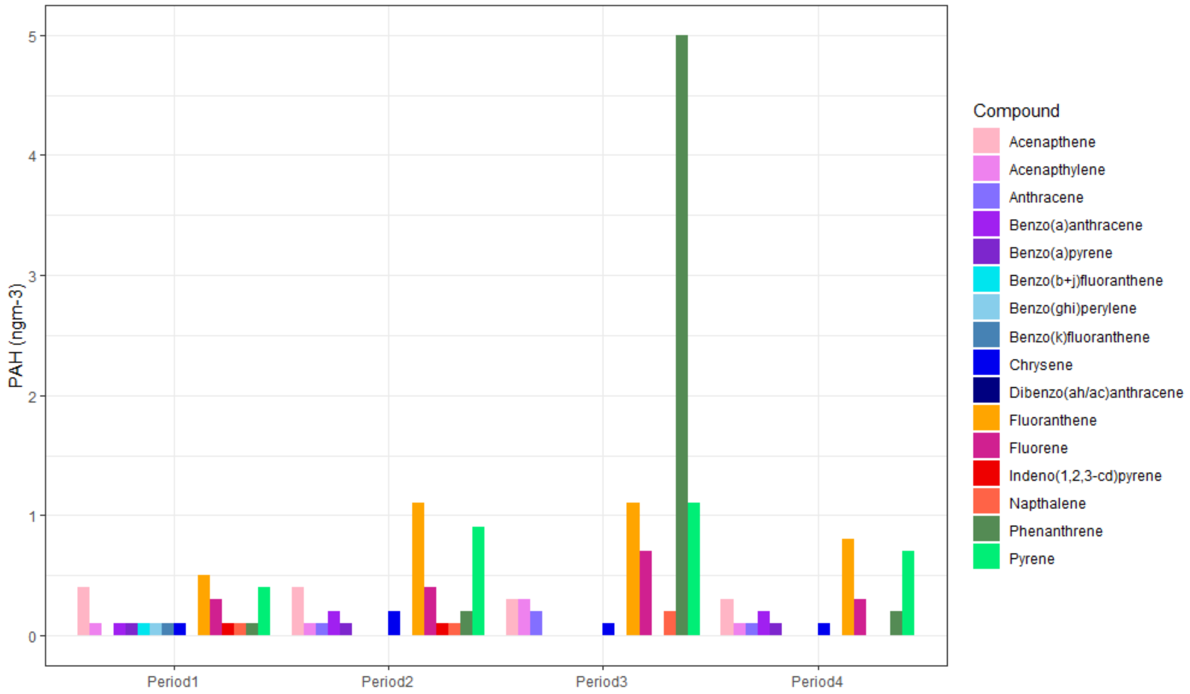

Figure 13: PAH concentrations measured at Helsby during 2020.

3.5 Dioxins, Furans and PCB Analysis

The TOMPs data (Dioxins, Furans and PCBs) for Helsby have been converted to Toxic Equivalency using the World Health Organization Toxic Equivalency Factors (see Appendix A2). The annual mean concentrations for each set of compounds measured at Helsby are provided in the tables below.

Table 7: Summary statistics for Dioxins at Helsby during 2020.

Compound	Annual Mean (fgm^{-3} TEF)
2378 Tetra CDD	0.55

Compound	Annual Mean (fgm^{-3} TEF)
12378 Penta CDD	2.4
123478 Hexa CDD	0.22
123678 Hexa CDD	0.59
123789 Hexa CDD	0.43
1234678 Hepta CDD	0.46
OCDD Octa CDD	0.011

Table 8: Summary statistics for Furans at Helsby during 2020.

Compound	Annual Mean (fgm^{-3} TEF)
2378 Tetra CDF	0.8
12378 Penta CDF	0.39
23478 Penta CDF	6.7
123478 Hexa CDF	1.2
123678 Hexa CDF	1
234678 Hexa CDF	1.7
123789 Hexa CDF	0.43
1234678 Hepta CDF	0.37
1234789 Hepta CDF	0.069
OCDF Octa CDF	0.0028

Table 9: Summary statistics for PCBs at Helsby during 2020.

Compound	Annual Mean (fgm^{-3} TEF)
PCB-81	0.0019
PCB-77	0.007
PCB-123	0.00026
PCB-118	0.017
PCB-114	0.0004
PCB-105	0.0051
PCB-126	0.69
PCB-167	0.00051
PCB-156	0.001
PCB-157	0.00023
PCB-169	0.0058
PCB-189	0.00016

Bar plots showing the concentrations of Dioxins, Furans and PCBs measured at Helsby for each of the four periods in 2020 are shown in Figures 14 to 16, below. The data for each period and compound are provided in Table C3 in Appendix A3.

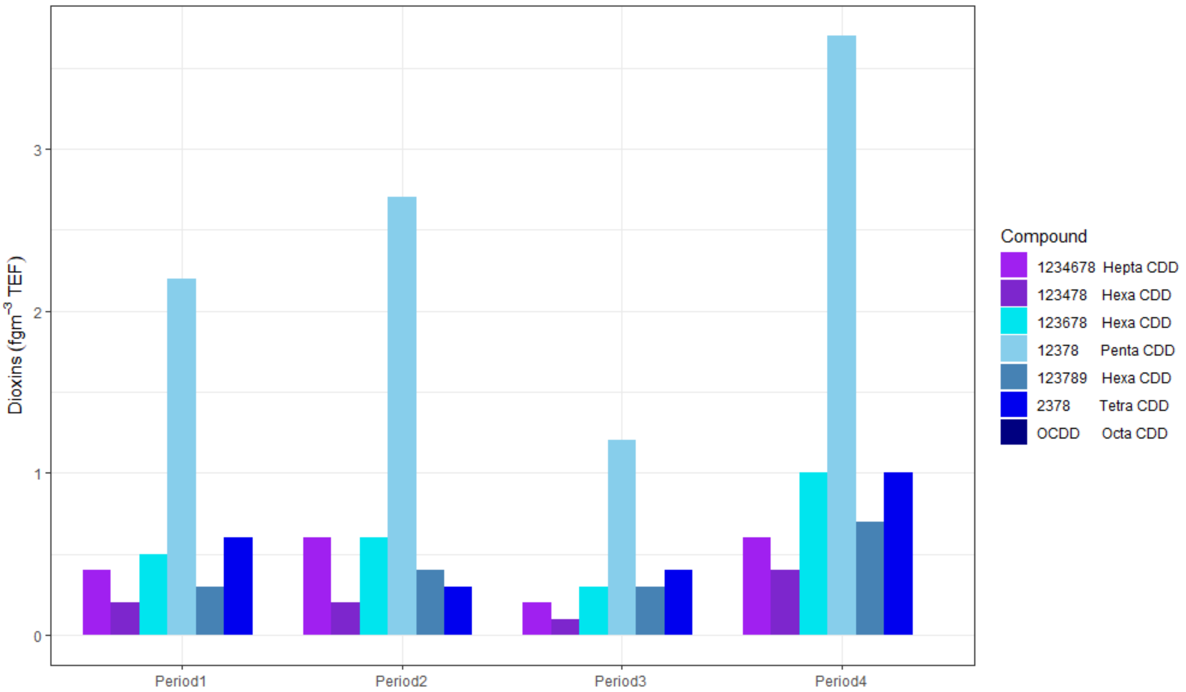

Figure 14: Dioxin concentrations measured at Helsby during 2020.

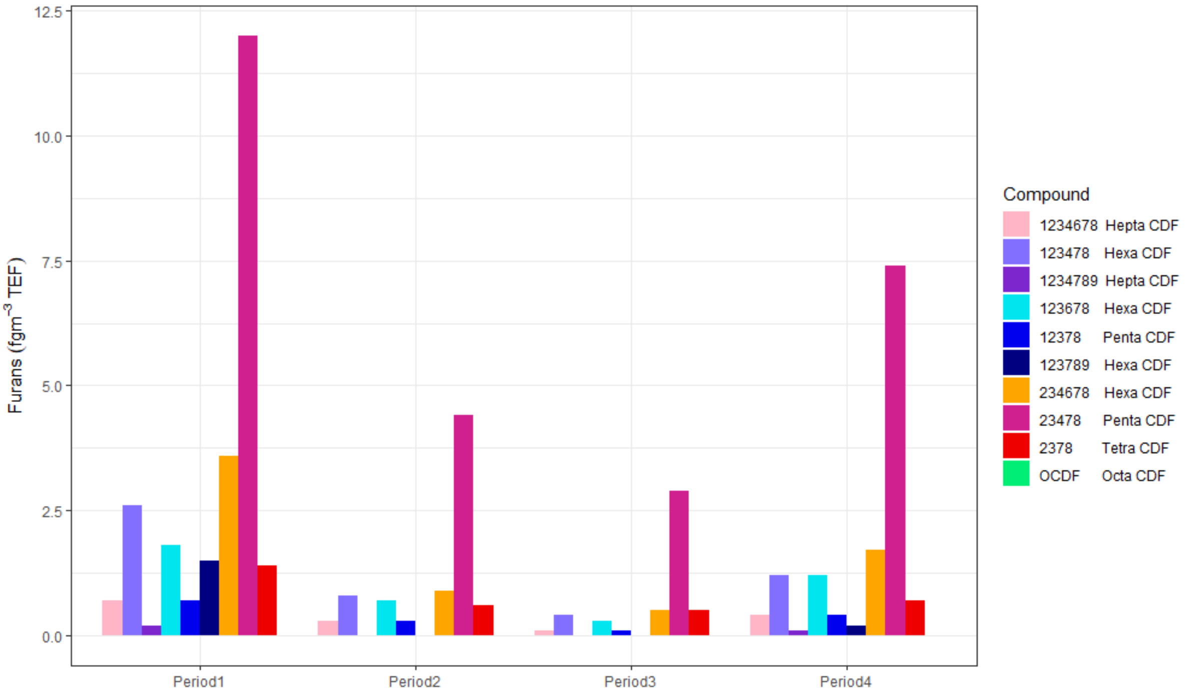

Figure 15: Furan concentrations measured at Helsby during 2020.

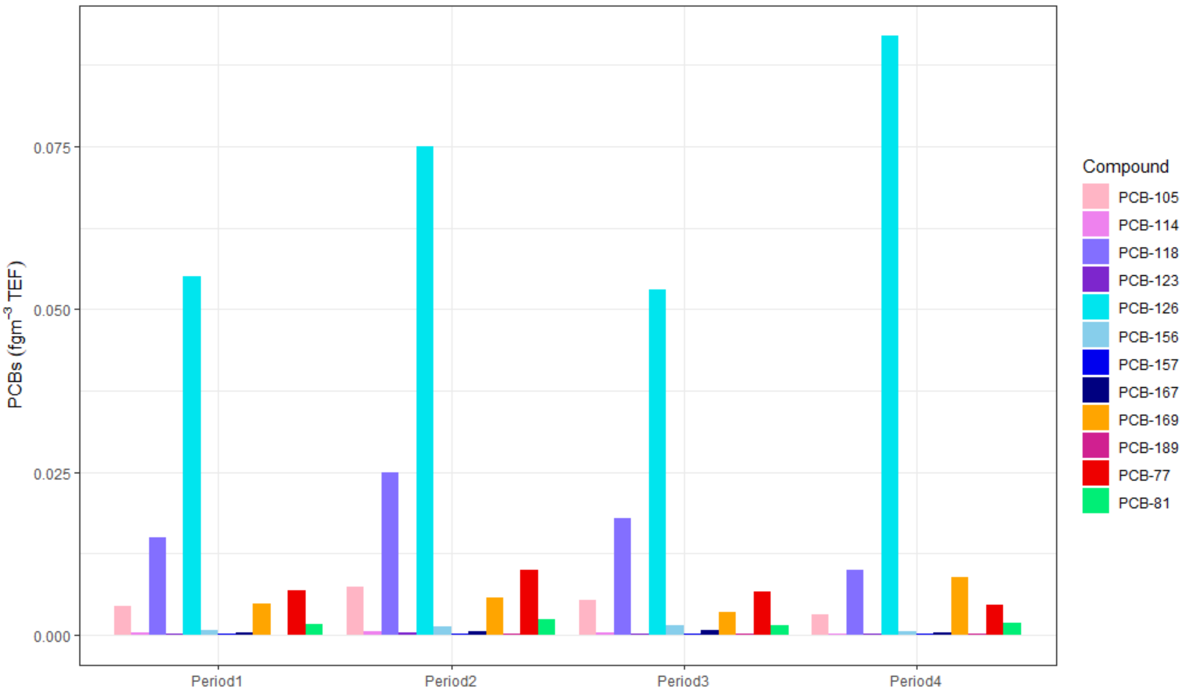

Figure 16: PCB concentrations measured at Helsby during 2020. Note, for PCB-126 actual concentrations are x10.

4 Conclusions

This report provides the results from the analysis of the pollutant data measured at the site in Helsby in 2020.

The results show that both PM_{10} and $PM_{2.5}$ annual means in 2020, were well below the annual mean AQS objective of 40 μgm^{-3} for PM_{10} and 25 μgm^{-3} for $PM_{2.5}$. There were no exceedances of the 24-hour PM_{10} limit of 50 μmg^{-3}.

Variations in hourly PM_{10} and $PM_{2.5}$ concentrations with wind speed and direction were assessed to investigate sources of particulates. Higher concentrations of PM_{10} were associated with high winds from the west, whereas for $PM_{2.5}$, the highest concentrations were observed under low wind speeds.

Filter samples of PM_{10} were collected every month and heavy metal concentrations extracted - all annual mean concentrations were below their associated target value.

Samples were collected and collated every 3 months for analysis of dioxins, furans, PCBs, and PAHs. The annual mean concentrations of Benzo(a)pyrene (B[a]P), which is used as a marker compound for PAHs, was 0.071 ngm^{-3} in 2020, which is below the European (1 ng^{-3}) and UK (0.25 ngm^{-3}) objectives.

5 References

Carslaw, D. (2020). worldmet: Import Surface Meteorological Data from NOAA Integrated Surface Database (ISD). Retrieved from https://CRAN.R-project.org/package=worldmet

Defra. (2016). *Air emissions risk assessment for your environmental permit.* Retrieved from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

NOAA. (2020). *Integrated Surface Database (ISD)*. Retrieved from https://www.ncdc.noaa.gov/isd

Appendices

A1 Air Pollution Bandings

Table A1 Description of air pollution bandings

Banding	Index	Accompanying health messages for at-risk individuals
Low	1,2,3	Enjoy your usual outdoor activities.
Moderate	4,5,6	Adults and children with lung problems, and adults with heart problems, who experience symptoms, should consider reducing strenuous physical activity, particularly outdoors.
High	7,8,9	Adults and children with lung problems, and adults with heart problems, should reduce strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also reduce physical exertion.
Very High	10	Adults and children with lung problems, adults with heart problems, and older people, should avoid strenuous physical activity. People with asthma may find they need to use their reliever inhaler more often.

A2 Toxic Equivalency Factors

The International Toxic Equivalent (ITEQ) values for individual congeners are calculated for each sample using the WHO schemes. The factors are provided in Table B2. Where an isomer has a result less than the LOD a value equivalent to the LOD is used to determine the ITEQ. Therefore, these values represent a worst case assessment. Additional total ITEQ values are also calculated, assuming that where a result is less than the limit of detection then the ITEQ contribution is zero.

Table B2 Toxic equivalency factors for TOMPs

Compound	WHO TEF	Compound	WHO TEF
DIOXINS		**PCBs**	
2378 Tetra CDD	1	PCB-81	0.0003
12378 Penta CDD	1	PCB-77	0.0001
123478 Hexa CDD	0.1	PCB-123	0.00003
123678 Hexa CDD	0.1	PCB-118	0.00003
123789 Hexa CDD	0.1	PCB-114	0.00003
1234678 Hepta CDD	0.01	PCB-105	0.00003
OCDD Octa CDD	0.0001	PCB-126	0.1
FURANS		PCB-167	0.00003
2378 Tetra CDF	0.1	PCB-156	0.00003
12378 Penta CDF	0.05	PCB-157	0.00003
23478 Penta CDF	0.5	PCB-169	0.003
123478 Hexa CDF	0.1	PCB-189	0.00003
123678 Hexa CDF	0.1		
234678 Hexa CDF	0.1		
123789 Hexa CDF	0.1		
1234678 Hepta CDF	0.01		
1234789 Hepta CDF	0.01		
OCDF Octa CDF	0.0001		

A3 Datasets

Tables C1 to C3 provide the analysis of heavy, metals, PAHs, Dioxins, Furans and PCBs, for each period during 2020.

Table C1: Analysis of heavy metals for each period. Values with the prefix "<" denote data where the values were below the limit of detection.

start	end	Report ID	As	Cd	Co	Cr	Cu	Hg	Mn	Ni	Pb	Sb	Tl	V	Zn	Cr VI
1/3/2020	2/7/2020	ASC/45605.001	<9.90	<12.38	<4.95	24.75	12.38	<12.38	<9.90	11.14	<12.38	<9.90	<24.75	<7.43	<12.38	<3.71
2/7/2020	3/6/2020	ASC/45605.002	<2.40	<3.00	<1.20	12	9	<3.00	3	3	6	<2.40	<6.00	2.1	<3.00	<0.90
3/6/2020	4/3/2020	ASC/45605.003	<2.40	<2.99	<1.20	8.98	11.98	<2.99	8.98	2.99	23.96	2.99	<5.99	1.8	5.99	<0.90
4/3/2020	5/1/2020	ASC/45605.004	<2.48	<3.10	<1.24	9.29	9.29	<3.10	12.39	3.1	15.49	3.1	<6.20	3.1	12.39	<0.93
5/1/2020	5/29/2020	ASC/45605.005	<2.40	<2.99	<1.20	11.98	8.98	<2.99	5.99	2.99	8.98	2.7	<5.99	2.4	<2.99	<0.90
5/29/2020	6/26/2020	ASC/45605.006	<2.42	<3.03	<1.21	6.06	12.12	<3.03	6.06	3.03	6.06	2.42	<6.06	2.12	<3.03	<0.91
6/26/2020	7/31/2020	ASC/45605.007	1.92	<2.40	<0.96	9.58	9.58	<2.40	4.79	2.4	7.19	2.4	<4.79	1.68	<2.40	<0.72
7/31/2020	8/28/2020	ASC/47740.001	2.7	<3.00	<1.20	8.99	8.99	<3.00	3	3	5.99	<2.40	<5.99	2.1	<3.00	<0.90
8/28/2020	9/25/2020	ASC/47740.002	<3.00	<3.00	<1.20	8.99	20.97	<3.00	8.99	3	8.99	5.99	<5.99	2.4	<3.00	<0.90
9/25/2020	10/23/2020	ASC/47740.003	<2.40	<2.99	<1.20	8.98	17.96	<2.99	5.99	2.99	8.98	2.99	<5.99	2.4	<2.99	2.1

Table C2: Analysis of PAHs for each period.

Compound	Period 1	Period 2	Period 3	Period 4
Napthalene	0.089	0.06	0.149	0.044
Acenapthylene	0.141	0.1	0.316	0.073
Acenapthene	0.384	0.425	0.293	0.308
Fluorene	0.296	0.354	0.73	0.257
Phenanthrene	0.12	0.229	5.016	0.166
Anthracene	0.025	0.115	0.232	0.084
Fluoranthene	0.536	1.084	1.09	0.787
Pyrene	0.43	0.936	1.09	0.679
Benzo(a)anthracene	0.072	0.232	0.023	0.168
Chrysene	0.134	0.147	0.054	0.106
Benzo(b+j)fluoranthene	0.067	0.024	0.017	0.018
Benzo(k)fluoranthene	0.074	0.027	0.015	0.02
Benzo(a)pyrene	0.119	0.088	0.013	0.064
Indeno(1,2,3-cd)pyrene	0.067	0.065	0.018	0.047
Dibenzo(ah/ac)anthracene	0.001	0.004	0.003	0.008
Benzo(ghi)perylene	0.082	0.004	0.024	0.041

Table C3: Analysis of Dioxins, Furans and PCBs, for each period.

Compound		Period 1	Period 2	Period 3	Period 4
DIOXINS					
2378	Tetra CDD	0.59	0.27	0.37	0.99
12378	Penta CDD	2.2	2.7	1.2	3.7
123478	Hexa CDD	0.17	0.23	0.11	0.37
123678	Hexa CDD	0.47	0.6	0.32	0.98
123789	Hexa CDD	0.33	0.44	0.27	0.69
1234678	Hepta CDD	0.41	0.65	0.23	0.57
OCDD	Octa CDD	0.0091	0.018	0.0038	0.013
FURANS					
2378	Tetra CDF	1.4	0.61	0.53	0.66
12378	Penta CDF	0.71	0.29	0.13	0.43
23478	Penta CDF	12	4.4	2.9	7.4
123478	Hexa CDF	2.6	0.77	0.39	1.2
123678	Hexa CDF	1.8	0.74	0.33	1.2
234678	Hexa CDF	3.6	0.94	0.47	1.7
123789	Hexa CDF	1.5	0.012	0.024	0.17
1234678	Hepta CDF	0.66	0.28	0.12	0.41
1234789	Hepta CDF	0.19	0.0013	0.017	0.067
OCDF	Octa CDF	0.0064	0.0019	0.00078	0.0022
PCBs					
PCB-81		0.0017	0.0025	0.0014	0.0019

Compound	Period 1	Period 2	Period 3	Period 4
PCB-77	0.0069	0.0099	0.0067	0.0046
PCB-123	0.00017	0.00047	0.00027	0.00012
PCB-118	0.015	0.025	0.018	0.01
PCB-114	0.00039	0.00058	0.00038	0.00026
PCB-105	0.0045	0.0074	0.0054	0.0031
PCB-126	0.55	0.75	0.53	0.92
PCB-167	0.00034	0.00064	0.00075	0.00031
PCB-156	0.0007	0.0013	0.0014	0.00062
PCB-157	0.00017	0.00028	0.00027	0.00019
PCB-169	0.0048	0.0058	0.0035	0.0089
PCB-189	0.000087	0.00014	0.00027	0.00015

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