KENT AND MEDWAY AIR QUALITY MONITORING NETWORK

2022 NETWORK ANNUAL REPORT

Report for: Kent and Medway Air Quality Monitoring Partnership (KMAQP)

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GLOSSARY

AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
ASR	Annual Status Report
AURN	Automatic Urban and Rural Network
CO_2	Carbon Dioxide
DAQI	Daily Air Quality Index
Limit Value	Legally binding limit
LGV	Light Goods Vehicles (e.g. vans, small trucks)
Target Value	Limits to be attained where possible by taking all necessary measures not entailing disproportionate costs.
LAQM	Local Air Quality Management
Indicative measurement	Measurements which meet data quality objectives that are representative of indicative classification
NAEI	National Atmospheric Emissions Inventory
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides (NOx = NO + NO_2)
O_3	Ozone
PM_{10}	particles that pass through a size-selective inlet with 50% efficiency at an aerodynamic diameter of 10µm
$PM_{2.5}$	particles that pass through a size-selective inlet with 50% efficiency at an aerodynamic diameter of 2.5µm
QAQC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide

EXECUTIVE SUMMARY

This report provides and overview of the air quality monitoring that was undertaken for the Kent and Medway Air Quality Monitoring Network (KMAQMN) in 2022.

Seventeen automatic air quality monitoring sites were operational during 2022 measuring Nitrogen Dioxide (NO_2), Ozone (O_3), Particulate Matter as PM_{10} and $PM_{2.5}$ and Sulphur Dioxide (SO_2). Three of the seventeen sites also form part of the Automatic Urban and Rural Network (AURN).

Ambient NO_2 is also monitored across the KMAQMN via diffusion tubes - a passive monitoring technique that provides “indicative” measurements of NO_2 for comparison against air quality objectives.

Exceedances of the Air Quality Strategy (AQS) Objectives

In 2022, only one site, Maidstone Upper Stone Street, exceeded the annual mean limit value for NO_2 of 40 µgm^{-3}. The annual mean value at this site was 47.5 µgm^{-3}. No sites exceeded the hourly mean objective of 200 µgm^{-3} more than 18 times.

No sites exceeded the annual mean limit values for PM_{10} of 40 µgm^{-3} or the annual mean limit value for $PM_{2.5}$ of 20 µgm^{-3}. Only one site exceeded the 24-hour mean objective for PM_{10} of 50 µgm^{-3}, more than the allowable exceedances of 35 times in a year. The Swale St Pauls Street site exceeded this 24-hour mean objective 62 times within the year.

The 8-hour running meaning objective for O_3 of 100 µgm^{-3}, not to be exceeded more than 10 times in the year, was exceeded at both sites that measure O_3. The Canterbury site had 32 exceedances of this objective and the Rochester Stoke site exceeded this objective 22 times within the year.

Rochester Stoke is the only site to measure SO_2. For this site, all objectives for SO_2 were met in 2022.

Pollution episodes

The Daily Air Quality Index (DAQI) was used to assess the number of days of “Moderate”, “High” and “Very High” pollution.

In 2022, no episodes of moderate NO_2 or SO_2 were recorded at any sites. For O_3, 31 and 22 instances of Moderate O_3 days were observed at Canterbury and Rochester Stoke sites respectively, no instances of High or Very High days were recorded.

Twelve sites recorded Moderate PM_{10} days, with the Swale St Pauls Street site recording 41 instances of Moderate PM_{10} days. Two sites recorded one or more days of High PM_{10} pollution, of which Swale St Pauls Street recorded 12 instances. Swale St Pauls Street also recorded 7 instances of Very High pollution days. For $PM_{2.5}$, five sites recorded instances of Moderate $PM_{2.5}$ pollution, of which Maidstone Upper Stone Street recorded 9 instances. Four sites also recorded High $PM_{2.5}$ instances and Rochester Stoke site recorded one instance of Very High $PM_{2.5}$ pollution in 2022. The Very High pollution episodes occurred in March where pollution episodes were seen across the UK with Very High pollution seen across South East and Greater London Regions.

Long term trends

Annual mean concentrations from 1998 to 2022 from the KMAQMN sites were compared to the UK averages.

Many sites observed a reduction in annual mean NO_2 concentrations likely due to a reduction in traffic volumes during the Covid-19 lockdowns in the UK. NO_2 concentrations at all sites within the KMAQMN have remained below the pre-covid levels in 2022.

PM_{10} and $PM_{2.5}$ have also shown general decreasing trends, following the trend of the UK annual average. Annual mean concentrations of both PM_{10} and $PM_{2.5}$ at traffic monitoring sites in the KMAQMN are all higher than the UK average in 2022.

Annual trends in O_3 concentrations are shown to be variable, however O_3 concentrations are highly variable year on year, as O_3 production depends greatly on the meteorological conditions. The annual average SO_2

concentrations as Rochester Stoke show decreasing trends in line with the UK average due to a reduction of sulphur in fuels and the move away from power plants that use coal.

Diffusion tube results

Exceedances in the annual mean NO_2 concentrations measured by diffusion tubes in the network were recorded by the following local authorities:

- One site by Canterbury City Council
- One site by Gravesham Borough Council
- Seven sites by Maidstone Borough Council
- Five sites by Medway Council
- One site by Swale Borough Council
- One site by Tonbridge and Malling Borough Council
- Two sites by Tunbridge Wells Borough Council

1. INTRODUCTION

This report provides details of the air quality monitoring data from the Kent and Medway Air Quality Monitoring Network (KMAQMN) for the calendar year 2022. The network was first formed in 1997 to undertake and report measurements of key air quality pollutants in the Kent and Medway region.

The report presents results and data for nitrogen dioxide (NO_2), particulate Matter (PM_{10} and $PM_{2.5}$), ozone (O_3) and sulphur dioxide (SO_2) from the seventeen continuous monitoring stations that were operational in the network in 2022. NO_2 data from the non-continuous NO_2 diffusion tube monitoring network are also presented here.

Summary statistics of all measured air pollutants and comparisons against UK Air Quality Strategy Objectives are provided. The report also includes details of exceedances and periods of significant air pollution episodes in 2022. Long term trends in the pollutant concentrations from the KAQMN are also presented and compared to data from the Automatic Urban and Rural Network (AURN).

2. KENT AND MEDWAY AIR QUALITY NETWORK

2.1 KENTAIR WEBSITE

The KentAir website (https://kentair.org.uk/) is a publicly accessible website that contains up to date information, data and resources relating to air quality in the region.

Pages on the site provide important information such as:

- Details on the key ambient pollutants, their sources and impacts on health.
- How the pollutants are monitored.
- The Daily Air Quality Index (DAQI) bands and how these can be used.
- Current legislation, policy, standards and objectives.

The front page includes an interactive map which displays the current DAQI for each monitoring site, and a postcode selector to allow users to zoom into specific locations. Information on the monitoring sites, including photos, reports and statistics is easily accessible via the map. Users can also sign up to air pollution forecasts via the website.

A tab on the front page links to the Care for Air website (https://care-for-air.kentair.org.uk), an educational resource which provides information about what causes pollution and how individuals can help to reduce it. Fact sheets and teaching materials can be downloaded, and an emissions calculator can be used to estimate an individual's emissions based on their travel choices.

KentAir

2.2 AUTOMATIC MONITORING SITES

Eighteen automatic air quality monitoring sites were operational during 2022. Of these eighteen, three are part of the Automatic Urban and Rural Network (AURN).

A map of the locations of the monitoring sites is provided in Figure 1. Details of the pollutants measured at each site is shown in Table 2-1.

Figure 1 Automatic monitoring locations in the KMAQMN (blue circles) and UK national network (red circles).

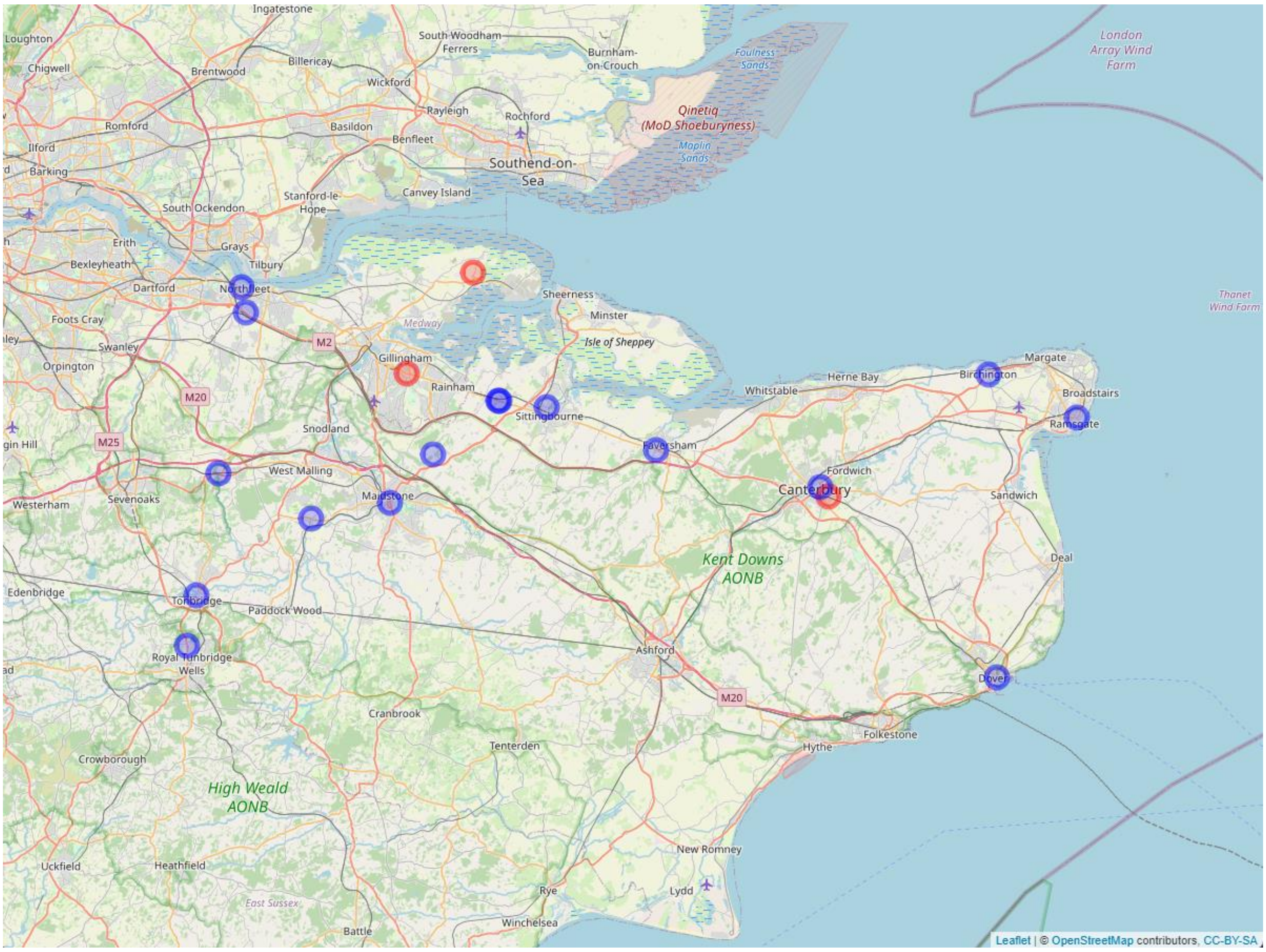


Table 2-1 Automatic monitoring stations within the KMAQMN during 2022

Site Name	Site Type	Network	Start	Pollutants Monitored
Canterbury	Urban background	AURN	02/01/2001	NO_2, O_3, PM_{10}, $PM_{2.5}$
Canterbury Military Road	Roadside	KMAQMN	01/10/2006	NO_2
Chatham Roadside	Urban traffic	AURN	01/07/2010	NO_2, PM_{10}, $PM_{2.5}$
Dover Centre Roadside	Roadside	KMAQMN	21/12/2000	PM_{10}
Gravesham A2 Roadside	Roadside	KMAQMN	31/12/1998	NO_2, PM_{10}
Gravesham Industrial Background	Urban background	KMAQMN	01/01/1999	NO_2, PM_{10}
Maidstone Rural	Rural	KMAQMN	01/01/1999	NO_2, PM_{10}
Maidstone Upper Stone Street	Roadside	KMAQMN	09/05/2018	NO_2, PM_{10}, $PM_{2.5}$
Rochester Stoke	Rural	AURN	26/01/1996	NO_2, O_3, PM_{10}, $PM_{2.5}$, SO_2
Swale Newington	Roadside	KMAQMN	07/04/2021	NO_2, PM_{10}, $PM_{2.5}$
Swale Ospringe Roadside 2	Roadside	KMAQMN	15/03/2006	NO_2, PM_{10}, $PM_{2.5}$
Swale St Pauls Street	Roadside	KMAQMN	21/01/2013	NO_2, PM_{10}, $PM_{2.5}$

Site Name	Site Type	Network	Start	Pollutants Monitored
Thanet Birchington Roadside	Roadside	KMAQMN	19/03/2007	NO_2, PM_{10}
Thanet Ramsgate Roadside	Roadside	KMAQMN	01/01/2003	NO_2, PM_{10}
Tonbridge High Street	Roadside	KMAQMN	14/07/2022	NO_2
Tonbridge and Malling, Borough Green Roadside	Roadside	KMAQMN	10/07/2005	NO_2, PM_{10}
Tunbridge Wells A26 Roadside	Roadside	KMAQMN	20/06/2005	NO_2, PM_{10}, $PM_{2.5}$

2.3 NETWORK CHANGES IN 2022

- A new station on Tonbridge High Street opened on 14/07/2022.
- Installation of a $PM_{2.5}$ measurements added to Tunbridge Wells A26 Roadside on 26/05/2022.
- Installation of a FIDAS PM_{10} and $PM_{2.5}$ analyser at the Canterbury site on 27/05/2022.

2.4 POLLUTANTS MONITORED

The KMAQMN monitors nitrogen dioxide (NO_2), particulate Matter (PM_{10} and $PM_{2.5}$), ozone (O_3) and sulphur dioxide (SO_2) at the automatic monitoring sites. Details of the sources and health impacts of each pollutant and methods for monitoring are provided below:

Nitrogen Dioxide: NO_2 is formed from combustion processes and has a primary (emitted directly) and secondary (formed from chemical reactions in the atmosphere) component. In urban areas road transport is the main source of ambient NO_2. NO_2 can have an adverse effect on human health through inflammation of the airways and can cause issues with the respiratory system, in particular to those with underlying conditions.

Particulate Matter: Particulate matter in the atmosphere has many sources in the UK including combustion and road vehicle emissions. Similarly to NO_2, PM can consist of both primary and secondary sources. Secondary PM can be formed in the atmosphere from precursors such as nitrogen oxides, sulphur dioxide and ammonia. PM can also be transported long distances, therefore increases in PM can often occur in the UK when pollution is transported from the continent. PM_{10} and $PM_{2.5}$ are monitored in the KMAQMN, these are particles that pass through a size-selective inlet with 50% efficiency at an aerodynamic diameter of 10 and 2.5 µm, respectively. The smaller particles are of particular concern to human health as they can penetrate deep into the lungs. PM can also cause inflammation of the airways and exacerbate symptoms in those with heart and lung diseases. Small particles may also carry surface absorbed carcinogenic compounds into the lungs.

Ozone: Ozone is a secondary pollutant which is formed in the atmosphere via reactions between its precursors - nitrogen oxides (NOx) and volatile organic compounds (VOCs) - in the presence of sunlight. Ozone and its precursors can travel long distances, therefore the ozone measured at one location, may have originated many miles away. Ozone reacts rapidly with nitrogen oxide (NO), therefore ozone levels are typically lower in urban areas, where NO emissions are higher as a result of emissions from vehicle exhausts. Ozone can cause irritation to the eyes and nose and inflammation to the airways at high concentrations.

Sulphur Dioxide: The main source of SO_2 is from the combustion of fuels which contain sulphur. Exposure to SO_2 can cause irritation and constriction of the airways and exacerbate symptoms in those with underlying respiratory issues. In the atmosphere, SO_2 and water vapour can mix and form acid rain, which can have a destructive effect on the ecosystem.

2.5 MONITORING METHODS

The LAQM Technical Guidance LAQM.TG(22)[1] provides information on the monitoring techniques that can be used to monitor ambient pollutants as part of a local air quality monitoring programme. The KMAQMN includes the following montioring methods:

[1] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

- Continuous NO_2 is measured by the chemiluminescence technique, which is the standard reference method of measuring NO, NO_2 and NOx.
- PM_{10} is measured by either Tapered Element Oscillating Microbalance (TEOM), Beta Attenuation Monitoring (BAM) or a fine dust monitoring system (FIDAS). $PM_{2.5}$ is measured by BAM or FIDAS. Correction factors to the data are required for the TEOM and BAMs before comparisons to air quality standards, as described in the LAQM Technical Guidance LAQM.TG(22). PM_{10} data from the TEOMs are corrected using the volatile correction model (VCM)[2] developed by King's College. PM_{10} data from the BAM is corrected using a multiplication value of 0.833. No corrections are necessary for $PM_{2.5}$ data.
- Ozone is measured using the standard ultraviolet (UV) absorption technique.
- SO_2 is measured by the UV fluorescence technique.

Ambient NO_2 is also monitored in the KMAQMN by diffusion tubes. Diffusion tubes are a passive monitoring technique that provides "indicative" measurements of NO_2 for comparison against air quality objectives. The tubes are exposed over 4-5 weeks, approximately coinciding with monthly periods, and an annual mean calculated from the data. NO_2 diffusion tubes are known to have biases, when compared to chemiluminescence NO_2 measurements, therefore the annual means from the tubes are required to be bias corrected, using local or national correction factors. If there is less than 9 months of data in a calendar year, the annual means are also required to be annualised, using local data from nearby automatic monitoring stations.

3. AUTOMATIC MONITORING RESULTS

3.1 NETWORK DATA CAPTURE

Table 3-1 shows the data capture rates for each site and pollutant measured during 2022. The target annual data capture rate is 90%, however, those analysers with a data capture greater than 75% can still provide representative annual means. Analysers with a data capture rate below 75% not representative of the full year.

Table 3-1 Data capture rates, 2022. Red values represent data capture rates < 90 %.

Site Name	NO_2	PM_{10}	$PM_{2.5}$	O_3	SO_2
Canterbury	87.4	58.0(b)	58.0(b)	99.1	
Canterbury Military Road	84.8				
Chatham Roadside	98.9	97.2	97.2		
Dover Centre Roadside		87.2			
Gravesham A2 Roadside	99.1	98.0			
Gravesham Industrial Background	97.6	97.1			
Maidstone Rural	99.7	98.1			
Maidstone Upper Stone Street	96.7	99.2	95.4		
Rochester Stoke	98.1	96.5	96.5	99.0	83.2
Swale Newington 4	99.6	94.1	96.1		
Swale Ospringe Roadside 2	95.7	94.9			
Swale St Pauls Street	98.5	96.6	97.2		
Thanet Birchington Roadside	99.6	96.2			

[2] http://www.volatile-correction-model.info/

Site Name	NO_2	PM_{10}	$PM_{2.5}$	O_3	SO_2
Thanet Ramsgate Roadside	99.7	93.9			
Tonbridge and Malling, Borough Green Roadside	97.1	99.7			
Tonbridge High Street	37.2[(a)]				
Tunbridge Wells A26 Roadside	98.3	97.8	56.3[(b)]		
Number of sites	**16**	**15**	**7**	**2**	**1**
Number of sites >= 90%	**13**	**13**	**5**	**2**	**0**

(a) New site - opened part way through the year.
(b) Installation of new PM analyser part way through the year.

3.2 COMPARISON WITH AQS OBJECTIVES

Table 3-2 provides an overview of the Air Quality Strategy Objectives applicable to local authorities in England (objectives for some pollutants are different in Scotland). The UK air quality objectives were originally transposed into UK law from the European Commission Directive on Ambient Air Quality and Cleaner Air for Europe[3]. Since leaving the EU, the UK is no longer tied to the EU limits, however, current objectives in the UK are based on those stated in the Directive.

Table 3-2 Air Quality Strategy Objectives (applicable to local authorities in England).

Pollutant	Limit Value	Averaging Period
Nitrogen Dioxide (NO_2)	200 μgm^{-3} not to be exceeded more than 18 times a year	1-hour mean
	40 μgm^{-3}	Annual mean
Particulate Matter (PM_{10})	50 μgm^{-3} not to be exceeded more than 35 times a year	24-hour mean
	40 μgm^{-3}	Annual mean
Particulate Matter ($PM_{2.5}$)	20 μgm^{-3}	Annual mean
Sulphur dioxide (SO_2)	266 μgm^{-3} not to be exceeded more than 35 times a year	15-minute mean
	350 μgm^{-3} not to be exceeded more than 24 times a year	1-hour mean
	125 μgm^{-3} not to be exceeded more than 3 times a year	24-hour mean
Ozone (O_3)	100 μgm^{-3} not to be exceeded more than 10 times a year	Daily maximum running 8-hour mean

Table 3-3 shows the annual mean concentrations for all pollutants measured in the network, at each site. One site, Maidstone Upper Stone Street, exceeded the annual mean limit value of 40 μgm^{-3} in 2022, with a value of 47.5 μgm^{-3}. No sites exceeded the PM_{10} annual mean limit value of 40 μgm^{-3}, or the $PM_{2.5}$ limit value of 20 μgm^{-3}.

[3] European Commission, "DIRECTIVE 2008/50/EC OF The European Parliament And Of The Council of 21 May 2008 On Ambient Air Quality And Cleaner Air For Europe," 2008. [Online]. Available: https://www.legislation.gov.uk/eudr/2008/50/contents.

Table 3-3 Annual mean concentrations, 2022. Values in red indicate those which exceed the relevant annual mean objective or target (applicable to NO_2, PM_{10} and $PM_{2.5}$ only)

Site Name	NO_2	PM_{10}	$PM_{2.5}$	O_3	SO_2
Canterbury	10.7	14.2*	9.2*	53.7	
Canterbury Military Road	20.5				
Chatham Roadside	18.8	17.3	11.7		
Dover Centre Roadside		22.5			
Gravesham A2 Roadside	22.2	15.3			
Gravesham Industrial Background	18.2	22.5			
Maidstone Rural	7.7	13.1			
Maidstone Upper Stone Street	47.5	22.1	13.8		
Rochester Stoke	11.2	16.1	10.8	53.9	1.0
Swale Newington 4	21.9	18.2	12.4		
Swale Ospringe Roadside 2	24.8	24.4			
Swale St Pauls Street	30.4	37.5	11.5		
Thanet Birchington Roadside	24.6	18.4			
Thanet Ramsgate Roadside	17.4	25.6			
Tonbridge and Malling, Borough Green Roadside	24.4	25.0			
Tonbridge High Street	22.5*				
Tunbridge Wells A26 Roadside	25.1	21.3	8.0*		

* annual means have been annualised as annual data capture < 75%

A comparison of 2022 data with short-term Air Quality Strategy Objectives is provided in Table 3-4.

Table 3-4 Number of exceedances of short term objectives in 2022. Values in red indicate those which exceed the relevant short-term mean objective more than the permitted number of times.

Site Name	NO_2	PM_{10}	O_3	SO_2		
	1 hour	**24 hour**	**Daily max running 8-hour**	**24 hour**	**1 hour**	**15 min**
Canterbury	0	0 (19.5)[(b)]	32			
Canterbury Military Road	0					
Chatham Roadside	0	5				
Gravesham A2 Roadside	0	0				
Gravesham Industrial Background	0	6				
Maidstone Rural	0	0				
Maidstone Upper Stone Street	0	1				
Rochester Stoke	0	6	22	0	0 (4.2) [(c)]	0 (4.9) [(d)]
Swale Newington 4	0	5				
Swale Ospringe Roadside 2	0	11				

Site Name	NO_2	PM_{10}	O_3	SO_2		
Swale St Pauls Street	0	62				
Thanet Birchington Roadside	0	2				
Thanet Ramsgate Roadside	0	7				
Tonbridge and Malling, Borough Green Roadside	0	12				
Tonbridge High Street	0					
Tunbridge Wells A26 Roadside	0 (87)[a]	2				

[a]Value in bracket represents the 99.8th percentile where the valid data capture for year is less than 85%.
[b]Value in bracket represents the 90.4th percentile where the valid data capture for year is less than 85%.
[c]Value in bracket represents the 99.7th percentile where the valid data capture for year is less than 85%.
[d]Value in bracket represents the 99.9th percentile where the valid data capture for year is less than 85%.

3.3 DAILY AIR QUALITY INDEX (DAQI)

The Daily Air Quality Index (DAQI)[4] is used to provide information on air pollution levels and recommendations on the actions that can be taken depending on the index value. The index ranges from 1 to 10 and is sub categorised into 4 bands (Low, Moderate, High, Very High). The bands are based on recommendations from the Committee on the Medical Effects of Air Pollutants (COMEAP). An overview of the bands for O_3, NO_2, SO_2 $PM_{2.5}$ and PM_{10} is provided in Table 3-5.

Table 3-5 Daily Air Quality Index (DAQI) bands for each pollutant.

Index	Band	Ozone 8-Hourly Mean (μgm^{-3})	Nitrogen Dioxide Hourly Mean (μgm^{-3})	Sulphur Dioxide 15 Minute Mean (μgm^{-3})	$PM_{2.5}$ Daily Mean (μgm^{-3})	PM_{10} Daily Mean (μgm^{-3})
1	Low	0-33	0-67	0-88	0-11	0-16
2	Low	34-66	68-134	89-177	12-23	17-33
3	Low	67-100	135-200	178-266	24-35	34-50
4	Moderate	101-120	201-267	267-354	36-41	51-58
5	Moderate	121-140	268-334	355-443	42-47	59-66
6	Moderate	141-160	335-400	444-532	48-53	67-75
7	High	161-187	401-467	533-710	54-58	76-83
8	High	188-213	468-534	711-887	59-64	84-91
9	High	214-240	535-600	888-1064	65-70	92-100
10	Very High	241 or more	601 or more	1065 or more	71 or more	101 or more

[4] https://uk-air.defra.gov.uk/air-pollution/daqi?view=more-info

The overall DAQI for a specific site is calculated as the highest index from each the five different pollutants and actions and health advice provided for each of the bandings, as shown in Table 3-6.

Table 3-6 DAQI bandings and associated actions and health advice. Taken from https://uk-air.defra.gov.uk/air-pollution/daqi

Air Pollution Banding	Index Value	Accompanying health messages for at-risk individuals*	Accompanying health messages for the general population
Low	1-3	**Enjoy** your usual outdoor activities.	**Enjoy** your usual outdoor activities.
Moderate	4-6	Adults and children with lung problems, and adults with heart problems, **who experience symptoms**, should **consider reducing** strenuous physical activity, particularly outdoors.	**Enjoy** your usual outdoor activities.
High	7-9	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.	Anyone experiencing discomfort such as sore eyes, cough or sore throat should **consider reducing** activity, particularly outdoors.
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.	**Reduce** physical exertion, particularly outdoors, especially if you experience symptoms such as cough or sore throat.

*Adults and children with heart or lung problems are at greater risk of symptoms. Follow your doctor's usual advice about exercising and managing your condition. It is possible that very sensitive individuals may experience health effects even on Low air pollution days. Anyone experiencing symptoms should follow the guidance provided below.

Table 3-7 to Table 3-11 show the number of days when a Moderate or above DAQI was recorded at each monitoring site in 2022 for the different pollutants. The results for each pollutant are considered below.

NO_2: There were no instances of Moderate, High or Very High NO_2 concentrations recorded at any site in the network in 2022.

PM_{10}: 12 of the 15 monitoring stations recorded at least one day with Moderate or above DAQI for PM_{10}. Swale St Pauls Street observed the highest number of Moderate or above days for PM_{10}, recording 41 days in the Moderate band, 12 days in the High band and 7 days in the Very High band.

$PM_{2.5}$: 5 of the 7 sites monitoring $PM_{2.5}$ observed $PM_{2.5}$ in the Moderate band, four sites also observed $PM_{2.5}$ in the high band and Rochester Stoke also observed High $PM_{2.5}$ on one day in 2022.

O_3: Canterbury and Rochester Stoke observed 31 days and 23 days, respectively of Moderate O_3 concentrations. There were no instances of High or Very High O_3.

SO_2: There were no days when the SO_2 concentrations measured at the Rochester Stoke site reached the Moderate or above band.

Further information on the days when Moderate or high pollution was observed is provided in Section 3.4.

Table 3-7 Numbers of days with "Moderate" or above NO_2 concentrations in 2022.

Site Name	Moderate	High	Very High
Canterbury	0	0	0
Canterbury Military Road	0	0	0
Chatham Roadside	0	0	0
Gravesham A2 Roadside	0	0	0
Gravesham Industrial Background	0	0	0
Maidstone Rural	0	0	0
Maidstone Upper Stone Street	0	0	0
Rochester Stoke	0	0	0
Swale Newington 4	0	0	0
Swale Ospringe Roadside 2	0	0	0
Swale St Pauls Street	0	0	0
Thanet Birchington Roadside	0	0	0
Thanet Ramsgate Roadside	0	0	0
Tonbridge and Malling, Borough Green Roadside	0	0	0
Tonbridge High Street[a]	0	0	0
Tunbridge Wells A26 Roadside	0	0	0

[a]Annual data capture < 75 %, therefore some pollution episodes may not have been recorded.

Table 3-8 Numbers of days with "Moderate" or above PM_{10} concentrations in 2022.

Site Name	Moderate	High	Very High
Canterbury[a]	0	0	0
Chatham Roadside	5	0	0
Dover Centre Roadside	2	0	0
Gravesham A2 Roadside	0	0	0
Gravesham Industrial Background	6	0	0
Maidstone Rural	0	0	0
Maidstone Upper Stone Street	1	0	0
Rochester Stoke	4	2	0
Swale Newington 4	5	0	0
Swale Ospringe Roadside 2	9	2	0
Swale St Pauls Street	41	12	7
Thanet Birchington Roadside	2	0	0
Thanet Ramsgate Roadside	6	0	0
Tonbridge and Malling, Borough Green Roadside	11	0	0
Tunbridge Wells A26 Roadside	2	0	0

[a]Annual data capture < 75 %, therefore some pollution episodes may not have been recorded.

Table 3-9 Numbers of days with "Moderate" or above $PM_{2.5}$ concentrations in 2022.

Site Name	Moderate	High	Very High
Canterbury(a)	0	0	0
Chatham Roadside	4	3	0
Maidstone Upper Stone Street	9	0	0
Rochester Stoke	3	3	1
Swale Newington 4	4	1	0
Swale St Pauls Street	6	2	0
Tunbridge Wells A26 Roadside	0	0	0

(a) Annual data capture < 75 %, therefore some pollution episodes may not have been recorded.

Table 3-10 Numbers of days with "Moderate" or above O_3 concentrations in 2022.

Site Name	Moderate	High	Very High
Canterbury	31	0	0
Rochester Stoke	23	0	0

Table 3-11 Numbers of days with "Moderate" or above SO_2 concentrations in 2022.

Site Name	Moderate	High	Very High
Rochester Stoke	0	0	0

3.4 SIGNIFICANT AIR POLLUTION EPISODES

Table 3-12 shows the days when at least one of the pollutants (NO_2, PM_{10}, $PM_{2.5}$, O_3 and SO_2) observed Moderate or higher pollution. Section 3.2 illustrates the limit values.

Table 3-12 Dates when one or more pollutants were in the moderate or higher band.

Date	NO_2 DAQI	PM_{10} DAQI	$PM_{2.5}$ DAQI	O_3 DAQI	SO_2 DAQI
14/01/2022	3	3	4	1	1
15/01/2022	2	3	4	1	1
16/01/2022	2	2	4	2	1
20/01/2022	3	6	2	2	1
21/01/2022	3	5	2	2	1
23/01/2022	2	6	3	2	1
24/01/2022	2	9	3	2	1
25/01/2022	2	7	3	2	1
26/01/2022	2	5	3	2	1
26/02/2022	2	6	2	3	1
27/02/2022	1	4	2	3	1

28/02/2022	2	6	2	3	1
02/03/2022	2	3	4	2	1
03/03/2022	3	9	3	2	1
04/03/2022	2	7	3	1	1
07/03/2022	2	7	2	3	1
08/03/2022	2	10	3	3	1
09/03/2022	2	10	3	3	1
10/03/2022	2	9	3	3	1
14/03/2022	2	5	2	3	1
15/03/2022	2	10	2	2	1
16/03/2022	2	10	2	2	1
18/03/2022	2	6	2	3	1
19/03/2022	1	4	2	3	1
21/03/2022	2	9	5	3	1
22/03/2022	3	10	7	3	1
23/03/2022	3	10	9	4	1
24/03/2022	3	8	10	3	1
25/03/2022	2	10	8	3	1
26/03/2022	2	7	5	4	1
28/03/2022	2	7	3	3	1
29/03/2022	1	7	4	3	1
30/03/2022	2	4	3	3	1
08/04/2022	3	6	2	3	1
11/04/2022	2	8	2	3	1
12/04/2022	2	8	2	3	1
14/04/2022	2	4	2	3	1
15/04/2022	2	4	2	3	1
16/04/2022	1	4	4	3	1
19/04/2022	2	4	2	4	1
20/04/2022	2	4	2	3	1
21/04/2022	2	5	2	3	1
22/04/2022	1	5	2	3	1
23/04/2022	1	5	3	3	1
28/04/2022	2	4	2	3	1
02/05/2022	1	2	2	4	1
03/05/2022	1	4	2	3	1
09/05/2022	2	4	2	3	1
15/05/2022	2	5	3	4	1
02/06/2022	1	3	2	4	1
14/06/2022	2	3	2	4	1
15/06/2022	2	4	2	5	1
16/06/2022	2	5	2	6	No Data
17/06/2022	2	4	2	6	No Data

18/06/2022	2	3	2	4	No Data
23/06/2022	2	4	2	5	No Data
24/06/2022	2	3	2	4	No Data
02/07/2022	2	3	4	3	No Data
08/07/2022	2	2	2	4	No Data
11/07/2022	2	3	2	4	No Data
13/07/2022	2	3	2	4	No Data
17/07/2022	2	2	1	4	No Data
18/07/2022	2	3	2	6	No Data
19/07/2022	2	3	2	6	No Data
20/07/2022	2	3	2	5	No Data
27/07/2022	2	4	1	3	1
30/07/2022	2	2	1	4	1
07/08/2022	2	2	1	4	1
08/08/2022	2	3	2	4	1
10/08/2022	2	3	2	4	1
11/08/2022	2	3	2	5	1
12/08/2022	2	5	2	5	1
13/08/2022	2	3	2	6	1
14/08/2022	3	3	2	6	1
15/08/2022	2	3	2	5	1
16/08/2022	2	4	2	4	1
17/08/2022	2	3	2	5	1
18/08/2022	2	2	2	4	1
02/09/2022	2	3	2	4	1
03/09/2022	2	2	2	4	1
22/09/2022	2	4	2	3	1
03/10/2022	2	4	2	2	1
12/10/2022	2	4	2	2	1
14/10/2022	2	4	2	2	1
18/10/2022	2	4	1	2	1
19/10/2022	1	4	2	2	1
28/10/2022	2	4	2	3	1
31/10/2022	2	4	1	2	1
11/11/2022	1	5	1	3	1
12/11/2022	1	5	2	2	1
14/11/2022	2	8	2	2	1
22/11/2022	2	4	2	2	1
30/11/2022	2	6	2	2	1
01/12/2022	2	5	2	2	1
07/12/2022	2	5	2	2	1
10/12/2022	2	3	5	2	1
11/12/2022	2	2	4	2	1

3.4.1 Particulate Matter Episodes

During 2022 particulate matter episodes occurred at sites in the Kent region. The limit values that set the thresholds for episodes are described in Section 3.2. Figure 3 and Figure 4, show the daily mean PM_{10} and $PM_{2.5}$ concentrations for those sites that observed moderate or higher pollution during 2022.

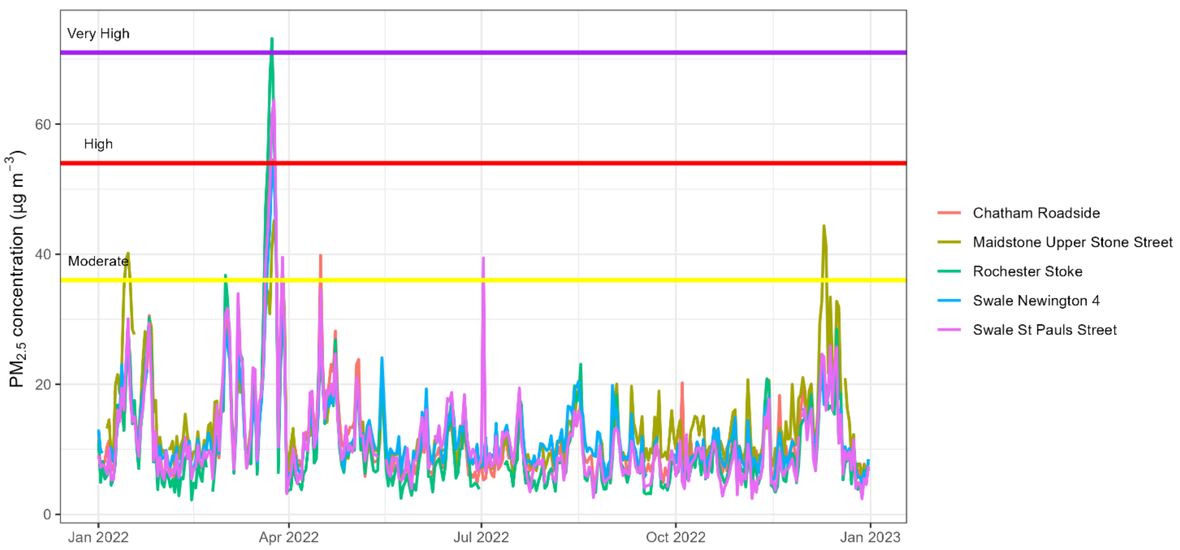
Very High PM_{10} were recorded on the following dates:

- 8th March, **138 µgm^{-3}** at Swale St Pauls Street
- 9th March, **101 µgm^{-3}** at Swale St Pauls Street
- 15th March, **124 µgm^{-3}** at Swale St Pauls Street
- 16th March, **107 µgm^{-3}** at Swale St Pauls Street
- 22nd March, **114 µgm^{-3}** at Swale St Pauls Street
- 23rd March, **126 µgm^{-3}** at Swale St Pauls Street
- 25th March, **113 µgm^{-3}** at Swale St Pauls Street

$PM_{2.5}$ concentrations also reached the Very High band on 24th March at Rochester Stoke with a peak daily average $PM_{2.5}$ concentration of 73 µgm^{-3} recorded.

Figure 2: Daily mean PM_{10} concentrations for sites that observed moderate or higher pollution during 2022.

Figure 3: Daily mean $PM_{2.5}$ concentrations for that observed moderate or higher pollution during 2022.

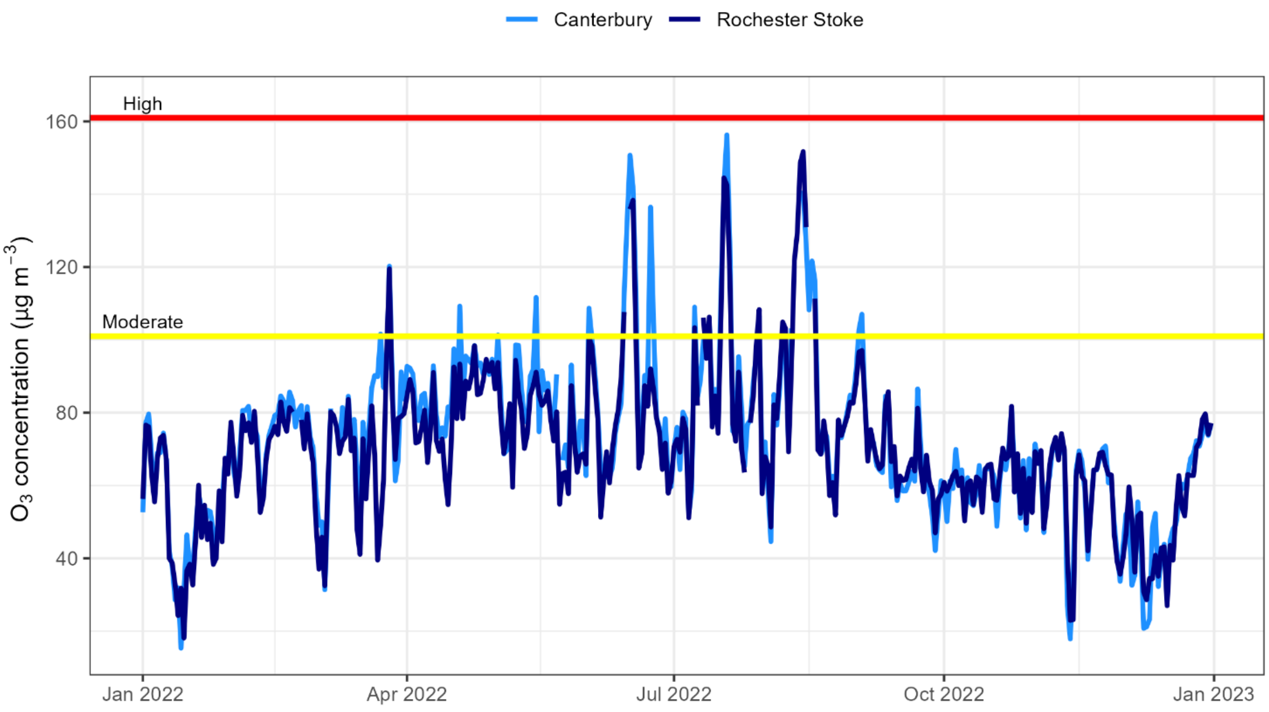


3.4.2 Ozone Episodes

Figure 5 shows the daily maximum 8-hour running mean ozone concentrations during 2022 for Canterbury and Rochester Stoke. The limit values that set the thresholds for episodes are described in Section 3.2.

Moderate ozone occurred on 34 days during 2022. The highest daily maximum 8-hour running mean for ozone was 156 µgm^{-3}, recorded at Canterbury on 19th July 2022. Ozone at Rochester on the same day was also elevated at 143 µgm^{-3}. The peak in ozone coincided with a heatwave in the UK, with record temperatures recorded on this day. Moderate and High ozone were recorded across many areas of the UK between 18th - 20th July.

Figure 4: Ozone maximum 8-hour running mean concentrations for each day during 2022 at Canterbury and Rochester Stoke.



As discussed in Section 2.4, ozone is formed in the atmosphere via reactions between NOx and VOCs under the presence of sunlight. Therefore, ozone pollution episodes typically occur during the spring and summer months, when the conditions are favourable for ozone production – warm temperatures, sunshine and stable conditions. Ozone can remain in the troposphere (lower part of the atmosphere) for many days and even weeks, so the ozone measured in one location may actually be formed much further downwind.

3.5 LONG TERM TRENDS

To assess the changes in pollutant concentrations over time, plots of the annual mean concentrations from 1998 to 2022 have been produced. The annual means for each pollutant and site are compared to the UK averages. For NO_2, PM_{10}, $PM_{2.5}$ and O_3 the UK average annual means are taken from the air quality statistics tables available from Defra[5]. SO_2 UK annual means have been calculated from the hourly SO_2 data, downloaded from UKAir[6]. All annual means are calculated for those years when the data capture rate is 75% or above.

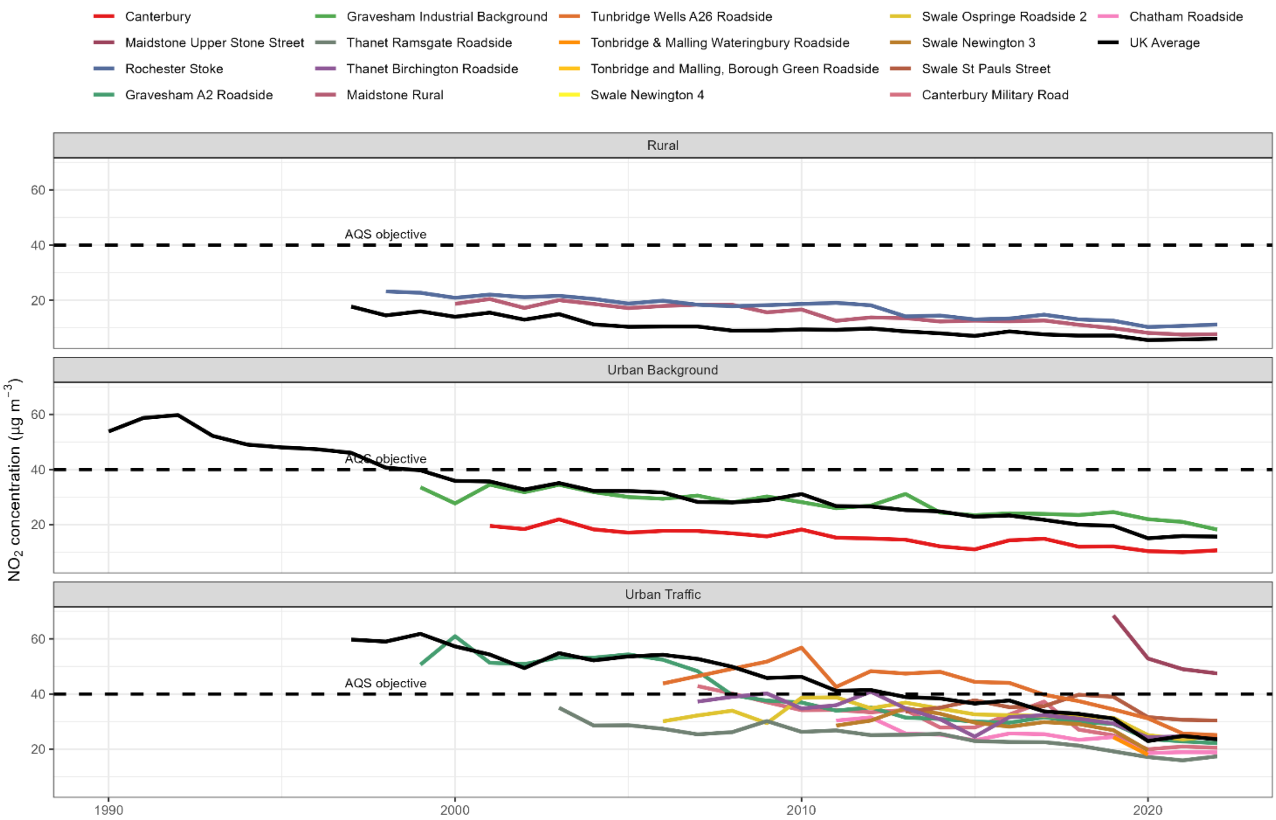
Figure 5 shows long term trends in NO_2 from rural, urban background and traffic monitoring stations in the KMAQMN along with UK averages from 1998 to 2022. NO_2 concentrations in general have decreased in the

[5] https://www.gov.uk/government/statistical-data-sets/env02-air-quality-statistics
[6] https://uk-air.defra.gov.uk/data/data_selector

UK since the late 1990's, most likely due to a reduction in emissions as new Euro standard vehicles are introduced into the fleet, and less coal used in energy generation. The annual means measured by the monitoring sites in the KMAQMN have been declining, generally following the trend observed in the UK averages. In 2020, many sites observed a reduction in annual mean NO_2 concentrations, which is likely to the reduction in traffic volumes during the Covid-19 lockdowns in the UK. Although some increases in annual mean NO_2 concentrations have been observed since 2020, none of the sites in the KMAQMN, have increased above pre-covid levels.

Some sites in the KMAQMN observe annual mean NO_2 concentrations much greater than the UK average. NO_2 concentrations can vary greatly from site to site, depending on the local sources. A large source of NO_2 emissions, particularly in urban areas, is from road transport, the measured NO_2 concentrations at different urban sites can vary greatly, depending on the location of the site and the local traffic volumes.

Figure 5: Trends in NO_2 annual means concentrations from rural, urban background and traffic monitoring stations in the KMAQMN, alongside the UK average from 1998 to 2022.



PM_{10} annual mean concentrations at urban background and traffic monitoring stations have decreased since measurements began, following the general downward trend in the AURN UK averages, as shown in Figure 7. However, PM_{10} concentrations at Gravesham Industrial Background are higher in 2022 compared to 2015. This may be related to changes in local sources in the area. For the traffic stations, the concentrations at all sites except Tunbridge Wells A26, are higher than the UK average. As the UK average includes all roadside stations in the UK, some of these may be located in areas which have much lower traffic volumes, and a lighter fleet composition thereby resulting in a lower annual mean concentration. Particulate matter also has many sources, which can result in variability across sites and due to the close proximity to Europe, the south-east of the UK can be particularly susceptible to pollution transported from the continent under certain meteorological conditions.

Figure 6: Trends in PM_{10} annual means concentrations from urban background and traffic monitoring stations in the KMAQMN, alongside the UK average from 1998 to 2022.

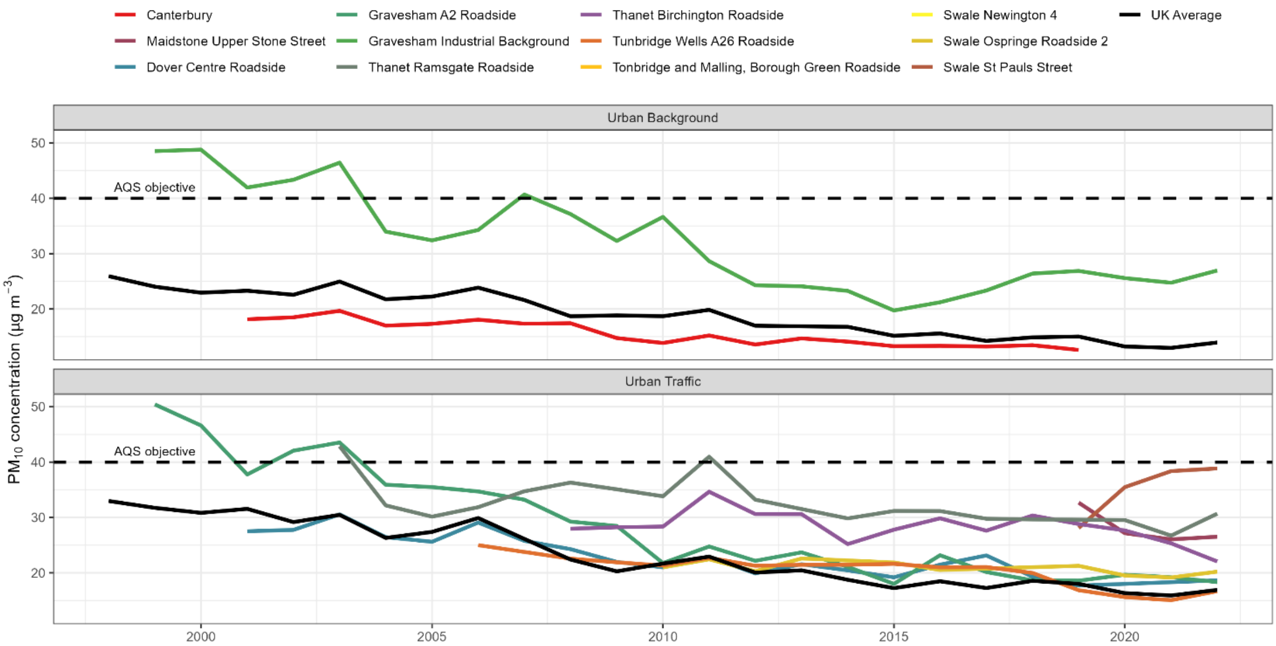
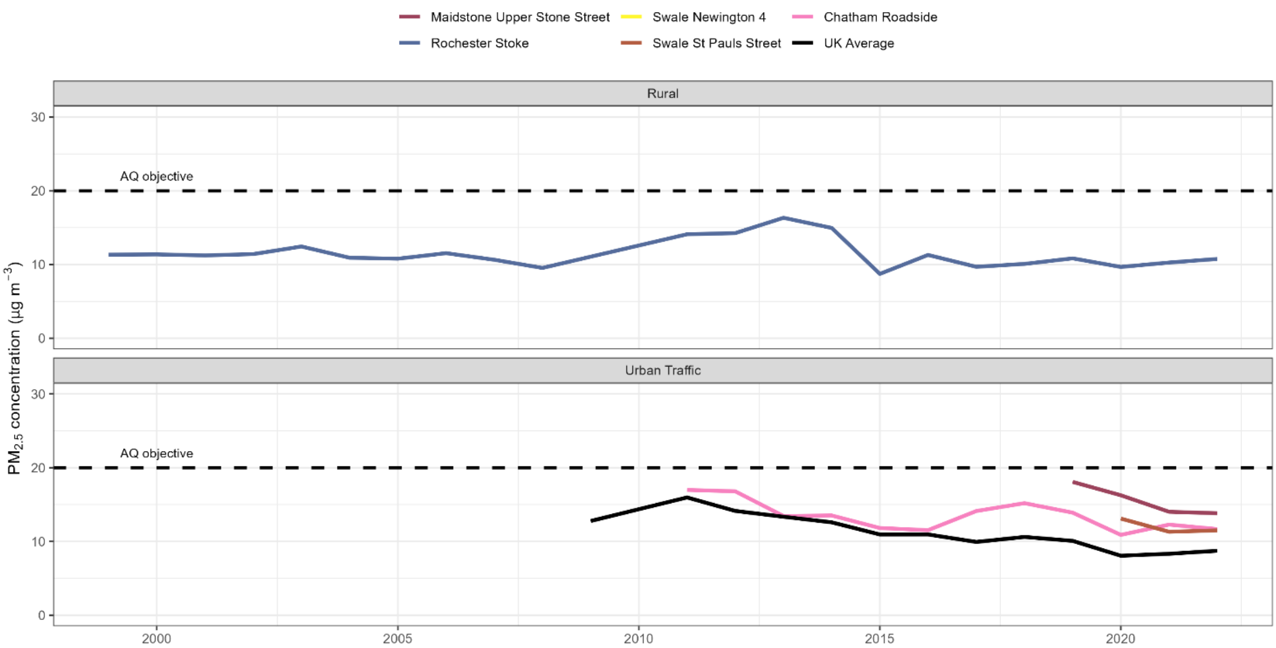


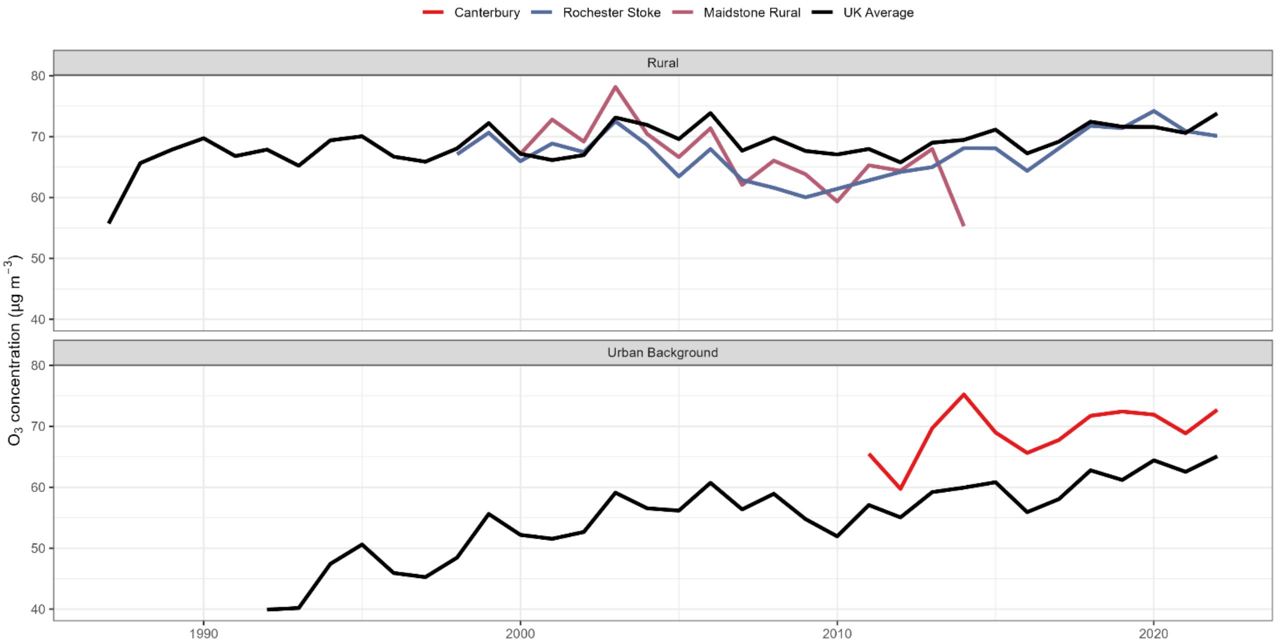
Figure 7 shows long term trends in $PM_{2.5}$ from rural and traffic monitoring stations in the KMAQMN. Note: there are no UK averages available for the rural monitoring sites, therefore a comparison with UK averages is only undertaken for the traffic monitoring sites. Chatham Roadside has been measuring $PM_{2.5}$ since 2011 and followed a similar downward trend to the UK average until 2016, after which annual mean concentrations increased until 2018 followed by another decrease. Annual mean concentrations at the three traffic monitoring sites in the KMAQMN are all higher than the UK average in 2022.

Figure 7: Trends in $PM_{2.5}$ annual means concentrations from rural and traffic monitoring stations in the KMAQMN, alongside the UK average from 1998 to 2022.



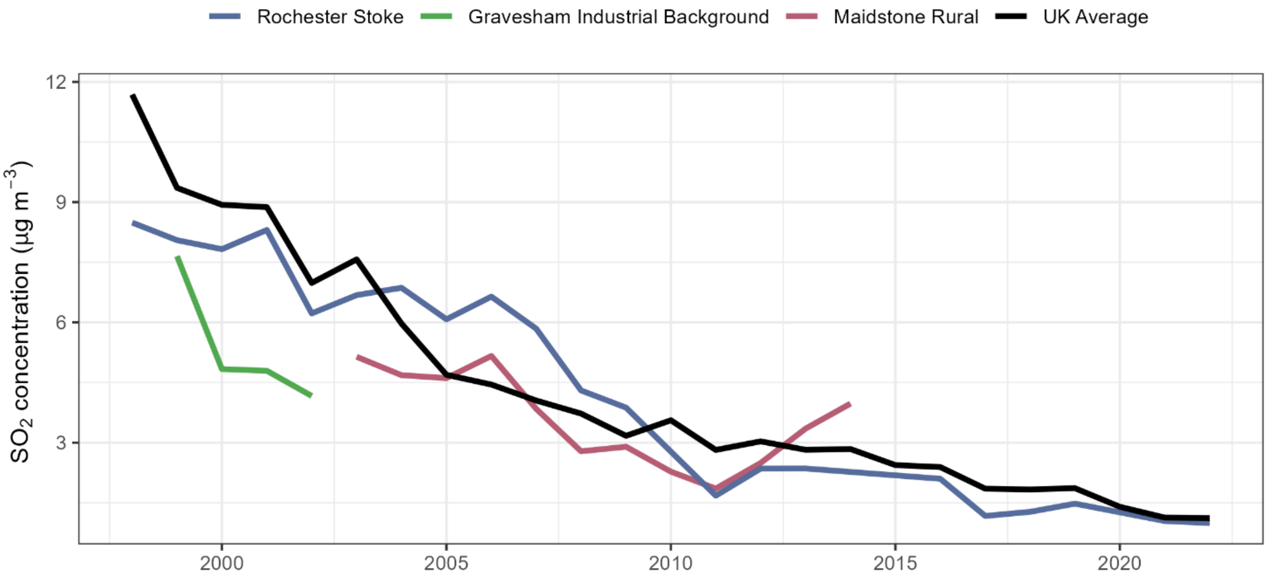
Ozone trends for rural and urban background monitoring stations are compared to the UK averages in Figure 8. For ozone the annual mean daily maximum running 8-hour mean concentration is compared here, as this provides a better comparison of peak ozone concentrations year on year. Ozone concentrations can vary greatly year on year as the formation of ozone is strongly dependant on meteorological conditions.

Figure 8: Trends in the annual mean of the daily maximum 8-hour mean O_3 concentrations from rural and urban background monitoring stations in the KMAQMN alongside the UK average from 1998 to 2022.



Sulphur dioxide has drastically reduced over the past few decades as a result of limitations put into place on the amount of sulphur in fuels and the reduction in power plants that use coal. The long-term trends observed at Rochester Stoke closely follows those of the UK average as shown in Figure 9.

Figure 9: Trends in SO_2 annual means concentrations from the KMAQMN alongside the UK average from 1998 to 2022.



3.6 TEMPORAL VARIATION OF POLLUTANT CONCENTRATIONS

In this section temporal variations of the pollutant concentrations at each site are assessed using the openair R package ‘timeVariation’ function.

Figure 10 shows the daily, weekly and monthly variations in NO_2 concentrations in 2022, for each of the monitoring stations. The plot shows that the cycles at each site are very similar, although vary in magnitude. Peaks in NO_2 are typically observed in the morning and evening, and the daily concentrations are lowest at the weekend, indicating that road traffic is likely to be a prominent source of NO_2.

The variations in ozone concentrations at the two sites are very similar, as shown in Figure 11. Ozone typically peaks in mid- afternoon, as this is the period when photochemical production of ozone is greatest, and there is also less NO available to react with and remove ozone. Ozone concentrations peak in April at both sites. This spring-time peak in ozone is a regular occurrence in the UK as conditions become conducive to ozone formation.

Figure 10: Daily, weekly and monthly variation in NO_2 concentrations at each monitoring station for 2022.

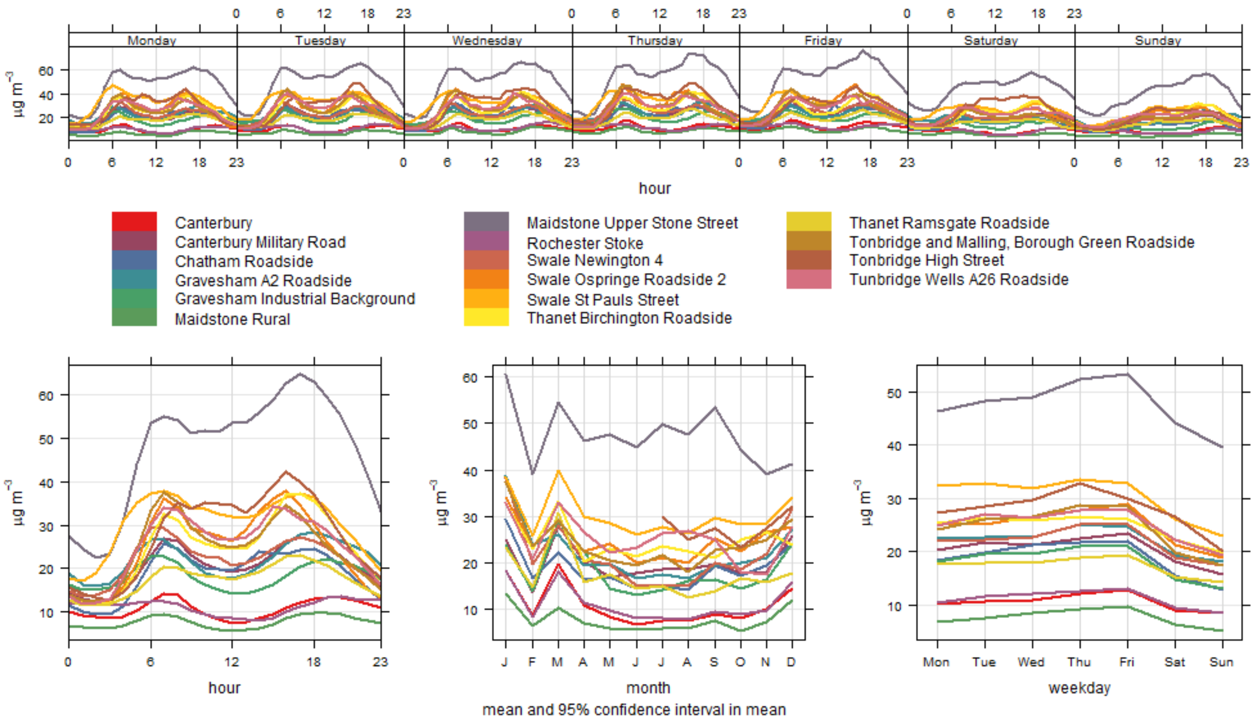
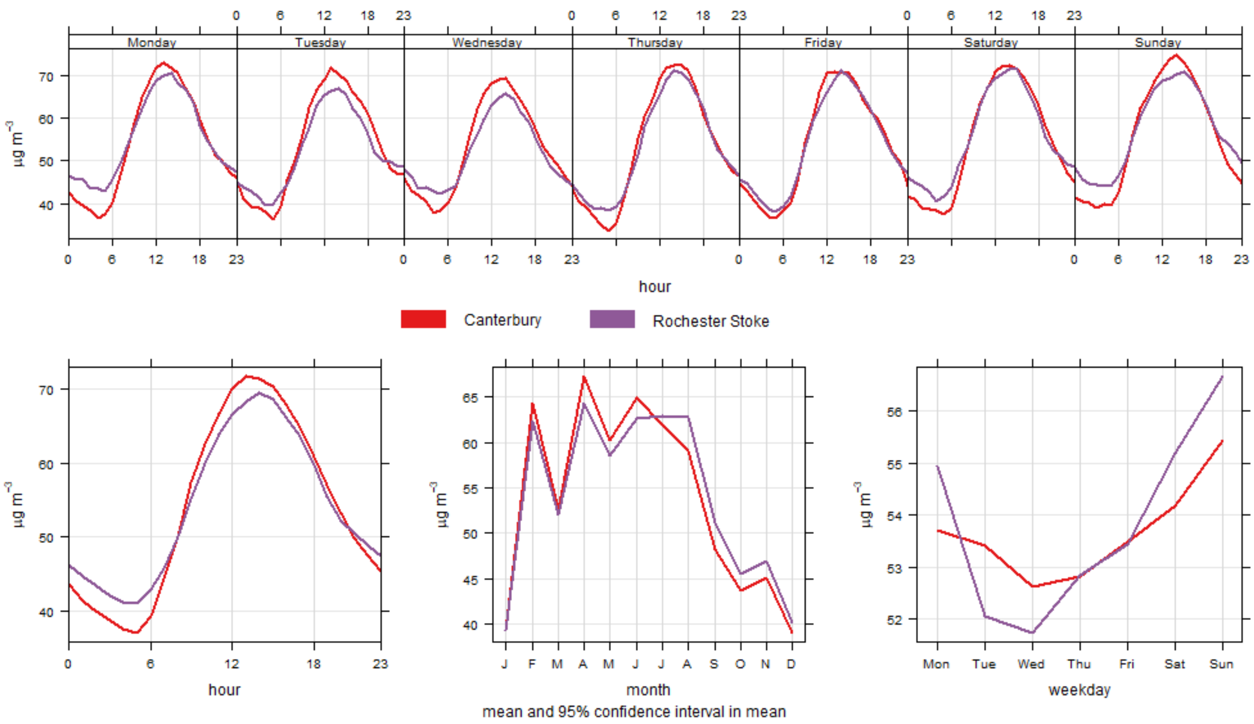


Figure 11: Daily, weekly and monthly variation in O_3 concentrations at each monitoring station for 2022.



The variations in PM_{10}, as shown in Figure 12 vary greatly from site to site. Some sites observe morning and evening peaks in PM_{10}, whilst Swale St Pauls Street has a much higher peak in the morning, which may be due to higher traffic flows at this location. $PM_{2.5}$ shows a similar diurnal trend at all sites, with peaks in the morning and late evening (Figure 14).

Figure 12: Daily, weekly and monthly variation in PM_{10} concentrations at each monitoring station for 2022.

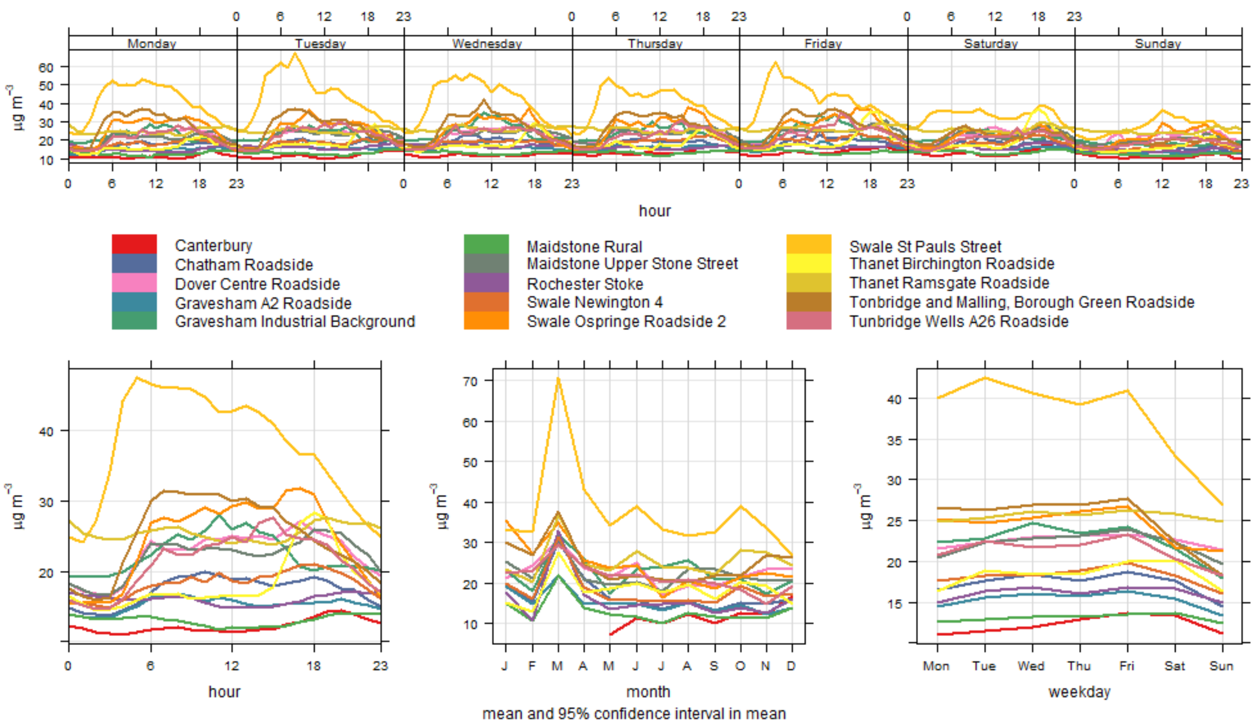
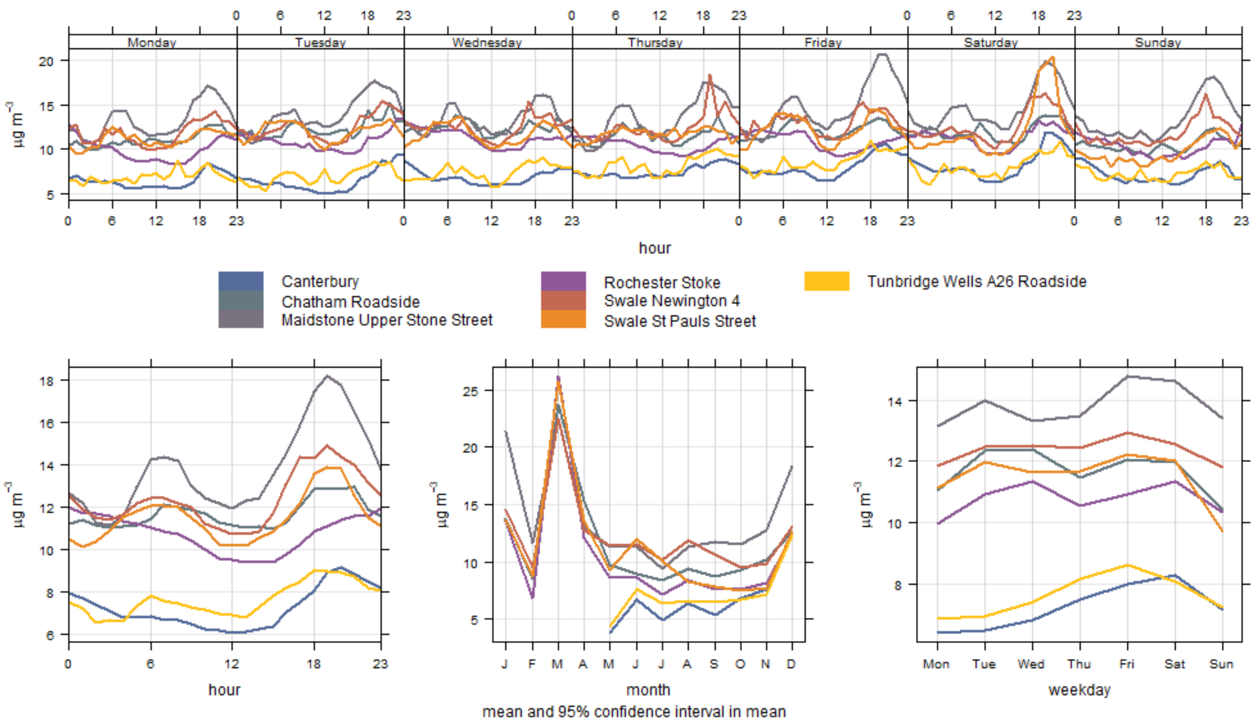


Figure 13: Daily, weekly and monthly variation in $PM_{2.5}$ concentrations at each monitoring station for 2022.



4. DIFFUSION TUBE MONITORING RESULTS

In addition to the automatic monitoring sites, the local authorities within the KMAQMN undertaken indicative measurements of Nitrogen dioxide using diffusion tubes. Diffusion tubes measure NO_2 via passive sampling. A reagent within the tube absorbs ambient NO_2 over a period of days or weeks. The tubes are then collected and analysed in a laboratory to determine the average concentration of NO_2 over the period the tube was exposed. As diffusion tubes are small and require no power, they can be easily attached to street furniture or façades of buildings. A network of these tubes can provide useful information on the spatial variation of NO_2 concentrations.

In this section a summary of the NO_2 diffusion tubes deployed in each local authority are presented for 2022. Table 4-1 shows the total number of sites operating during 2022, by each authority. At some locations, diffusion tubes are exposed in triplicate but are counted as one site here. Results and location information for each local authority's diffusion tube network are available through the KentAir website[7].

Table 4-1 NO_2 diffusion tube sites in Kent and Medway in 2022.

Local Authority	Number of Sites	Comments	Analytical Laboratory
Ashford Borough Council	25	1 triplicate location	Socotec (50% TEA in acetone)
Canterbury City Council	33	2 triplicate locations	Socotec (50% TEA in acetone)
Dover District Council	21	3 triplicate locations	Socotec (50% TEA in acetone)

[7] NO2 diffusion tube data - KentAir

Local Authority	Number of Sites	Comments	Analytical Laboratory
Folkstone and Hythe District Council	18	-	
Gravesham Borough Council	66	5 triplicate locations	Socotec (50% TEA in acetone)
Maidstone District Council	57	1 triplicate location	Socotec (50% TEA in acetone)
Medway Council	51	-	
Swale District Council	86	4 triplicate locations	Socotec (50% TEA in acetone)
Thanet District Council	40	5 triplicate locations	Socotec (50% TEA in acetone)
Tonbridge and Malling Borough Council	56	8 triplicate locations	Socotec (50% TEA in acetone)
Tunbridge Wells Borough Council	42	2 triplicate locations	

4.1.1 Site classifications

NO_2 diffusion tubes sites are classified according to the site classifications stated in the Local Air Quality Management Technical Guidance LAQM (TG22)[8]

Table 4-2 Site classifications used for NO_2 diffusion tube sites

Urban centre	An urban location representative of typical population exposure in towns or city centres, for example, pedestrian precincts and shopping areas
Urban background	An urban location distanced from sources and therefore broadly representative of citywide background conditions, e.g. urban residential areas
Suburban	A location type situated in a residential area on the outskirts of a town or city
Roadside	A site sampling typically within one to five metres of the kerb of a busy road (although distance can be up to 15 m from the kerb in some cases)
Kerbside	A site sampling within one metre of the kerb of a busy road
Industrial	An area where industrial sources make an important contribution to the total pollution burden
Rural	An open countryside location, in an area of low population
Other	Any special source-orientated or location category covering monitoring undertaken in relation to specific emission sources such as power stations, car-parks, airports or tunnels

The majority of the NO_2 diffusion tube sites within the KMAQMN are classified as either kerbside or roadside, with a few urban background, suburban rural and industrial sites. It is not always the case that kerbside sites measure higher NO_2 concentrations than roadside sites, despite being located closer to the road edge, as it also depends on the volume of traffic on the road. Therefore, kerbside and roadside sites are considered together in this report under one category, "Urban Traffic".

[8] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

4.1.2 Bias adjustment, annualisation and fall-off with distance

NO_2 diffusion tubes provide a low-cost method of measuring ambient NO_2, however the method is not as precise or accurate as automatic NO_2 monitoring techniques, hence they can only be used for “indicative” measurements of NO_2. Diffusion tubes can also be affected by interferences which can result in positive or negative biases, when compared to automatic monitoring techniques. As such annual mean concentrations derived from the monthly NO_2 diffusion tube samples require to be “bias-corrected”.

Local bias correction factors may be determined by locating triplicate tubes next to an automatic analyser and calculating the ratio of the annual means from both methods. The calculated bias correction factor can then be used to correct the diffusion tube data for the local authority. If a local authority does not have an automatic monitoring station, national bias adjustment factors[9] may be used. National bias adjustment factors are based on co-location studies from many sites in the UK. A factor is calculated for each analysing laboratory, preparation method and year.

If a diffusion tube has between 3 and 8 months of data, then the data needs to be annualised to calculate the annual mean. Diffusion tubes with less than 3 months of data cannot be annualised. Annualisation is performed by comparing the data from diffusion tubes to nearby automatic monitoring stations. Further information on annualisation of diffusion tubes is provided in the Local Air Quality Management Technical Guidance LAQM (TG22).

Diffusion tubes are typically placed at locations of relevant exposure. However, this is not always possible, therefore, local authorities can use the NO_2 fall-off with distance calculator[10] to predict the annual mean concentration of NO_2 at the nearest relevant receptor.

4.1.3 Final annual means and comparison with AQ objectives for each LA

In this section bias-adjusted and annualised (where relevant) diffusion tube NO_2 annual mean concentrations for each local authority are shown, along with the AQS objective of 40 μgm^{-3}. The data is taken directly from each local authority’s published annual status report located on the KentAir website here: https://kentair.org.uk/reports.

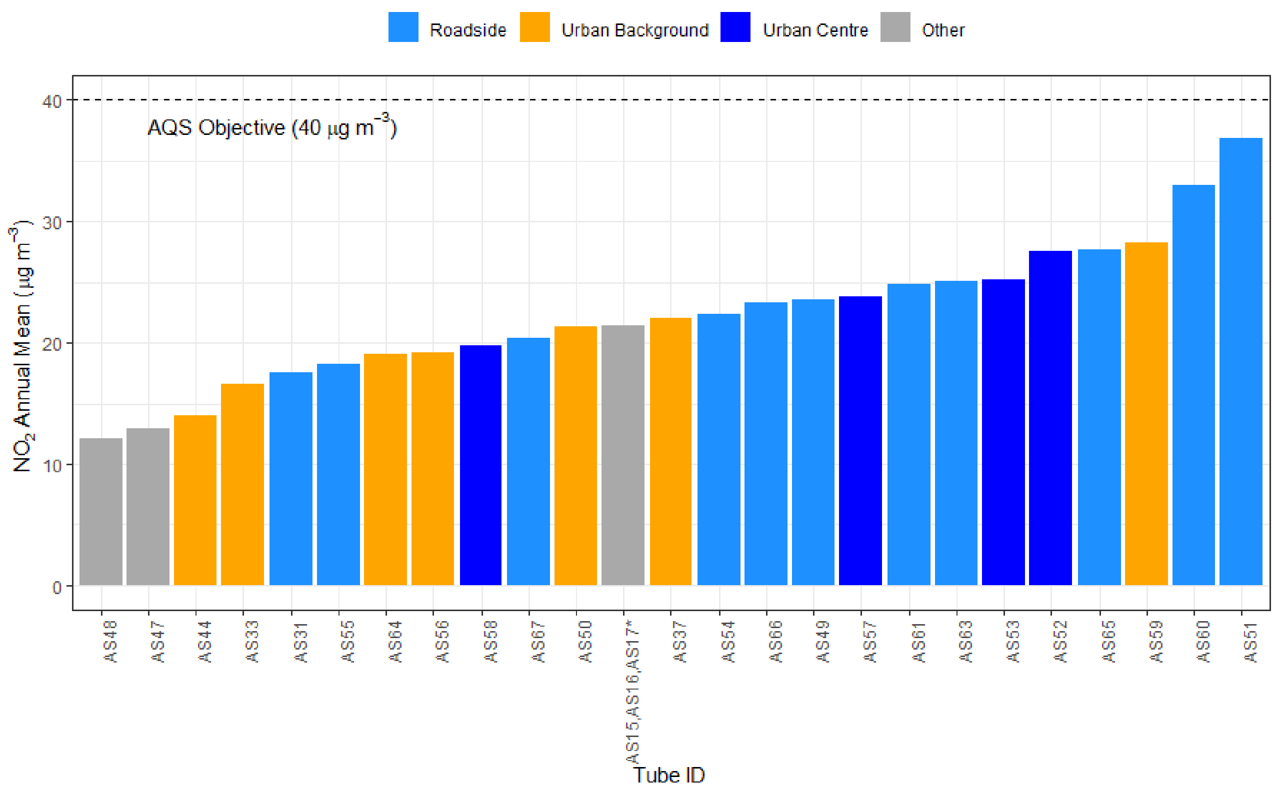
As diffusion tubes with less than 3 months of data cannot be annualised, the annual means for these tubes are not shown here. Sites with triplicate tubes are given by an asterisk (*), and a single value for the site shown, if this is how it is presented in the ASR. Please note that NO_2 concentrations presented in Figure 14 to Figure 24 are not corrected for fall-off with distance (where relevant) and represent the concentrations measured at the tube location, rather than the nearest relevant receptor.

[9] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/national-bias/
[10] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/no2-falloff/

4.1.3.1 Ashford Borough Council

In Ashford Borough NO_2 annual mean concentrations were measured at 25 diffusion tube sites in 2022. Of these, 11 sites were classified as Roadside, 7 as Urban Background, 4 as Urban Centre and 3 as Other (Other are located near motorways). Annual mean concentrations at all sites were below the AQS objective in 2022. An annual mean NO_2 concentration of 36.8 μgm^{-3} was recorded at the site on Wellesley Road (AS51), which is within 10% of the AQS objective.

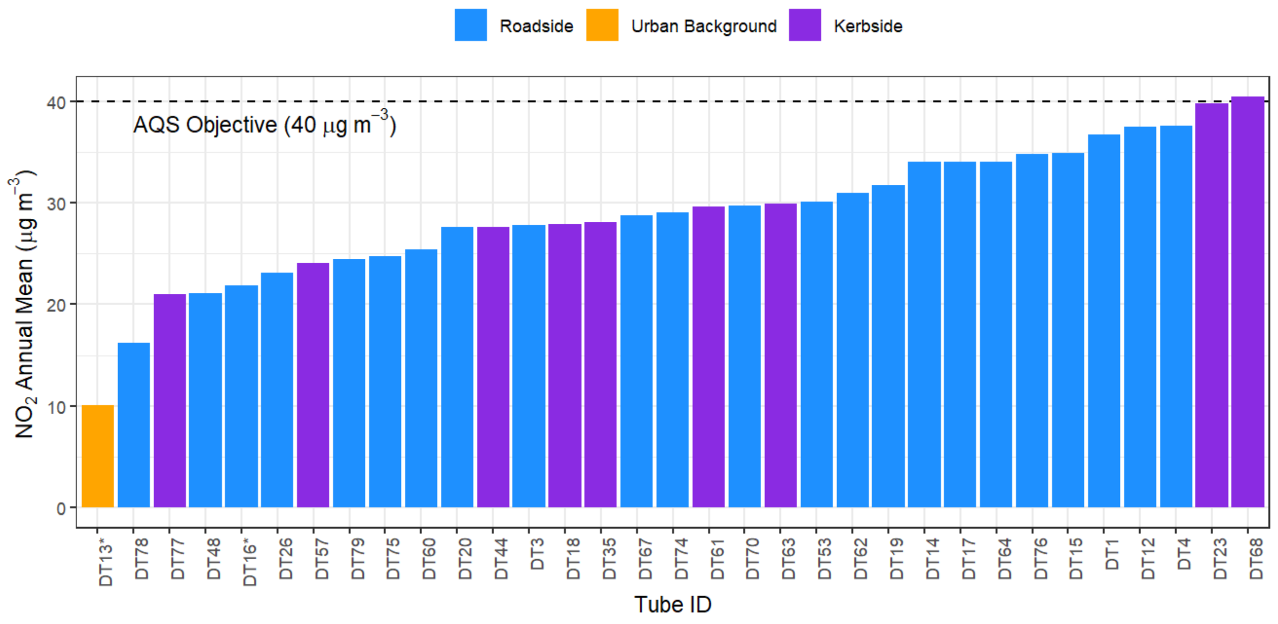
Figure 14 Ashford Borough Council diffusion tube NO_2 annual means for 2022



4.1.3.2 Canterbury City Council

In Canterbury NO_2 annual mean concentrations were measured at 33 diffusion tube sites in 2022. Of these, 9 sites are classified as Kerbside, 23 as Roadside, and 1 as Urban Background. Annual mean concentrations at all sites, except a kerbside site located on St George's Place (DT68), which recorded an NO_2 concentration of 40.5 μgm^{-3}, were below the AQS objective in 2022. Four sites were sites also recorded an annual mean NO_2 concentration within 10% of the AQS objective.

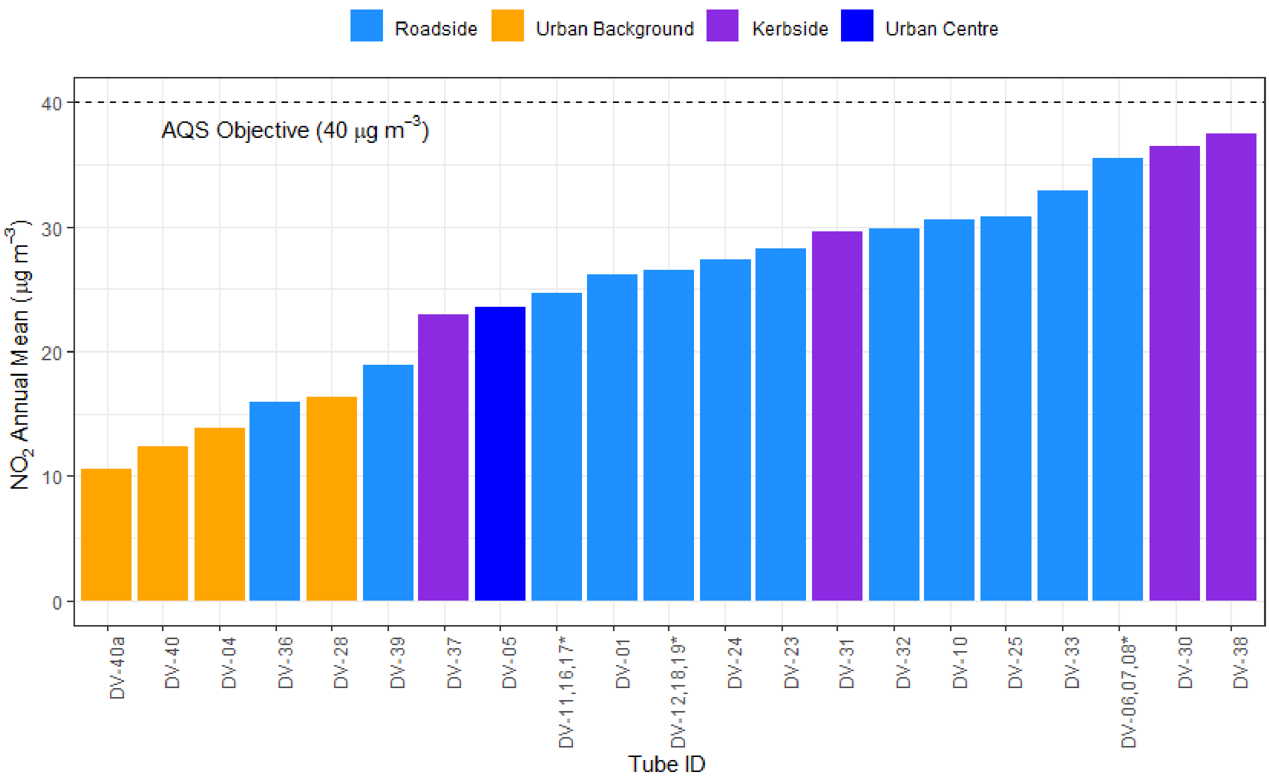
Figure 15 Canterbury City Council diffusion tube NO_2 annual means for 2022



4.1.3.3 Dover District Council

In Dover NO_2 annual mean concentrations were measured at 21 diffusion tube sites in 2022. Of these, 4 sites are classified as Kerbside, 12 as Roadside, 1 as Urban Centre, and 4 as Urban Background. Annual mean concentrations at all sites were below the AQS objective in 2022. Two sites (DV-38 and DV-30) were within 10% of the AQS objective.

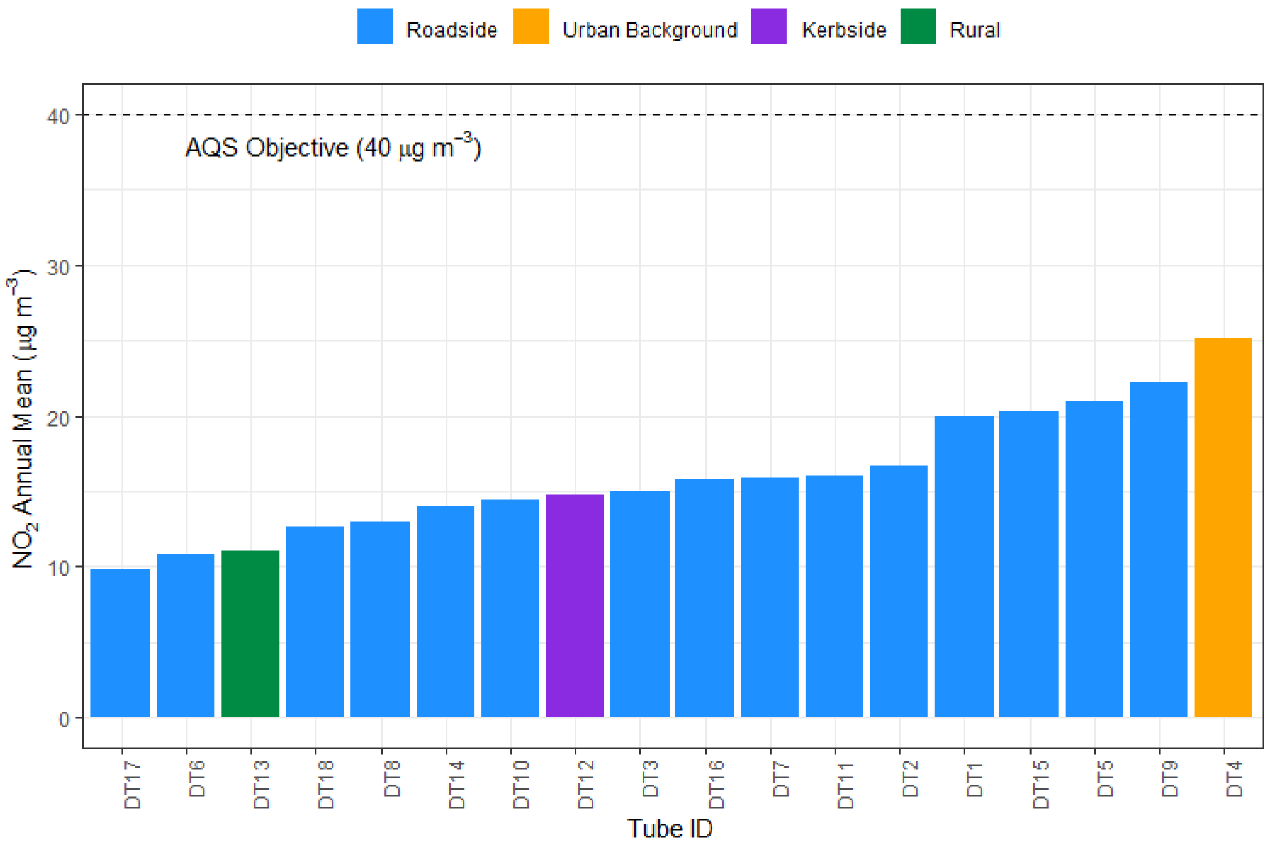
Figure 16 Dover District Council diffusion tube NO_2 annual means for 2022



4.1.3.4 Folkstone and Hythe District Council

In Folkestone and Hythe NO_2 annual mean concentrations were measured at 18 diffusion tube sites in 2022. Of these, 1 site is classified as Kerbside, 15 as Roadside, 1 as Urban Background, and 1 as Rural. Annual mean concentrations at all sites were below the AQS objective in 2022.

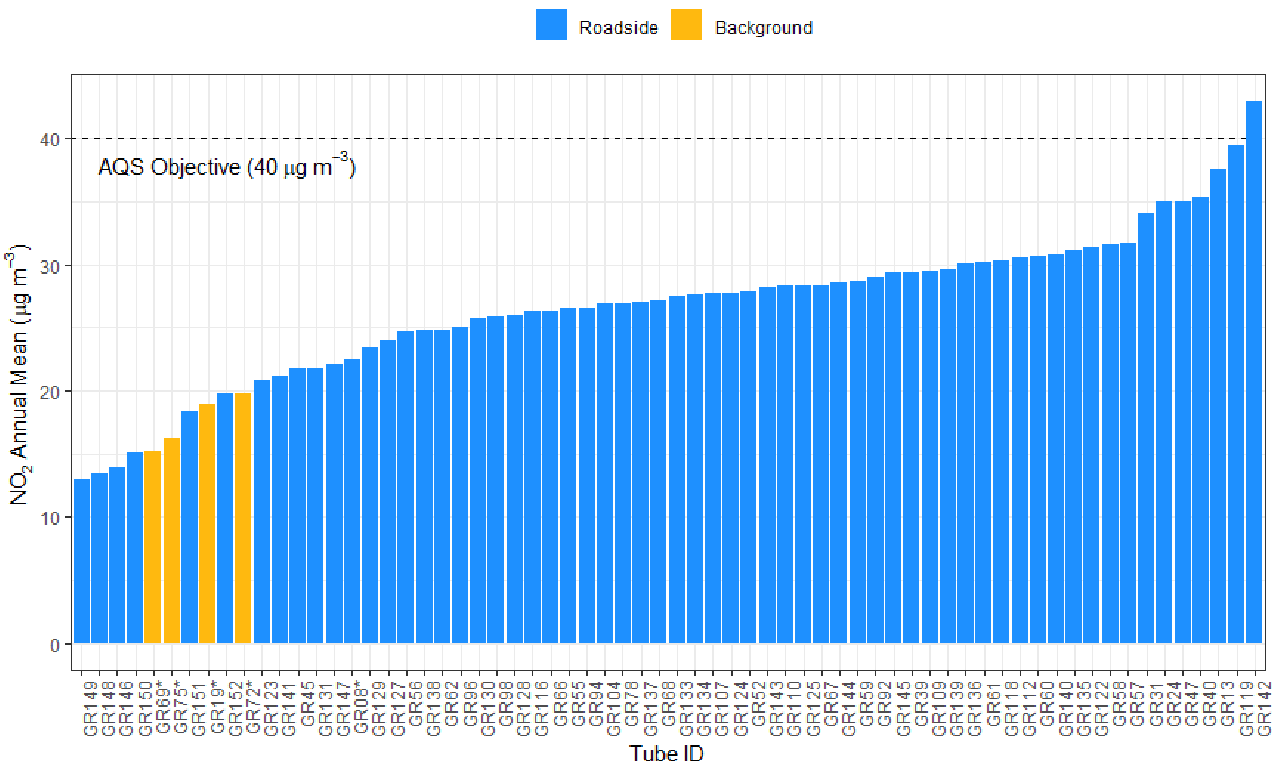
Figure 17 Folkstone and Hythe District Council diffusion tube NO_2 annual means for 2022



4.1.3.5 Gravesham Borough Council

In Gravesham NO_2 annual mean concentrations were measured at 66 diffusion tube sites in 2022. Of these, 62 sites are classified as Roadside, and 4 as Background. One site (GR142) recorded annual mean NO_2 concentrations of 42.9 μgm^{-3}, which is above the AQS objective in 2022. Two sites (GR119 and GR13) were within 10% of the AQS objective.

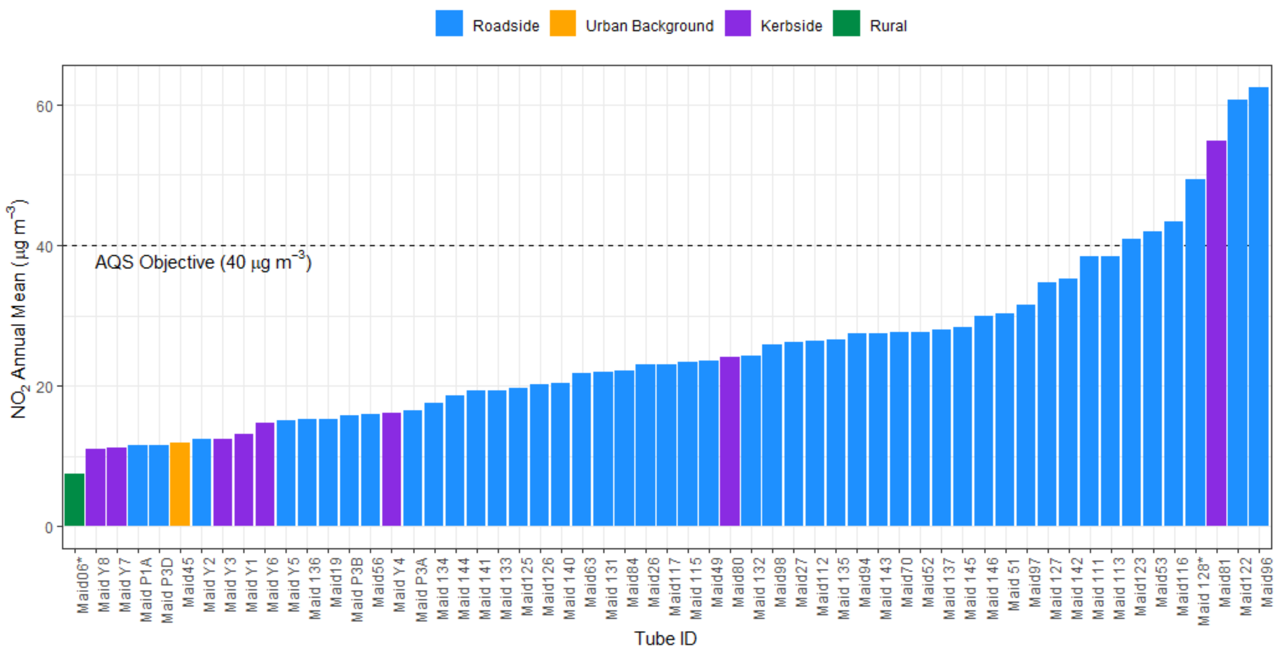
Figure 18 Gravesham Borough Council diffusion tube NO_2 annual means for 2022



4.1.3.6 Maidstone Borough Council

In Maidstone, NO_2 annual mean concentrations were measured at 57 diffusion tube sites in 2022. Of these, 8 sites are classified as Kerbside, 47 as Roadside, 1 as Background and 1 as Rural. Seven sites (Maid 96, Maid 122, Maid 81, Maid 128, Maid 116 and Maid 53, Maid 123) recorded annual mean NO_2 concentrations above the AQS objective in 2022. A further two sites were within 10% of the AQS objective.

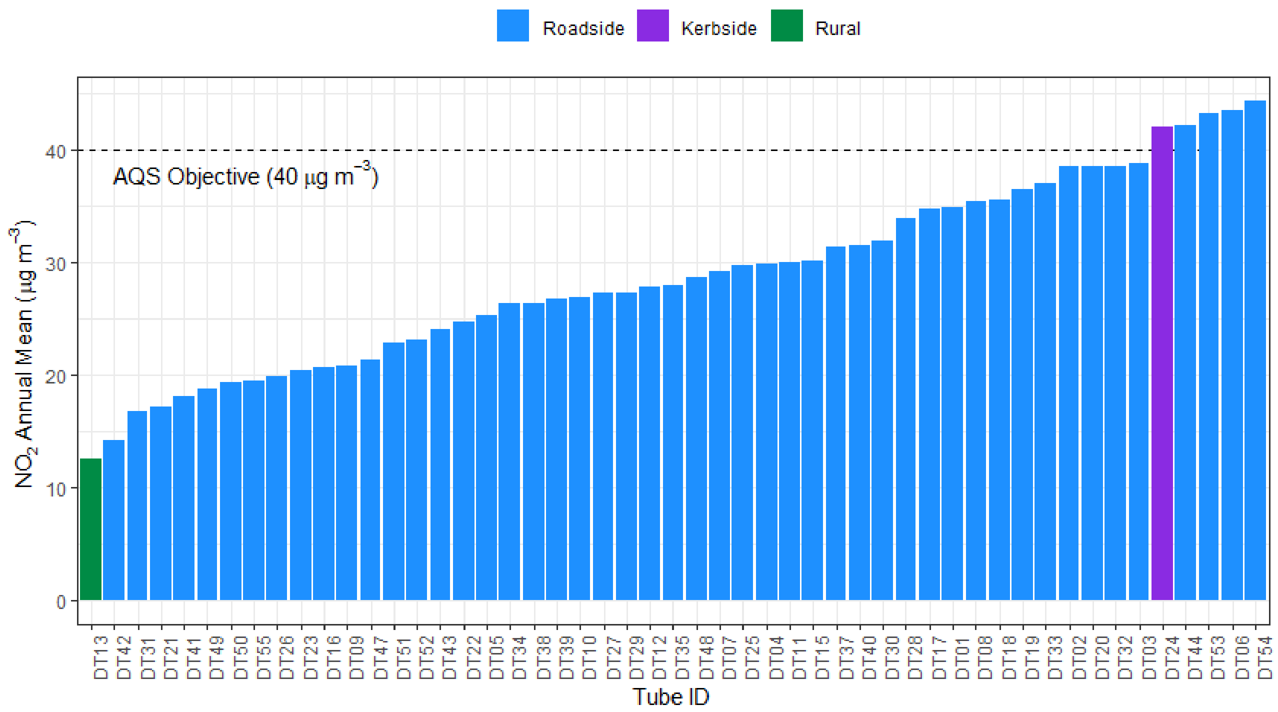
Figure 19 Maidstone District Council diffusion tube NO_2 annual means for 2022



4.1.3.7 Medway Council

NO_2 annual mean concentrations were measured at 51 diffusion tube sites in 2022 by Medway Council. Of these, 49 sites are classified as Roadside, 1 as Kerbside and 1 as Rural. Five sites (DT54, DT06 DT53, DT44 and DT24) recorded annual mean NO_2 concentrations above the AQS objective in 2022. A further six sites were within 10% of the AQS objective.

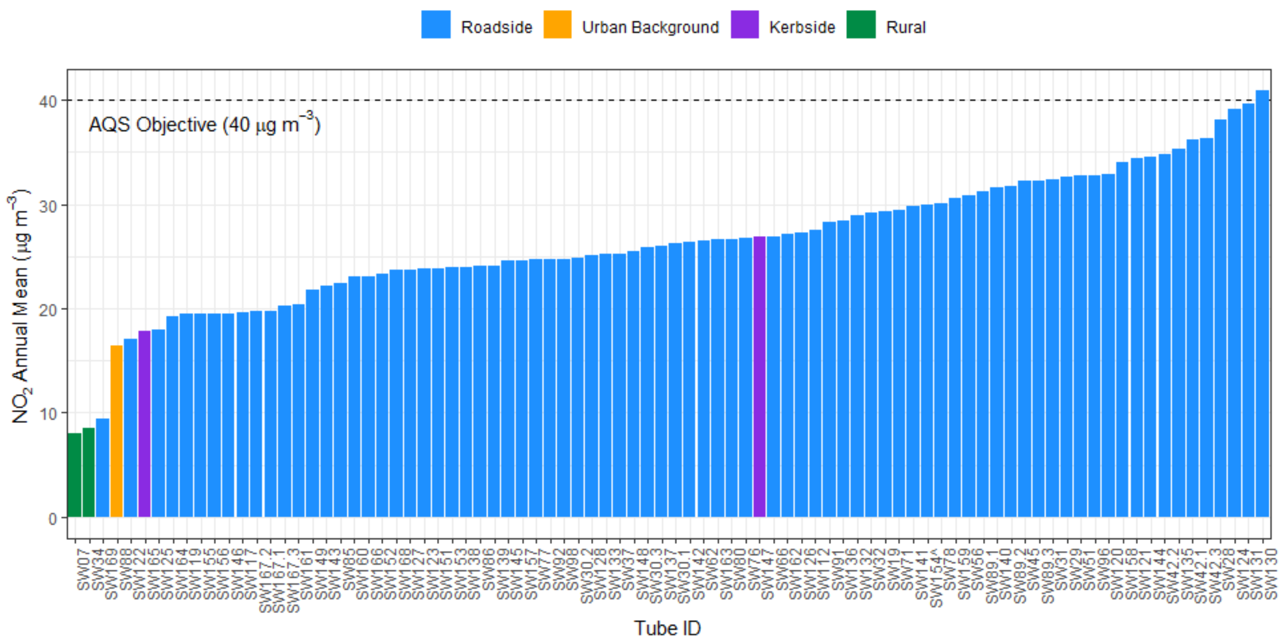
Figure 20 Medway Council diffusion tube NO_2 annual means for 2022



4.1.3.8 Swale Borough Council

In Swale NO_2 annual mean concentrations were measured at 86 diffusion tube sites in 2022. Of these, 2 sites are classified as Kerbside, 81 as Roadside, 1 as Urban Background and 2 as Rural. NO_2 concentrations measured at SW130 were above the AQS objective in 2022, with an annual mean of 40.9 µgm^{-3} recorded. All other sites were below the objective, however five sites recorded and annual mean within 10% of the AQS objective.

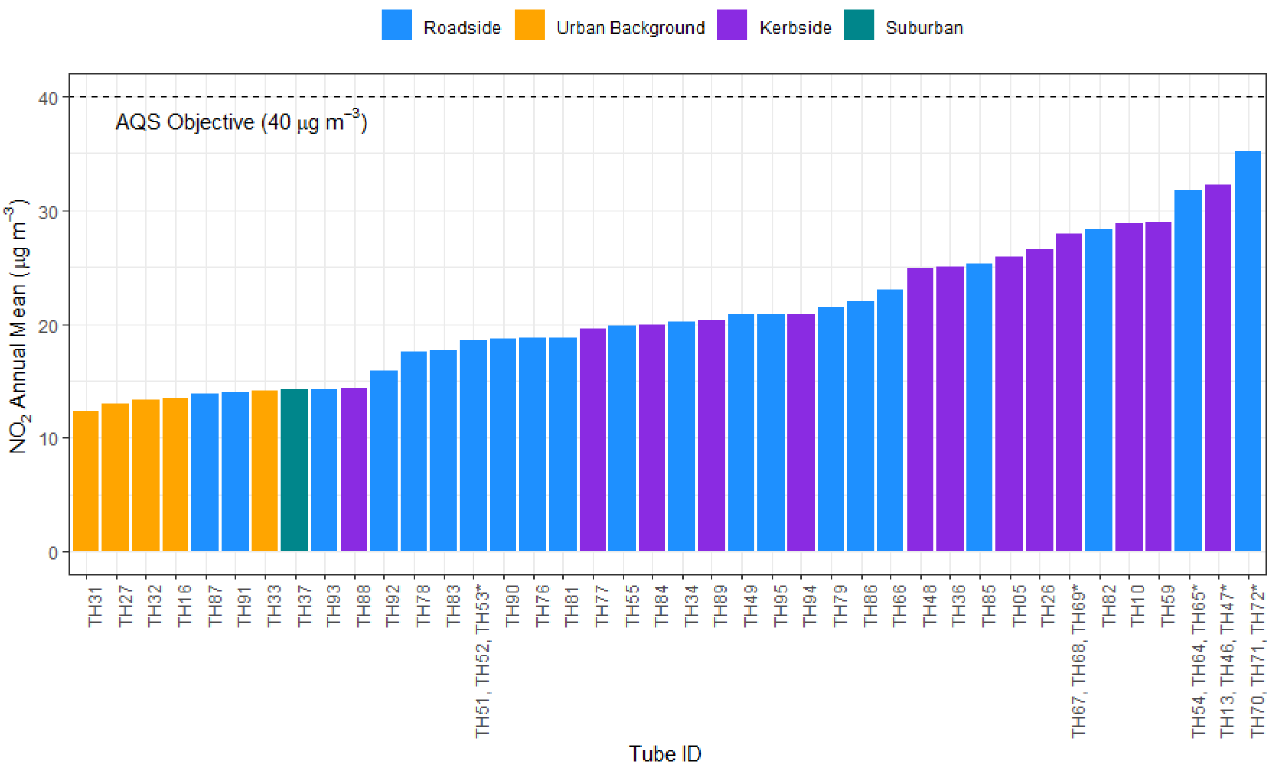
Figure 21 Swale District Council diffusion tube NO_2 annual means for 2022



4.1.3.9 Thanet District Council

In Thanet, NO_2 annual mean concentrations were measured at 40 diffusion tube sites in 2022. Of these, 13 sites are classified as Kerbside, 21 as Roadside, 5 as Urban Background and 1 as Suburban. Annual mean concentrations at all sites were below the AQS objective in 2022.

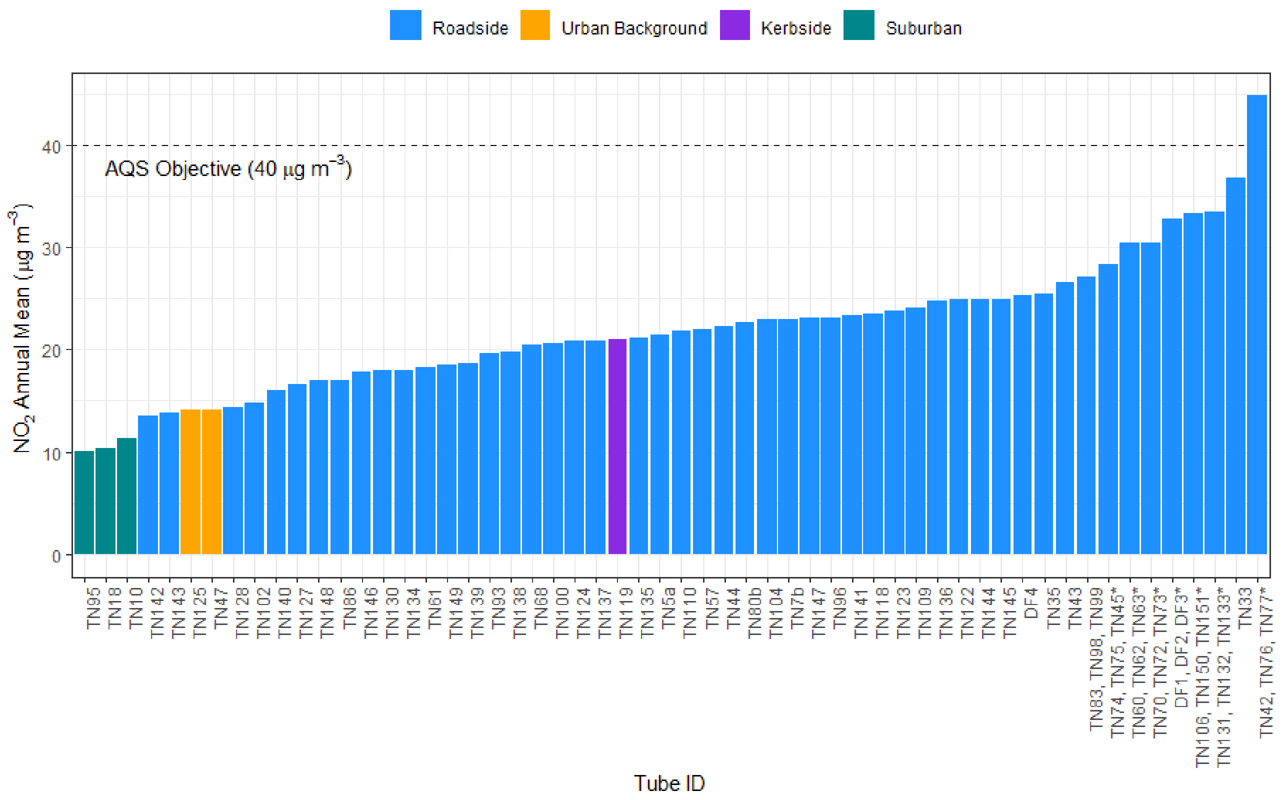
Figure 22 Thanet District Council diffusion tube NO_2 annual means for 2022



4.1.3.10 Tonbridge and Malling Borough Council

In Tonbridge and Malling NO_2 annual mean concentrations were measured at 56 diffusion tube sites in 2022. Of these, 50 sites are classified as Roadside, 21 as Kerbside, 2 as Urban Background and 3 as Suburban. A triplicate site located on Tonbridge Road, Wateringbury (TN42, TN76,TN77) recorded an annual mean NO_2 concentration of 44.8 µgm^{-3} in 2022, which is above the AQS objective of 40 µgm^{-3}. A site (TN33), further along the same road recorded an annual mean NO_2 concentration of 36.8 µgm^{-3} in 2022, which is within 10% of the AQS objective.

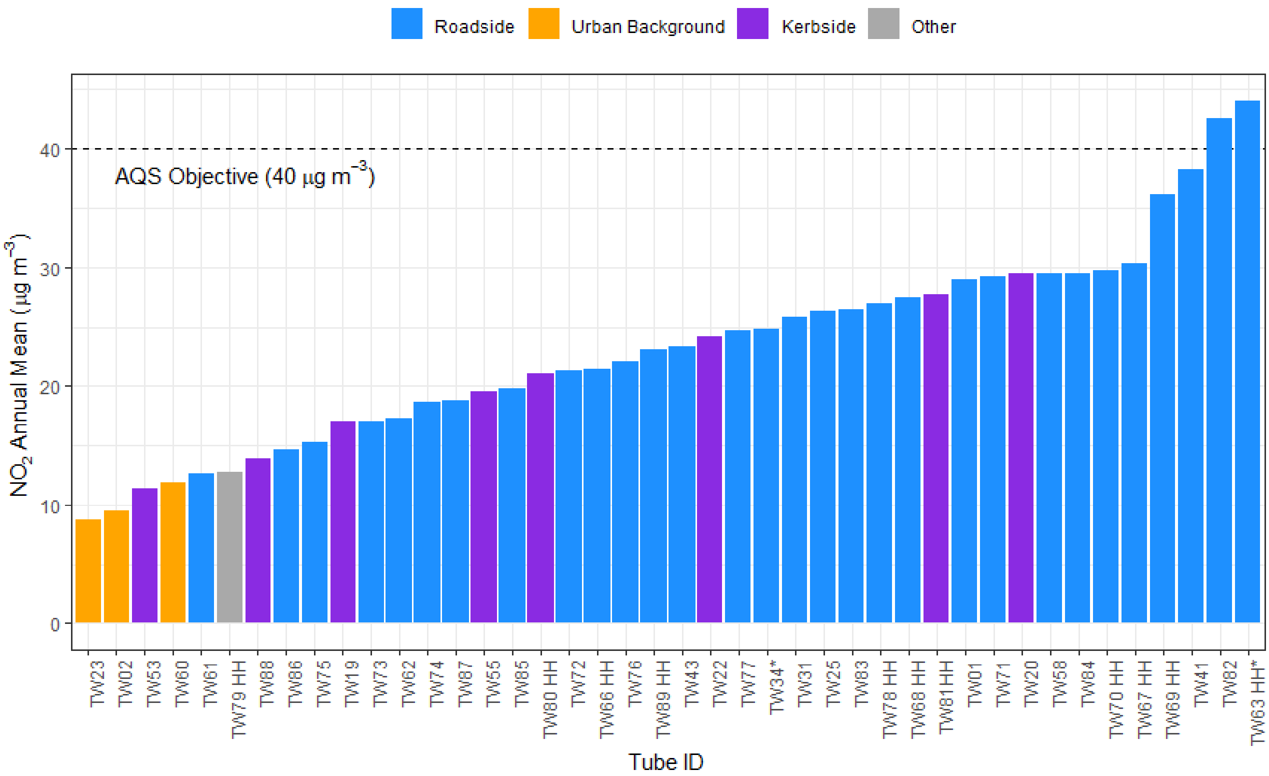
Figure 23 Tonbridge and Malling Borough Council diffusion tube NO_2 annual means for 2022



4.1.3.11 Tunbridge Wells Borough Council

In Tunbridge Wells NO_2 annual mean concentrations were measured at 42 diffusion tube sites in 2022. Of these, 8 sites are classified as Kerbside, 30 as Roadside, 3 as Urban Background and 1 as Other. Two sites recorded annual mean NO_2 concentrations above the AQS objective of 40 µgm-3. These are TW63 HH, a triplicate site on Cranbrook Road, and TW82 on Pembury Road. Two other sites recorded annual mean concentrations within 10% of the AQS objective.

Figure 24 Tunbridge Wells Borough Council diffusion tube NO_2 annual means for 2022



5. LOCAL AUTHORITY ACTIONS TO IMPROVE AIR QUALITY

In this section a summary of the air quality actions in progress or planned for the future are provided for each borough/district. Further details on local authority actions can be found in the individual Annual Status Reports (ASRs) published on the KentAir website here: https://kentair.org.uk/reports.

Ashford Borough Council

Ashford Borough Council undertook passive NO_2 monitoring at 25 diffusion tube sites in 2022. There are no automatic monitoring sites in the Borough. One diffusion tube site recorded an annual mean NO_2 concentration within 10% AQS objective. All other sites were below the objective. As such there are no AQMAs declared in the Borough.

Ashford Borough Council have continued to work to improve air quality, with the following measures in 2022:

- Implementation of electric vehicle charging points. In 2022, 35,165 kWh total energy consumption were recorded within the Ashford EV charging points network
- Contribution to the Kent Air and Care for Air websites to provide communications campaign and education resource about air quality.
- Supported Kent and Medway Air Quality Partnership in obtaining Defra funding for digital educational resource (Pollution Patrol) and contributed funding towards this project.
- Supported Kent and Medway Air Quality Partnership in obtaining Defra grant for support to public health/medical professionals, including commitment to funding.
- Planning conditions require EV charging points where appropriate.
- Given a grant of £1,000 to the KM Charity Walk to School scheme which runs green travel initiatives for schools for 2022/2023.
- The major developments to be built or in operation are all in line with guidance from the Institute of Air Quality Management.
- A 3-year scheme to encourage electric and hybrid taxis is now completed and has been extended to March 2025.

For 2023 priorities include:

- Raise awareness of climate change and air quality to increase understanding and knowledge.
- Ensure the council’s decision-making processes, strategic documents and procedures contribute to reducing carbon emissions, improving air quality, and increasing local resilience to climate change.
- Encourage and enable a shift towards cleaner modes of transport and reduce car dependency.
- Protect, enhance, and increase green space for the benefit of people and wildlife.

Canterbury City Council

Canterbury City Council monitored NO_2 at two automatic monitoring sites and 33 diffusion tubes sites in 2022. One diffusion tube site recorded an NO_2 concentration above the AQS objective in 2022. There are currently two AQMAs declared for NO_2 in the district.

In December 2018, an Air Quality Action Plan 2018-2023 was produced. The council have completed the following actions in 2022:

- Delivery of nine battery electric vans to replace nine diesel vans used by the Council’s enforcement teams.
- Installation of a new $PM_{2.5}$ and PM_{10} FIDAS analyser at the Chaucer AURN automatic monitoring site (CM1).
- An upgrade of the NO_2 continuous analyser at the Military Road automatic monitoring site (CM3).
- Updating the existing electronic signs to display real-time information on availability of parking spaces so that motorists can avoid queuing for car parks that are already full.

- Zero emission taxi and private hire vehicle incentives of 20% Licence fee discount, advertising on application and free overnight parking permit of £100 per annum.

The following measures are expected to be implemented in 2023:

- To work on Littlebourne Road cycling facilities as part of the City Centre Canterbury active travel scheme.
- To enact the Wincheap road scheme, with the aim of easing rush-hour gridlock.
- To install six air quality centres in Canterbury in June 2023 and display data on the Kentair website, as part of a Defra funded air quality grant funded project to deliver behaviour change.

Dover District Council

The District of Dover has two automatic sites to monitor PM_{10} concentrations, and annual mean NO_2 concentrations were recorded at 21 diffusion tube sites in 2022. Measured annual mean concentrations at all sites were below the AQS objective. There are currently two AQMAs declared for NO_2 in the District of Dover.

Dover District Council have implemented the following measures in 2022:

- Introduced Cycling Hire scheme in January 2022.
- Worked with the Kent & Medway Air Quality Partnership to develop Pollution Patrol which is an interactive education tool for children, parents and teachers to learn about air quality, its effects and how to reduce air pollution.
- Development of a new Dover District Local Plan to assess how future development will impact air quality within the area, with particular attention paid to any scenarios that will negatively impact air quality in sensitive areas, (e.g. AQMAs or the internationally designated sites).

Priorities for 2023 are as follows:

- To release the new AQAP in late 2023, which will identify a package of measures to improve air pollution within the district.
- To succeed in OLEV funding bid for 19 sites, 42 units to be completed in 2023. 7 ELV chargers have been installed at Council office car park and the possibility to increase numbers for public use may be explored.
- Dover Fastrack, which will become a zero-emission bus service with a fleet of electric buses, has a new route under construction 2023.

Folkstone and Hythe District Council

NO_2 monitoring was undertaken at 18 diffusion tube sites in Folkstone and Hythe in 2022. Annual mean concentrations at all sites were below the AQS objective. There are no declared AQMAs in Folkstone and Hythe.

Ashford Borough Council have continued to work to improve air quality, with the following measures in 2022:

Folkstone and Hythe District Council have implemented the following measures in 2023 to improve air quality:

- Worked collaboratively with Kent local authorities project to successfully obtain Defra grant that will facilitate the development of a digital training resource for Health Care Professionals (HCPs) across the Kent and Medway Group to provide training, local evidence and resources to enable practitioners to advise patients with cardiovascular disease (CVD) or respiratory disease on how to reduce their exposure to air pollution.
- Launched a campaign in November 2022, working with councils across Kent and the National Health Service to help residents save energy in their homes in turn supporting the reduction of pollutant emissions.
- Provided investment into purchasing battery-operated grounds maintenance equipment where suitable to replace petrol-powered equipment.
- Continue to aim to hit net-zero carbon emissions on the Council's assets and fleets which have shared benefits in reducing both NO_2 and PM emissions.

- Continue to actively encourage large developers at the planning stage to install electric charging points or consider suitable infrastructure to allow for future cost-efficient installations.
- Continue to progress with the Click2cycle bike sharing service in Folkstone, Sandgate and Hythe.
- Continue to collaborate with Kent County council and 5 other local authorities to roll out an EV charging points programme across the district.

Gravesham Borough Council

Gravesham Borough Council monitor NO_2 and PM_{10} at two automatic monitoring sites and NO_2 at 66 diffusion tube sites. Both NO_2 and PM_{10} at automatic monitoring sites were in compliance with AQS objectives in 2022. One diffusion tube site recorded an NO_2 concentration above the AQS objective in 2022. There are currently four AQMAs declared in the Borough, two of the AQMAs are for NO_2 only, one is for PM_{10} only and another for NO_2 and PM_{10} combined.

While the actions outlined in the current action plans have made great improvement and resulted in the cancellation of three of the borough's seven AQMAs, significant additional work has been done to evaluate the air quality, including:

- The development of a new AQAP that incorporates all AQMAs into one AQAP; and
- The implementation of the Climate Change Management Plan (CCMP)

The main priorities for Gravesham Borough Council in 2023 are:

- To finalise and complete and implement the new AQAP.
- To implement and continue to progress the Climate Change Management Plan 2022.
- Continue working with partners in the Kent and Medway Air Quality Partnership (K&MAQP) to improve air quality throughout the area.
- Continue reviewing the NO_2 passive monitoring network, in order to identify any areas which may require additional monitoring and to identify any potential areas of exceedances.

Maidstone Borough Council

In 2022 Maidstone Borough Council undertook NO_2 and PM_{10} monitoring at two automatic sites. One of the automatic sites also monitored $PM_{2.5}$. In 2022, data from automatic monitoring of NO_2, PM_{10} and $PM_{2.5}$ were in compliance with AQS objectives. There were also 57 diffusion tube sites for monitoring NO_2. Seven of the diffusion tube sites recorded annual mean NO_2 concentrations above the AQS objective in 2022. Maidstone has one AQMA declared for NO_2.

Maidstone Borough Council have implemented a number of measures to improve air quality, these include:

- Review of the Park and Ride Scheme. The scheme had low patronage and regrettably it was necessary to discontinue this service.
- Installation of EV charging into Town Centre car parks.
- Green Planting in Upper Stone Street.
- Review of parking restrictions in Upper Stone Street.
- Acquisition of three new electric vehicles in MBC vehicle fleet, plus installation of EV charging points at the depot.
- Update of air quality Planning Guidance
- Anti-idling Signage
- Development of the DEFRA funded digital air quality resource “Pollution Patrol” with the other local authorities across Kent.
- Revocation of the existing AQMA and subsequent declaration of a new smaller AQMA based on Upper Stone Street.

The priorities of Maidstone Borough council for 2023 are:

- Continue to develop a new Action Plan for the new AQMA.

Medway Council

Medway Council undertook automatic continuous monitoring at two sites and diffusion tube monitoring of NO_2 at 51 sites during 2022. Five diffusion tube sites recorded annual mean NO_2 concentrations above the AQS objective in 2022. Medway currently has four AQMAs declared for NO_2.

To improve air quality, Medway council has implemented the following measures:

- Developed an Air Quality Action Plan for the Four Elms Hill AQMA.
- Received Air Quality grants for Rainham idling signage project and a taxi and private hire ULEV feasibility study.

In 2023, the main priorities of Medway council will be:

- To progress delivery of the AQAP, alongside ongoing implementation of the 2015 AQAP
- To continue implementation of the Medway Air Quality Planning Guidance.

Swale Borough Council

Swale Borough Council has three automatic monitoring stations in operation. All stations measured NO_2 and PM_{10} and two sites measured $PM_{2.5}$ in 2022. In addition Swale monitored NO_2 at 86 diffusion tube sites. One diffusion tube site recorded an annual mean NO_2 concentration above the AQS objective. NO2 concentrations at the three automatic monitoring sites met their AQS objectives in 2022. There were no exceedances of the PM_{10} annual mean, however there were 62 exceedances of the 24-hour mean limit of 50 μgm^{-3} (which is not to be exceeded more than 35 times per year) at one site. $PM_{2.5}$ was below the annual mean objective at both sites.

Swale currently has six AQMAs declared, five of these are for NO_2 and one is for NO_2 and PM_{10} combined.

Swale Borough Council have been working to improve air quality, including:

- Continued anti-idling campaign with more idling hotspot locations being identified and additional signage being installed.
- Supported low emission vehicle usage through; Faversham Car Club launched by Faversham Town Council; Kent REVS Up for Cleaner Air scheme (30+ businesses took part in Swale); Swale's Electric Vehicle Strategy (adopted June 2022) and 10 double EV charge points were installed in Council car parks.
- Engaged with schools through the Green School Forum and rolled out the 'Pollution Patrol' scheme.

For 2023, priorities include:

- Review data for the compliant AQMAs with the potential to revoke compliant AQMAs in 2023
- Continue to develop a new Air Quality Action Plan for the 2023 to 2028.
- Continue to monitor Newington's 20's Plenty campaign along the A2, to assess any significant impacts on air quality.

Thanet District Council

Thanet District Council undertook automatic monitoring of NO_2 and PM_{10} at two sites during 2022. Monitoring of NO_2 was also undertaken at 40 diffusion tube sites. There were no exceedances of the annual mean NO_2 AQS objective at any of the automatic or diffusion tubes sites. Measured PM_{10} concentrations also complied with AQS objectives.

Thanet currently has one declared AQMA for NO_2.

Thanet District Council has successfully implemented the following measures in 2023:

- Completion of the installation of rapid electric chargers for taxis and maintenance of electric charging points.

- Progressing the Taxi Licensing Policy, which is currently being updated. This will include incentives for ULEV and age restrictions of the existing fleet. For new licences, taxis must be Euro 6 vehicles, i.e. <7 years
- Progressing the social media campaign on air quality.
- Developing Pollution Patrol school resource to educate children on air pollution and the impact on health.
- Improvement of KentAir Webpage.
- The Kent and Medway Energy and Low Emission Strategy has been adopted and a travel plan monitoring officer appointed at Kent County Council.
- Revoking of the current Thanet Urban AQMA and subsequent declaration of a smaller AQMA in Ramsgate.

The District Council's priorities for 2023 are:

- Review the increased monitoring data obtained during 2023 within the new AQMA to assess whether the DA modelled risk of exceedance is reflected in real world conditions, and if so, progress the Action Plan.
- Continue to engage with land-use and transport planners to ensure the actions adhere to the Local Plan and are supported by all parts of the authority.
- Continue to raise awareness of air quality issues within the District.
- Continue to work with Kent County Council to undertake identified feasibility studies of measures to tackle air pollution, to determine more robustly the effectiveness and cost of options.
- Encourage the public to use sustainable transportation, including public transport, car sharing, cycling, and walking.
- Continue the partnership with Kent County Council to engage in a joint approach to tackle air quality issues and the implementation of the Thanet Transport Strategy.
- Progress KMAQP proposal for Air Pollution Training for healthcare professionals - to raise awareness and increase the confidence and skills of health care professionals to address air pollution in their day-to-day practice.
- Seek formal adoption of the Council's Net Zero Strategy and associated energy efficient Housing Strategies.

Tonbridge and Malling Borough Council

Tonbridge & Malling Borough Council undertook automatic monitoring of at two sites during 2022. One site measured NO_2 only, and the other site measured both NO_2 and PM_{10}. The council also undertook passive monitoring of NO_2 at 56 diffusion tube sites in 2022.

One diffusion tube site exceeded the NO_2 annual mean AQS objective and another further along the same road recorded an annual mean NO_2 concentration within 10% of the AQS objective. There were no exceedances of the AQS objectives for PM_{10}.

Tonbridge & Malling Borough Council have declared six AQMAs, all for NO_2.

Key measures completed by Tonbridge and Malling Borough Council include:

- Created Anti-idling zone at Tonbridge taxi rank and develop and enforce a borough wide anti-idling campaign.
- Installation of electric charging points within Council car parks throughout the borough.

Tonbridge & Malling Borough Council expects the following measures to be completed over the course of the next reporting year:

- Encourage companies to allow home working at least one day a week, create survey to get a sense of numbers involved and see if companies need any help in enabling staff to work from home.
- Education and encouragement in terms of air quality across the borough: public workshops, leaflet campaigns, advertising, approaching schools on anti-idling and pollution patrol education package, businesses, community centres.

Tunbridge Wells Borough Council

Tunbridge Wells Borough Council undertook automatic monitoring of NO_2 and PM_{10} at one site and passive monitoring of NO_2 at 42 diffusion tube sites, during 2022. Both NO_2 and PM_{10} measured at the automatic monitoring site met their AQS objectives in 2022. However, two diffusion tube sites recorded annual mean NO_2 concentrations above the AQS objective. Tunbridge Wells Borough Council currently have two AQMAs declared for NO_2.

Tunbridge Wells Borough Council adopted an air quality plan in 2019: The measures to improve air quality include:

- Support for measures to increase the use of sustainable transport modes such as walking and cycling.
- Consider the establishment of an Air Quality Protection zone to replace the AQMA, when we are confident that the AQMA can be revoked.
- Expansion of the Car Club scheme.
- Investigation of a Low Emission Standard for buses.
- Incorporation of an air quality Supplementary Planning Document (SPD) into the emerging Local Plan.
- Use S106 funding to introduce a bike share scheme.
- Engaging with schools to reduce the impact of school traffic.
- Launch of the Pollution Patrol digital resource, funded by a grant from DEFRA awarded in 2022.
- Produced and deployed anti-idling signage.

Priorities for Tunbridge Wells Borough council in 2023 include:

- To publish the new Air Quality Action Plan for the Hawkhurst AQMA.
- To continue with the Clean Air for Schools programme in which it is anticipated that the 'Pollution Patrol' DEFRA funded digital schools resource will be the main vehicle for engaging with schools in future.
- To continue with the incorporation of air quality measures into the new local plan.
- To review the main A26 AQMA, with a view to starting the process of its revocation.
- To begin developing a digital air quality resource aimed at health care professionals which will inform them about air quality, with a particular emphasis on enabling to help their vulnerable patients to protect themselves pending the awarding of DEFRA's air quality grant fund.

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