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Air Pollution in Scotland 2022

Ricardo
Energy & Environment

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Introduction

This brochure has been produced as part of the Scottish Air Quality Database (SAQD) project on behalf of the Scottish Government. The 2022 brochure is the 16th in an annual series. It aims to provide a summary of the local air quality monitoring and associated work carried out by and on behalf of the Scottish Government and local authorities during 2022.

The SAQD project was developed as a comprehensive centralised resource to provide high-quality harmonised data and information to help government (both national and local) and the Scottish public tackle the issue of air pollution. The data generated by the SAQD serves to improve research and analysis and support the development of air quality policy in Scotland.

While air quality in most of Scotland is generally good, levels of some pollutants still exceed air quality objectives, particularly in urban areas.

In 2022, for the first time outside of Covid-19 lockdown affected periods, all Nitrogen Dioxide objectives were met across the automatic monitoring network. However, there are still passive sampling sites (NO2 diffusion tubes) and one particulate matter (PM10)automatic site where objectives were exceeded. Therefore, continued efforts to reduce air pollution are vital, coupled with appropriate monitoring to assess progress. For more information on air quality in Scotland and more specifically, your area, please visit the Air Quality in Scotland website (http://www.scottishairquality.scot/).

A more detailed Annual Report on the SAQD project is available on the Air Quality in Scotland website.

2

Legislation and Policy

Air quality management is shaped by statutory requirements from EU and UK legislation and policies that have been adopted by Scotland. In the UK, air quality is a devolved matter, with the Scottish Government having responsibility for the development of air quality policy and legislation for Scotland.

Domestic air quality legislation is largely derived from the requirements of the Environment Act 1995 and the following air quality directives adopted by EU Member States:

- Directive 2008/50/EC - on ambient air quality and cleaner air for Europe (the Air Quality Directive).
- Industrial Emissions Directive 2010/75/EC – Controls emissions from industrial activities.
- National Emission Ceilings Directive 2016/2284/EU – sets emission limits for five important air pollutants
- Clean Air Policy Package and Clean Air Programme for Europe-new air quality objectives to 2030, to improve air quality within cities.

The Scottish Government has duly transposed these Directives into national law through the Air Quality Strategy and Air Quality Standards (Scotland) Regulations 2010, and the Pollution Prevention and Control (Scotland) Regulations 2012. Following the UK's exit from the EU, under retained EU law, the UK is required to continue meeting limit and target values for a range of air pollutants covered by the directives.

A substantial review of the EU's air quality policy, including the Air Quality Directive, was undertaken in 2013 with the European Commission adopting a new Clean Air Policy Package, including a new Clean Air for Europe programme with measures to ensure that existing targets are met in the short term and new air quality objectives for the period up to 2030. The Package also includes support measures to help cut air pollution, with a focus on improving air quality in cities, supporting research and innovation, and promoting international cooperation. A proposal for revision of the ambient air quality Directives was published in October 2022.

2.1 Air Quality Standards and Objectives

A set of air quality standards and objectives have been developed for several pollutants of concern for human health. The objectives are derived from the standards and are a compromise between what is desirable purely on health grounds and what is practicable in terms of feasibility and costs. Each objective has a date by when it must be achieved. The objectives adopted in Scotland for the purpose of local air quality management (LAQM) are set out in the Air Quality (Scotland) Regulations 2000, the Air Quality (Scotland) Amendment Regulations 2002 and the Air Quality (Scotland) Amendment Regulations 2016. It should be noted that Scotland has adopted more stringent objectives than the rest of the UK for both Particulate Matter up to 10 µm and 2.5 µm in diameter (PM_{10} and $PM_{2.5}$ respectively). A summary of the current Scottish air quality objectives is provided in Table 2.1.

Table 2.1 Summary of air quality in Scotland

Air Quality objective & pollutant	Concentration	Measured as	Date to be achieved by
Nitrogen dioxide (NO_2)	200 µg m^{-3} not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg m^{-3}	Annual mean	31.12.2005
Particulate matter (PM_{10})	50 µg m^{-3}, not to be exceeded more than 7 times a year	24-hour mean	31.12.2010
	18 µg m^{-3}	Annual mean	31.12.2010
Particulate matter ($PM_{2.5}$)	10 µg m^{-3}	Annual mean	31.12.2020
Sulphur dioxide (SO_2)	350 µg m^{-3}, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg m^{-3}, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg m^{-3}, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005
Benzene (C_6H_6)	3.25 µg m^{-3}	Running annual mean	31.12.2010
1,3 Butadiene (C_4H_6)	2.25 µg m^{-3}	Running annual mean	31.12.2003
Carbon monoxide (CO)	10.0 mg m^{-3}	Running 8-Hour mean	31.12.2003
Lead (Pb)	0.25 µg m^{-3}	Annual Mean	31.12.2008
Poly Aromatic Hydrocarbons*	0.25 ng m^{-3}	Annual Mean	31.12.2010
Ozone*	100 µg m^{-3} not to be exceeded more than 10 times a year	Daily maximum 8-hour running mean	31.12.2005

*not required to be monitored or assessed by local authorities under LAQM, however is a UK requirement under EU directive (Directives 2004/107/EC and 2008/50/EC)

2.2 Cleaner Air for Scotland – The Road to a Healthier Future

The first 'Cleaner Air for Scotland – The Road to a Healthier Future' (CAFS) strategy was published by the Scottish Government in November 2015. The purpose was to provide a national framework which set out how the Scottish Government and its partner organisations proposed to achieve further reductions in air pollution and fulfil their legal responsibilities to achieve the air quality objectives. It recognised that although progress has been made through Scotland, areas of poorer air quality still exist within towns and cities.

During the first half of 2019 the Scottish Government carried out an in-depth independent review of CAFS[1]. The Scottish Government used the information and recommendations made from this review to update CAFS in 2020. In July 2021, accompanied by a Delivery Plan, and replacing "Cleaner Air for Scotland – The Road to a Healthier Future", Scottish Government published Scotland's second air quality strategy called "Cleaner Air for Scotland 2 – Towards a Better Place for Everyone" (CAFS2).

2.3 Cleaner Air for Scotland 2 (CAFS2) Strategy

CAFS2 sets out how the Scottish Government and its partner organisations propose to further reduce air pollution to protect human health and fulfil Scotland's legal responsibilities over the period 2021-2026. CAFS2 aims to achieve the ambitious vision for Scotland "to have the best air quality in Europe".

The CAFS2 key partner organisations are:

- Scottish Government
- Transport Scotland
- Scottish Environment Protection Agency (SEPA)
- Public Health Scotland
- Local authorities

Engagement and support from a wide range of stakeholders including representatives from the transport and planning sectors and Non-Governmental Organisations (NGOs) is also vital to achieving the aims of CAFS2.

Progress is supported by the CAFS2 Delivery Group, which is directly accountable to a Ministerial Group.

[1] http://www.scottishairquality.scot/lez/cafs-review-documents

2.3.1 CAFS2 – Overview

CAFS2 is shaped around 10 policy themes, these are:

1. Health – A Precautionary Approach.

Evidence justifies adopting a precautionary public health approach to air pollution reduction. As a minimum, compliance is required with domestic and international air quality standards but, where practicable and feasible, there should be continued efforts to reduce preventable air pollution still further beyond these limits.

2. Integrated Policy.

Strategies, policies and plans being developed and implemented by central government for placemaking, climate change mitigation and adaptation, and related polices such as noise reduction, should be closely coordinated and aligned with those for air quality in order to maximise co-benefits.

3. Placemaking.

National Planning Framework 4 (NPF4) will transform how Scotland's planning system shapes our places and society over the years and decades to come. The Planning (Scotland) Act 2019 requires that the National Planning Framework must have regard to minister's national strategy for the improvement of air quality.

4. Data.

There are gaps in both quality and coverage of air quality, transport and human health data in Scotland. Addressing these gaps will help to improve public awareness and engagement, modelling, reporting and ultimately, policy implementation.

5. Public Engagement and Behaviour Change.

More research is needed to provide clear evidence on levels of knowledge, attitudes, and concern related to air pollution, as well as on willingness to change behaviours which contribute toward air pollution. Development of complementary and co-ordinated public engagement strategies is essential to deliver the required behavioural change outcomes and to avoid confusing or conflicting messages.

6. Industrial Emissions Regulations.

The Scottish Government has made clear its commitment to maintain or exceed EU standards, following the UK's departure from the European Union (EU). The UK Withdrawal from the European Union (Continuity) (Scotland) Act 2021 will bring the guiding European principles on the environment into force in Scots law, including the precautionary principle, polluter pays principle, prevention principle, rectification at source principle and the integration principle.

7. Tackling Non-Transport Emission Sources.

Domestic (household) burning and agriculture are two sectors not addressed in detail in CAFS, but which make an important contribution to air pollution. Consideration is needed of performance and standards for domestic fires, stoves and fuels, and local authority powers to permit and control these, and a refreshed approach to good agricultural practice, which includes aiming for increased nitrogen use efficiency in farming. Together, these have the potential to deliver significant improvements in air quality beyond current regulatory and management approaches.

8. Transport.

Increasing modal shift to active travel and public transport is key to further reductions in transport emissions

9. Governance, Accountability and Delivery.

Simple and effective governance arrangements and a focus on practical joined up delivery are imperative for CAFS2. We need to be clear on who is doing what, who is leading, who is supporting and who is ultimately responsible if CAFS2 is to be delivered as a coherent, integrated and successful strategy.

10. Further Progress Review.

As in the original version of CAFS, the intention is that CAFS 2 will have a five-year lifespan. A further review of progress on air quality improvements will commence during 2024 in order to track progress on delivering the actions in the new strategy.

2.4 Low Emissions Zones

In September 2017, the Scottish Government committed to the introduction of Low Emission Zones (LEZs) into Scotland's four biggest cities (Glasgow, Edinburgh, Aberdeen and Dundee) by 2020 and into all other Air Quality Management Areas (AQMAs) by 2023 where the NLEF appraisal advocates such mitigation.

On 31 December 2018, the first Scottish LEZ was introduced into Glasgow city centre and applied to buses only (phase 1). After delays resulting from the Covid-19 pandemic LEZs were also introduced across Aberdeen, Dundee, and Edinburgh on 31st May 2022. Local grace periods now apply until enforcement begins at the dates below:

The CAFS2 key partner organisations are:

- Glasgow (all other vehicle types) - 1st June 2023
- Dundee – 30th May 2024
- Aberdeen – 1st June 2024
- Edinburgh – 1st June 2024

More information on LEZs is available here: https://www.lowemissionzones.scot/about.

2.5 Local Air Quality Management

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas to determine if the air quality objectives are likely to be achieved. Where an exceedance is considered likely, the local authority must:

- Declare an AQMA
- Assess and identify the reasons for the problem
- Develop an Air Quality Action Plan (AQAP) to help address the problem

The LAQM policy and technical guidance documents are available online (www.scottishairquality.co.uk/air-quality/legislation).

2.6 Local Air Quality Management

In Scotland, there are 36 AQMAs declared across 14 of the Scottish local authorities. The AQMAs in Scotland are declared for either nitrogen dioxide (NO_2) and/or PM_{10} concentrations, with the exception of the Grangemouth AQMA which is for sulphur dioxide (SO_2). The AQMAs declared in Scotland are presented in Table 2.2. During 2021, two AQMAs in the Falkirk region were revoked and in Fife, two AQMAs were amended to remove PM_{10}. An interactive map which easily identifies where the AQMAs are in Scotland and provides additional information on the AQMAs can be found here https://www.scottishairquality.scot/laqm/aqma.

Table 2.2 Current AQMAs in Scotland

Local authority	Pollutant (no of AQMAs)	Main Source	AQMAs
Aberdeen	NO_2 and PM_{10}	Roads	3
City of Edinburgh	NO_2 (5) and PM_{10} (1)	Roads	6
Dundee City	NO_2 and PM_{10}	Roads	1
East Dunbartonshire	NO_2 and PM_{10}	Roads	2
East Lothian	NO_2	Roads	1
Falkirk	SO_2 (1), NO_2 (1), NO_2 and PM_{10} (1)	Industry and roads	3
Fife	NO_2	Roads	2
Glasgow City	NO_2 and PM_{10} (1), NO_2 (1)	Roads	2
Highland	NO_2	Roads	1
North Lanarkshire	PM_{10}	Industry and roads	4
Perth and Kinross	NO_2 and PM_{10}	Roads	2
Renfrewshire	NO_2 (2), NO_2 and PM_{10} (1)	Roads	3
South Lanarkshire	NO_2 (1) and PM_{10} (2)	Roads	3
West Lothian	NO_2 (2) and PM_{10} (1)	Roads	3

3

Networks and Data

3.1 Automatic monitoring in Scotland

Extensive air quality monitoring is carried out across Scotland. Some monitoring sites are run as part of UK-wide monitoring networks and others are operated by local authorities for LAQM purposes. The following AQS pollutants were monitored in Scotland during 2022:

- Benzene (C_6H_6)
- 1,3-butadiene (C_4H_6)
- Carbon monoxide (CO)
- Lead (Pb)
- Oxides of nitrogen (NOx), comprising nitric oxide (NO) and nitrogen dioxide (NO_2)
- Ozone (O_3)
- Particles (as PM_{10}, $PM_{2.5}$ and black carbon)
- Polycyclic aromatic hydrocarbons (PAH)
- Sulphur dioxide (SO_2)

Data and information on these pollutants and the sites where they are measured can be accessed via the Air Quality in Scotland website (https://www.scottishairquality.scot/latest). Data analysis tools are also available here (https://www.scottishairquality.scot/data/data-selector). Figure 3.1 illustrates the location of automatic sites and Scotland. These stations provide high-resolution, hourly information on a wide range of pollutants. Data from national network monitoring sites are updated hourly in near real time on the SAQD. Data from local authority operated monitoring sites are updated hourly or daily depending on the station configuration. A typical automatic monitoring site is shown in Figure 3.2.

Scotland's automatic monitoring is supplemented by non-automatic monitoring techniques. For example, the non-automatic techniques used to monitor nitrogen dioxide and metals (such as lead), the pumped-tube samplers used to monitor benzene, and the high-volume samplers used to measure PAH.

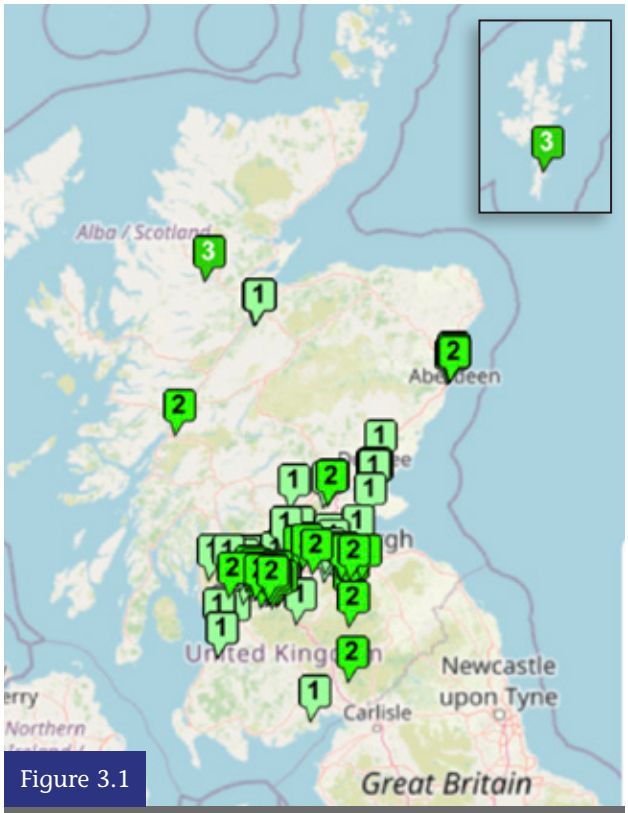

Figure 3.1

Location of automatic monitoring stations

Figure 3.2

Scottish Automatic Monitoring Site

3.2 Passive monitoring in Scotland

In 2022, Scottish local authorities combined had a network of around 1,000 passive monitoring diffusion tube sites monitoring NO_2. The Scottish Diffusion Tube Network map (https://www.scottishairquality.scot/latest) (launched in 2019) provides published bias corrected annual mean diffusion tube data, site type information, location and historical data in a format that is easy to understand. Diffusion tubes are used:

- As a low-cost alternative to automatic monitoring at a greater amount of locations of concern for use within Local Air Quality Management.
- To give an indication of longer-term average NO_2 concentrations.
- For highlighting areas of high NO_2 concentrations where installation of an automatic analyser isn't feasible.

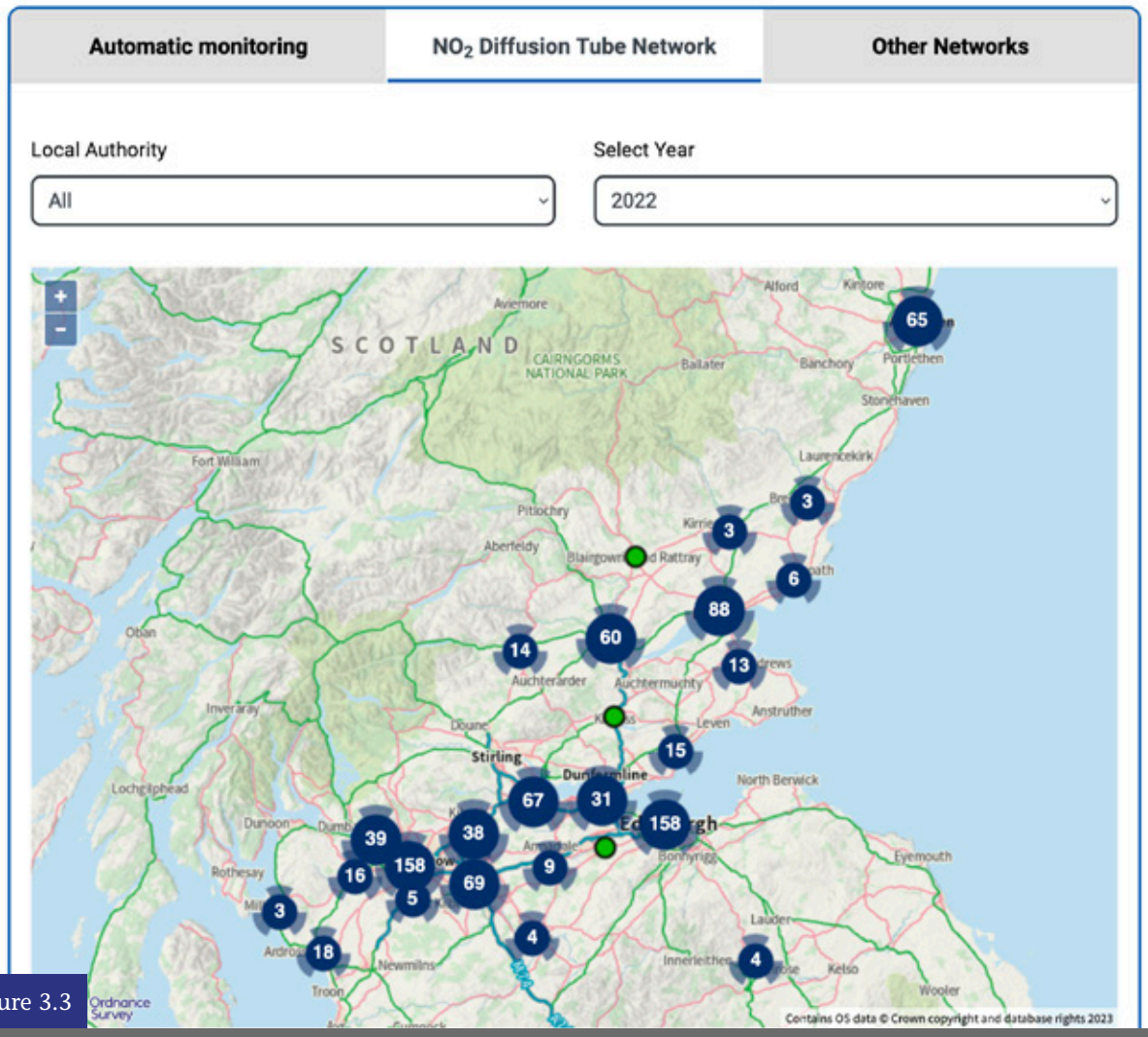

Figure 3.3 Diffusion Tube Site Map

3.3 Key Results for 2022

This section provides a summary of results from automatic and non-automatic monitoring in Scotland in 2022 including compliance with AQS objectives. Further information is provided on the Air Quality in Scotland website (https://www.scottishairquality.scot/). More information on these key results can also be obtain within the SAQD annual report 2022.

Benzene

This hydrocarbon is a constituent of vehicle exhaust emissions. Benzene was monitored using a non-automatic pumped-tube sampler at two sites (Glasgow Kerbside and Grangemouth) as part of the UK Non-Automatic Hydrocarbon Network. Benzene was also measured using an automatic technique at the rural supersite at Auchencorth Moss. All sites had annual mean concentrations below the AQS objective for the running annual mean.

1,3-Butadiene

1,3-butadiene is also a constituent of vehicle exhaust emissions. This pollutant was monitored at one rural site (Auchencorth Moss) as part of the UK Automatic Hydrocarbon Network. There were no exceedances of the 1,3-butadiene objective in 2022. There is no EU Directive covering 1,3-butadiene.

Carbon monoxide

This gas is a product of incomplete combustion, with vehicle exhaust emissions being an important source. It was monitored at one site in Scotland in 2020 - Edinburgh St Leonards. Ambient concentrations of CO were well within the AQS objective, as they have been for many years.

Lead

This toxic metal is emitted from some industrial processes (although emissions are now strictly controlled). Lead is monitored at two non-automatic sites in Scotland (Auchencorth Moss and Eskdalemuir). There were no exceedances of the lead objectives in 2022.

Nitrogen dioxide – Automatic monitoring

This toxic gas is emitted from most combustion processes, including power generation, domestic heating and vehicle engines. It was monitored at 89 automatic sites in Scotland during 2022. Of these, 16 achieved less than the 75% data capture generally considered necessary to calculate a representative annual mean. This was because of instrument/sampling issues and sites starting up or closing down part way through the year.

Of the remaining 73 sites with 75% data capture or more, no sites exceeded the annual mean objective for NO_2 (40 µg m^{-3}) in 2022. In 2021 one site (Glasgow Hope Street) exceeded the annual mean objective. The hourly mean objective of 200 µg m^{-3} (not to be exceed more than 18 times per annum) was also not exceeded at any site (same as 2021).

Figure 3.4 shows annual mean NO_2 concentrations at each site (with at least 75% data capture) for 2022.

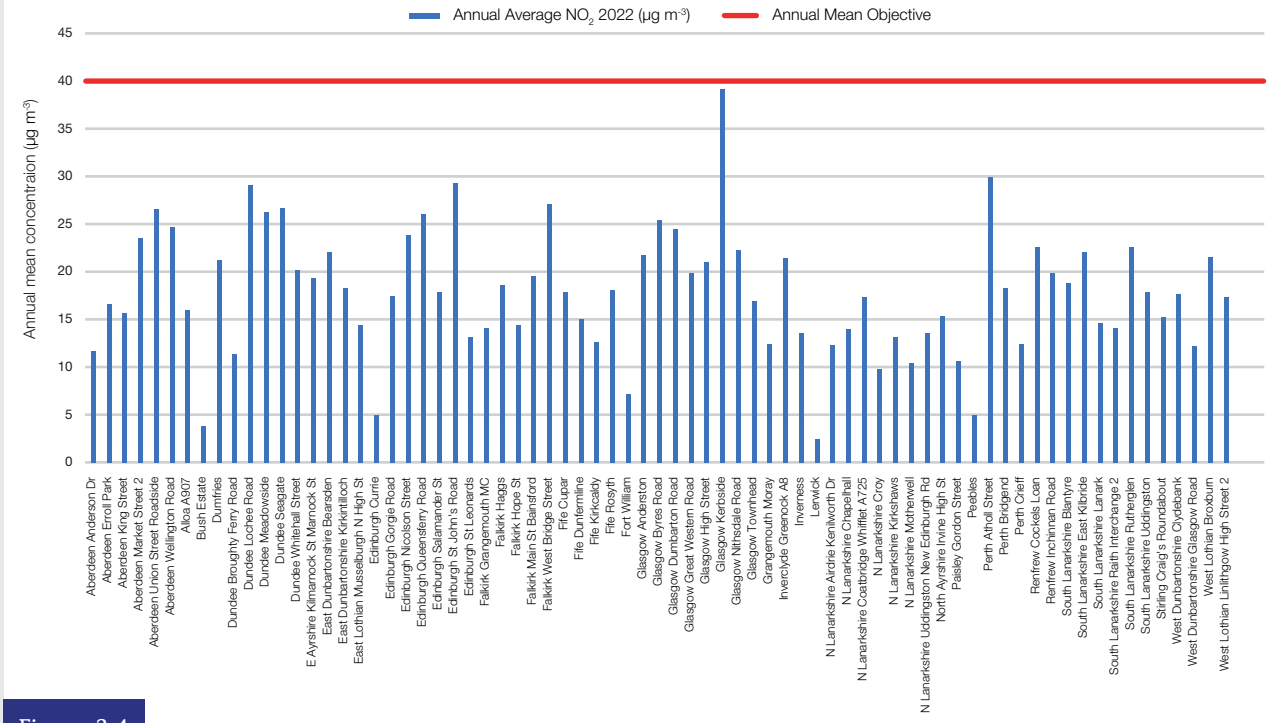

Figure 3.4

Annual mean NO_2 concentrations at sites with >75% data capture (2022)

Nitrogen dioxide – Passive monitoring

In 2022 seven NO_2 diffusion tube monitoring sites exceeded the annual mean objective, three more than in 2021. Figure 3.5 illustrates the number of exceeding sites since 2013. The seven sites that exceed were located in Aberdeen, Glasgow and Edinburgh city councils.

For more information on the 2022 data and historical diffusion tube data, go the Diffusion Tube site map on the Air Quality in Scotland website (https://www.scottishairquality.scot/latest). This diffusion tube data can also now be downloaded via the data selector tool (https://www.scottishairquality.scot/data/data-selector).

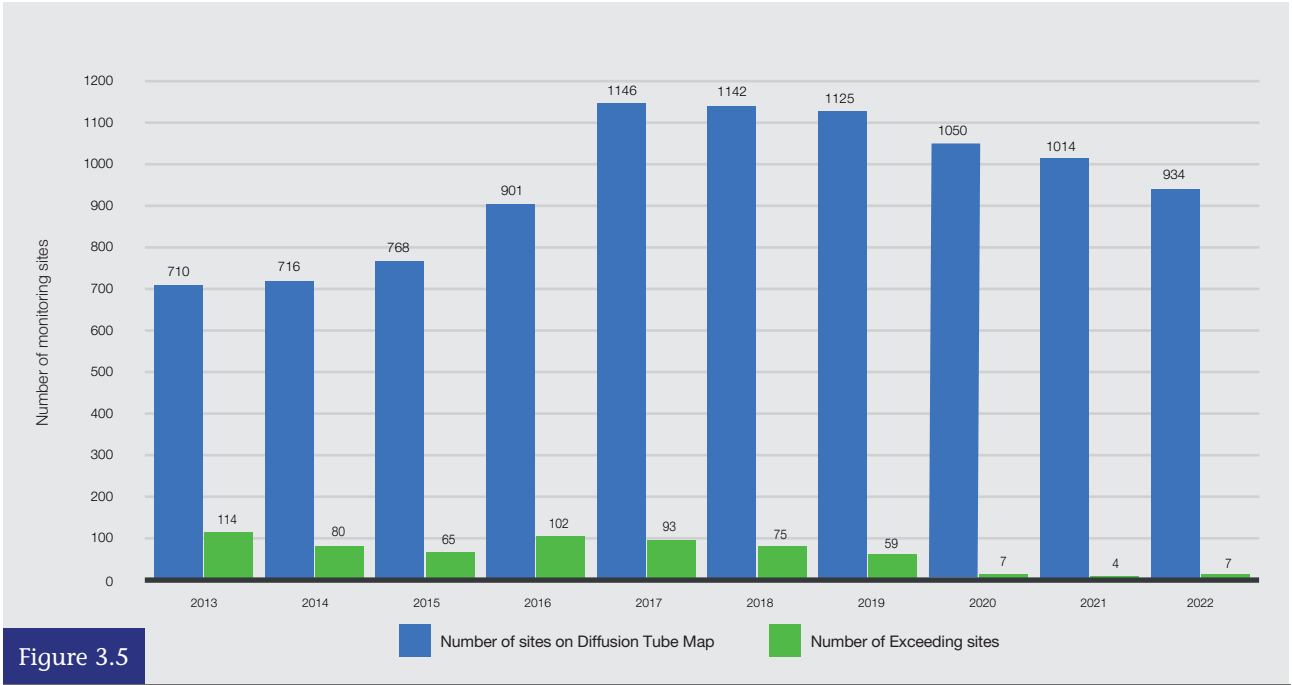

Figure 3.5

Number of NO_2 Diffusion Tube sites exceeding the Annual Mean Objective since 2013

Sulphur dioxide

This gas is emitted when fuels containing small amounts of sulphur (such as oil and coal) are burned. This pollutant was monitored at eight sites in 2022, though two sites did not achieve a data capture rate greater than 90% (Lerwick (12.6% and Grangemouth Moray 86.7%) needed for direct comparison to the SO2 AQS objectives. Of the remaining six sites, all met the requirements of the Air Quality Strategy for the 15-minute (no more than 35 times), 1-hour (no more than 24 times) and 24-hour (no more than 3 times) mean objectives in 2022.

Particulate matter as PM_{10}

Particulate matter arises from many sources. It can be directly emitted from combustion processes or formed from chemical reactions involving other pollutants. Natural sources (e.g. wind-blown dust and sea salt) also contribute. PM_{10} was monitored at 83 Scottish sites in 2022 using automatic monitoring.

Of the 76 sites with 75% or greater data capture, no sites exceeded the annual average PM_{10} Objective of 18 µg m^{-3}. The maximum PM_{10} annual mean concentration was measured at Edinburgh Salamander St with a measured annual mean concentration of 15.4 µg m^{-3}. The Scottish daily mean objective of 50 µg m^{-3} not to be exceeded more than 7 times in a year was however exceeded at one site during 2022. Edinburgh St Johns Road exceed the daily mean of 50 µg m^{-3} 12 times during 2022. The exceedance is attributed to road resurfacing work carried out next to the site between August and September.

Figure 3.6 provides annual mean PM_{10} concentrations for all sites in Scotland with 75% or more data capture.

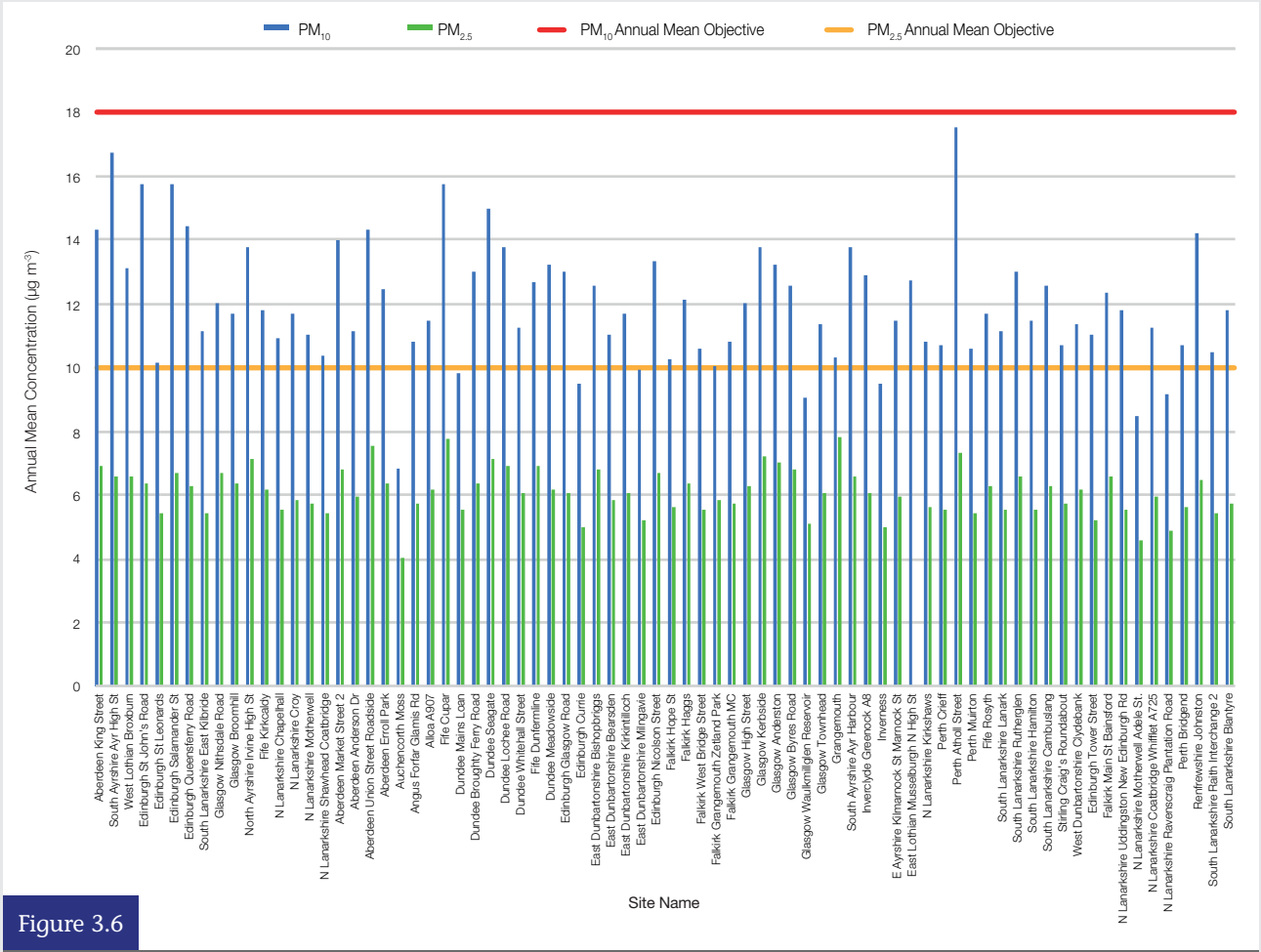

Figure 3.6

Annual mean PM_{10} and $PM_{2.5}$ concentrations at sites with >75% data capture (2022)

Particulate matter as $PM_{2.5}$

During 2022, the finer particle fraction, $PM_{2.5}$ was monitored at 83 Scottish sites. Of the 75 sites with 75% or greater data capture, no sites exceeded the annual average $PM_{2.5}$ Objective of 10 µg m^{-3}.

See Figure 3.6 for annual mean concentrations at all sites (with a data capture of 75% or more) compared to the annual mean objective.

Polycyclic aromatic hydrocarbons

This group of pollutants is monitored at four sites in Scotland (Kinlochleven, Glasgow Townhead, Edinburgh St Leonards and Auchencorth Moss). The AQS objective of 0.25 ng m^{-3} for benzo[a]pyrene was not exceeded at any sites in 2022. More information on these can be found in the "Other Networks" map in the Air Quality in Scotland website (https://www.scottishairquality.scot/latest).

Ozone

This is a secondary pollutant that is formed by reactions involving other pollutant gases in the presence of sunlight and over several hours. Once formed, it may persist for several days and be transported over long distances. This makes it difficult to control by local action. It was monitored at 11 sites in Scotland during 2022. Of these 11 sites, the AQS objective of 100 µg m^{-3} not to be exceeded more than 10 days (as a Daily Maximum 8-hour running mean) was not exceeded at any site (see Figure 3.8). However four sites (Aberdeen Erroll Place/Park, Eskdalemuir, and Lerwick had less the 75% data capture.

The AQS objective is not included in LAQM regulations. This is in recognition of the fact that it is transboundary in nature and that local authorities have very little control over concentrations in their areas.

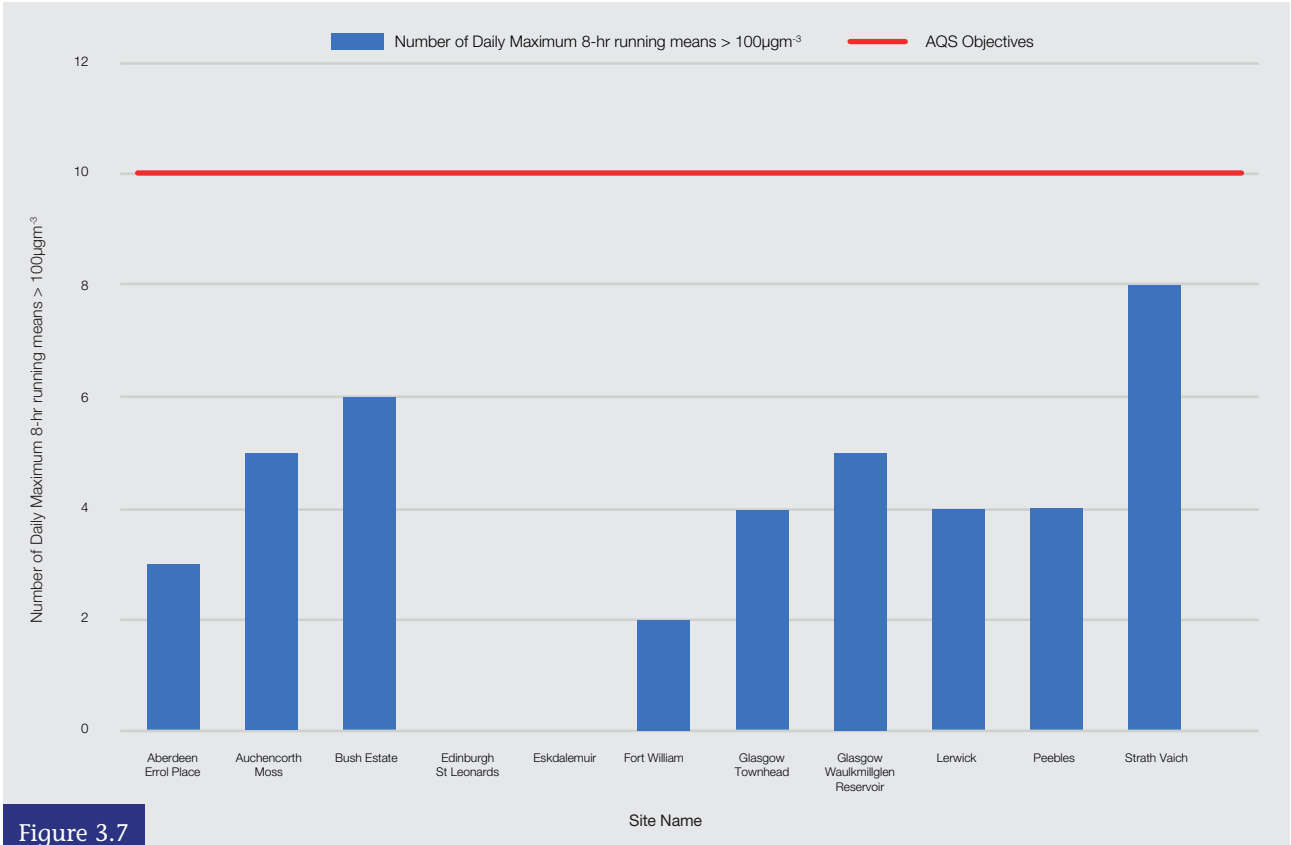

Figure 3.7

Exceedances of the Daily Maximum 8-hour running Mean AQS objective for Ozone (2022)

4

Air Quality Trends

This section summarises how air quality in Scotland has changed over recent years. As with previous years, the pollutants of interest are NO_2, PM_{10}, $PM_{2.5}$ and O_3.

All the sites featured in this section have been in operation for a minimum of five consecutive years, as this is usually considered to be the minimum required to assess long-term trends at a monitoring site. In most cases, it is now possible to do trend analysis for longer periods (e.g. 10 years).

The trend analysis presented in this section has been carried out using Openair; the air pollution analytical tool available via the Air Quality in Scotland website[2].

The trend analyses were carried out using the 'TheilSen' tool. This uses the Theil-Sen statistical method to determine trends in pollutant concentrations over several years. The trend analysis is based on monthly mean pollutant concentrations. The data used in these trend graphs has been 'de-seasonalised' (i.e. the data has been statistically modify to remove the influence of seasonal cycles, thus providing a clearer indication of the overall trend over the relevant time).

In these plots, the trend line is shown by a solid red line with 95% confidence intervals for the trend shown by dotted red lines. The trend is given at the top of the plot in green, with confidence intervals shown in square brackets. The trend is given as units (i.e. µg m^{-3}) per year, over the period shown. This may be followed by a number of stars:

* indicating that the trend is statistically significant at the 0.05 level

** indicating significance at the 0.01 level

*** indicating highly significance at the 0.001 level

The + symbol indicates that the trend is significant at the 0.1 level.

Further information on air quality trends for a range of pollutants is reported in more detail within the SAQD Annual Report and Local Air Quality Management (LAQM) reports; available at http://www.scottishairquality.scot/.

4.1 Nitrogen Dioxide

In Scotland (as elsewhere in the UK), the largest number of Air Quality Management Areas (AQMAs) have been declared in response to exceedances of the nitrogen dioxide (NO_2) objectives. This is also reflected in the number of monitoring stations reporting exceedances for this pollutant (see Section 3.3 of this report). In particular, the objective of 40 µg m^{-3} for annual mean NO_2 concentration is the most widely exceeded. Therefore, it is important to understand how concentrations of this pollutant vary with time.

4.1.1 NO_2 at Urban Background Sites

There are relatively few long-running urban non-traffic sites monitoring stations in Scotland due to the nature of the pollutant and its main source (vehicles). However it is important to obtain background levels of NO_2 to help ascertain what concentrations away from the source are like, as this helps identify general conditions affecting the population and also the extent of the issue at areas of concern. Five of these sites have been in operation for the past 15 years. These are as follows: Aberdeen Errol Place (closed in September 2021), Edinburgh St Leonards, Fort William, Glasgow Anderston and Grangemouth. For clarification, Fort William is classified as a 'suburban' site, Grangemouth is an 'urban industrial' site, and the other three are 'urban background'. For this report we are describing them all as Urban Non-traffic sites along with all other rural, background and industrial site types.

Figure 4.1 provides NO_2 trend for these sites from 2008 to 2022. All sites display statistically highly significant negative trends (at the 0.001 level) over this time period.

[2] Visit http://www.scottishairquality.scot/data/openair for more information on the Openair tools that are available and how to use them.

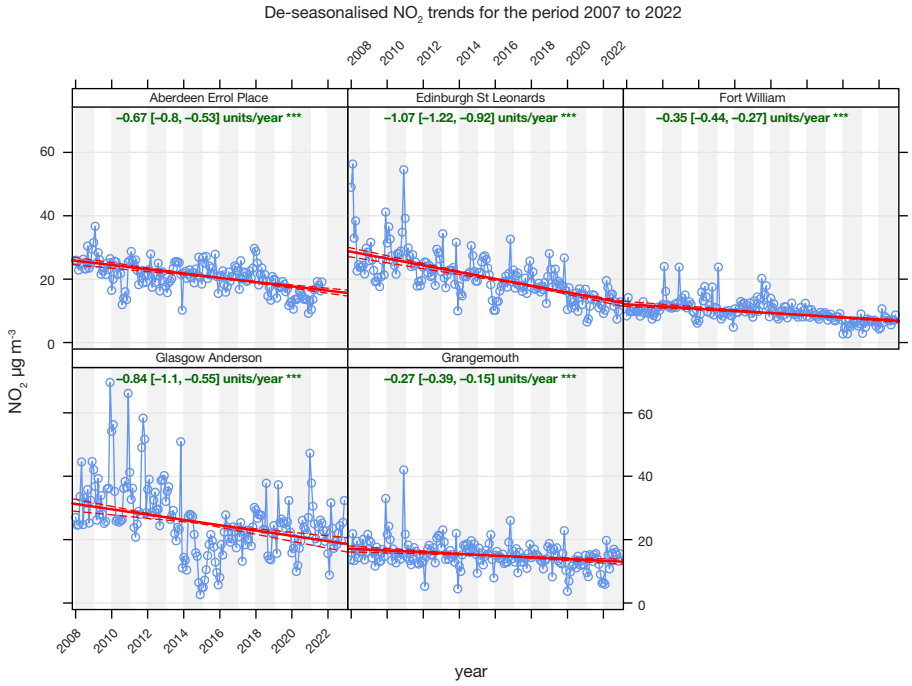

Figure 4.1

Trends in NO_2 Concentration at Five Long-running Urban Non-Roadside Sites, 2008-2022

Figure 4.2 takes into consideration analysis from all urban Non-traffic site in Scotland over the past five years to identify whether the trend is consistent over more recent times. As can be seen the decreasing trend continues across all sites in recent years however with varying statistical significancy.

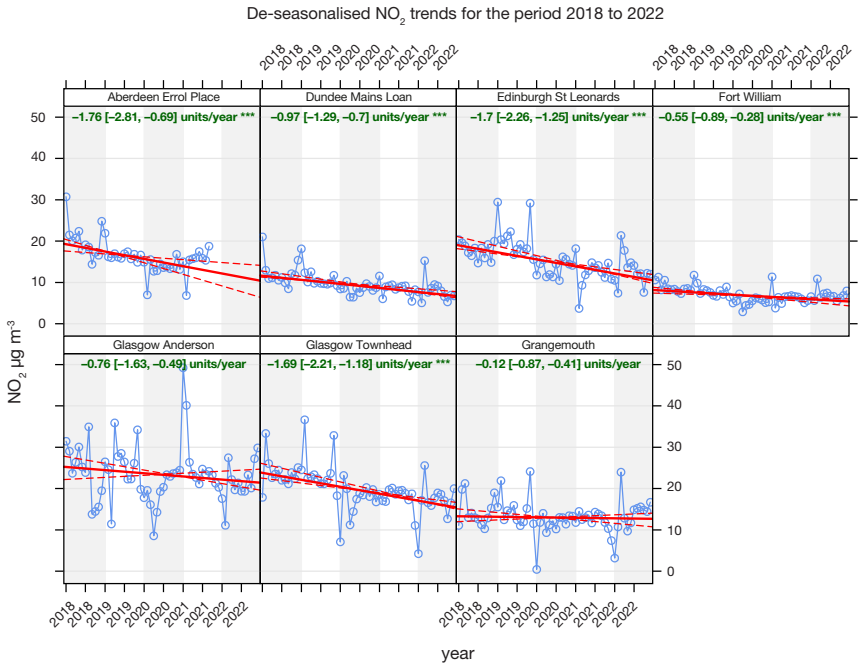

Figure 4.2

Trends in NO_2 Concentration at all Urban Non-Traffic Sites, 2018-2022

4.1.2 NO_2 at Urban Traffic Sites

Recent years have seen a substantial increase in the number of monitoring stations at urban traffic (roadside and Kerbside)-related sites in Scotland. There are now over 50 urban traffic (roadside and Kerbside) automatic monitoring sites in Scotland that have been in operation for 10 years or more and are still in operation. To identify where these sites are, please go to http://www.scottishairquality.scot/latest/.

This is a large number of sites, so for the purposes of this brochure we have selected eight sites from the list of long-running sites. These are:

- Aberdeen Union Street,
- Aberdeen Wellington Road,
- Dundee Lochee Road,
- Dundee Seagate,
- Edinburgh St Johns Road,
- Glasgow Kerbside (Hope Street),
- North Lanarkshire Chapelhall,
- Perth Atholl.

Figure 4.3 shows the trend plots for these sites from 2013 to 2022. As with the previous years' reports, all eight sites show statistically highly significant decreasing trends.

Trends over the most recent five complete years, 2018 – 2022, have also been examined for these sites (Figure 4.4). Comparing the 10-year and five-year trends, the patterns are similar with statistically highly significant decreasing trends . Notably, for the Aberdeen and Dundee sites, the decreasing trend has become greater in magnitude over the past five years.

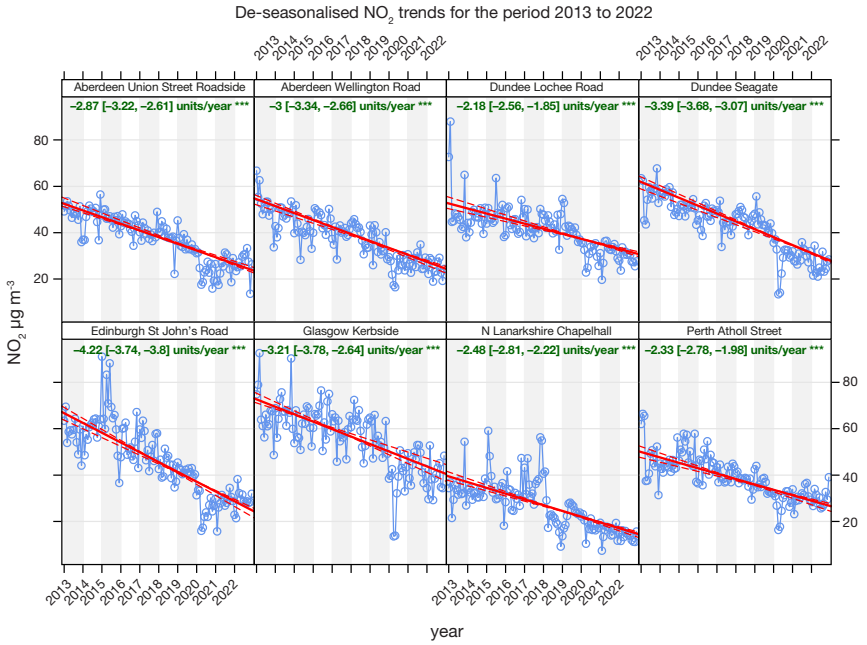

Figure 4.3

Trends in NO_2 Concentration at Eight Long-running Urban Traffic Sites with Exceedances (2013-2022)

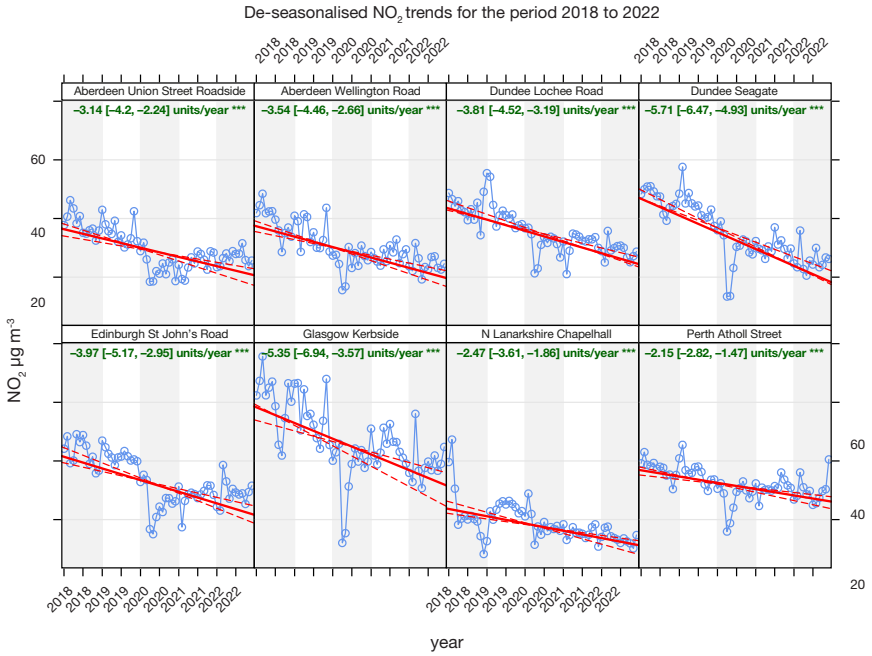

Figure 4.4

Recent Trends in NO_2 Concentration at Eight Long-running Urban Traffic Sites with Exceedances (2018-2022)

4.2 Particulate Matter (PM_{10} and $PM_{2.5}$)

This pollutant is of interest because:

- Current evidence suggests that there is no safe level of particulate matter in terms of human health effects.
- Scotland's current annual mean PM_{10} objective is 18 µg m^{-3}, which is more stringent than the objective of 40 µg m^{-3} adopted in the rest of the UK.
- In 2016 Scotland opted to make its annual mean $PM_{2.5}$ objective more stringent, by reducing it from 12 µg m^{-3} to 10 µg m^{-3} in line with the World Health Organization guideline.

4.2.1 PM_{10} at Urban Traffic Sites

There are 51 PM_{10} monitoring sites in Scotland that have been monitoring for over 10 years. Trends in de-seasonalised monthly mean PM_{10} concentrations for eight traffic-related sites in operation since 2010 or earlier are shown in Figure 4.5. The sites selected for this analysis are Aberdeen Wellington Road, East Dunbartonshire Bearsden, Edinburgh Salamander, Fife Cupar, Glasgow Anderston, Glasgow Byres Road, Perth Crieff and West Lothian Broxburn. These sites were chosen to be analysed because of the length of time they have been monitoring (10 years or more), historical exceedances of the annual mean objective and geographical coverage.

Figure 4.5 illustrates that all sites, except Glasgow Byres Road, show statistically highly significant decreasing trends (at the 0.001 level). These trends indicate that PM_{10} concentrations over the past 10 years is, in general, decreasing year on year at these urban traffic locations. The Glasgow Byres Road site trend analysis indicates no real change in concentration.

Trends in monthly mean PM_{10} concentrations for the same eight sites (plus Edinburgh Queensferry Road), for the most recent five complete years 2018 – 2022, are shown in Figure 4.6. The analysis shows that the decreasing trend is plateauing at a number of sites with varying levels of statistical significancy. In contrast to the 10-year analysis, the five-year analysis for Glasgow Byres Road shows that concentrations are now decreasing with highly statistical significancy.

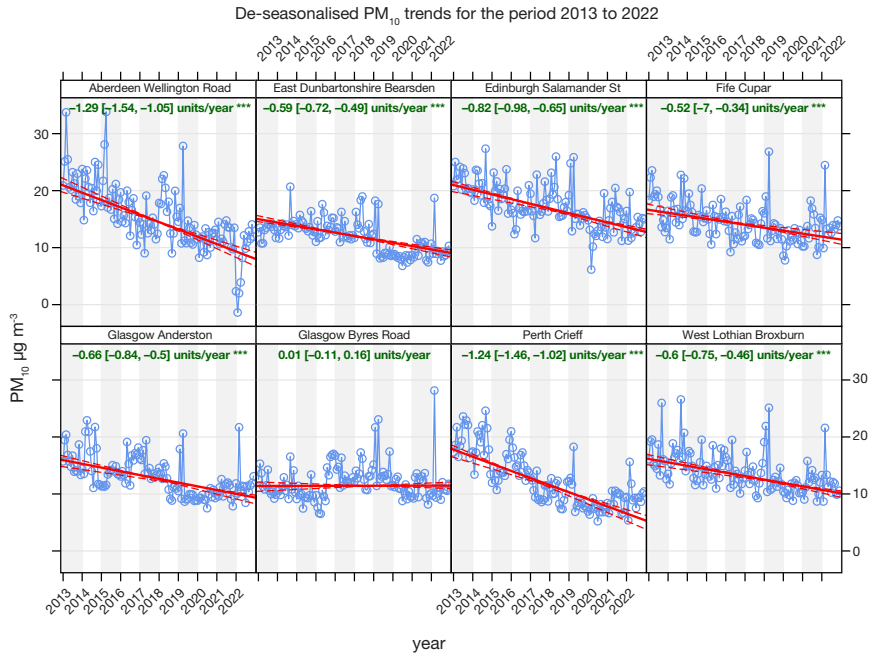

Figure 4.5

Trends in PM_{10} concentration at eight long-running urban traffic sites, 2013 – 2022

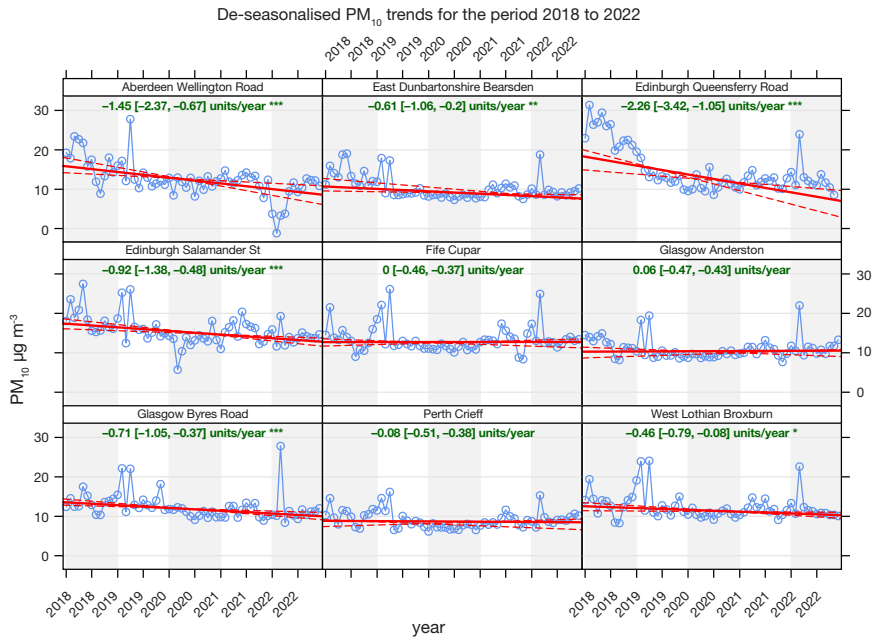

Figure 4.6

De-seasonalised PM_{10} trends for the period 2018 – 2022

4.2.2 Particulate Matter ($PM_{2.5}$)

At the time of writing this report there are 83 sites monitoring $PM_{2.5}$ in Scotland. However, the vast majority of these sites started monitoring in the last six years with the introduction of the $PM_{2.5}$ objective and the requirement for local authorities to measure the pollutant. By the end of 2022 there were four sites with 10 consecutive years of $PM_{2.5}$ data. These sites are: Aberdeen Errol Place (urban background), Auchencorth Moss (rural), Edinburgh St Leonards (urban background), and Grangemouth (urban industrial). The trend plot for these sites is shown in Figure 4.7.

The Analysis shows that all sites show a slight decreasing trend over the 10-year time period at varying levels of statistical significancy.

Trend analysis for a selection of urban traffic sites (chosen for their geographical coverage) that have been monitoring for the past 5 years is provided in Figure 4.8. As can be seen, all nine sites are very similar with slight decreasing trends at varying statistical significance. This is relatively consistent with the 10-year analysis carried out in Figure 4.7.

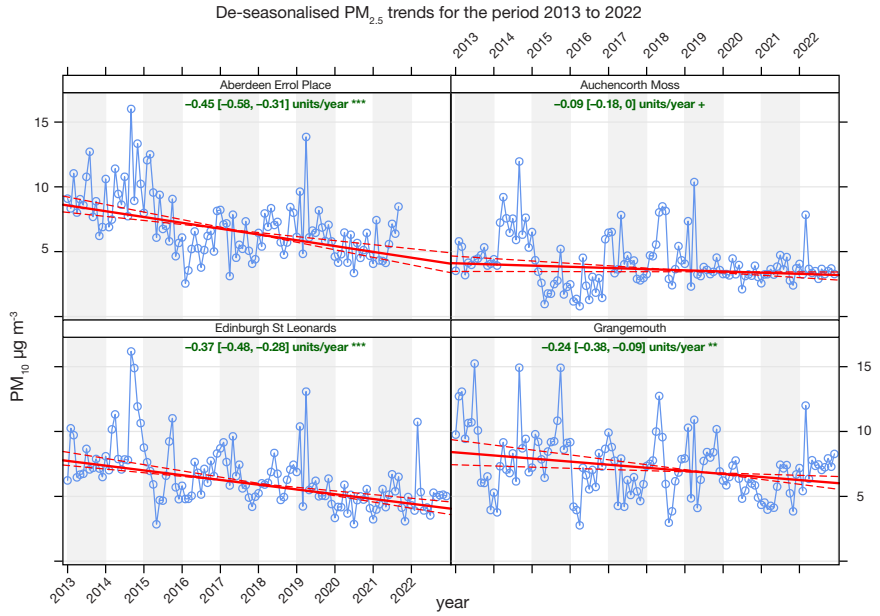

Figure 4.7

Trends in $PM_{2.5}$ Concentration at Four Long-Running Monitoring Sites, 2013 – 2022

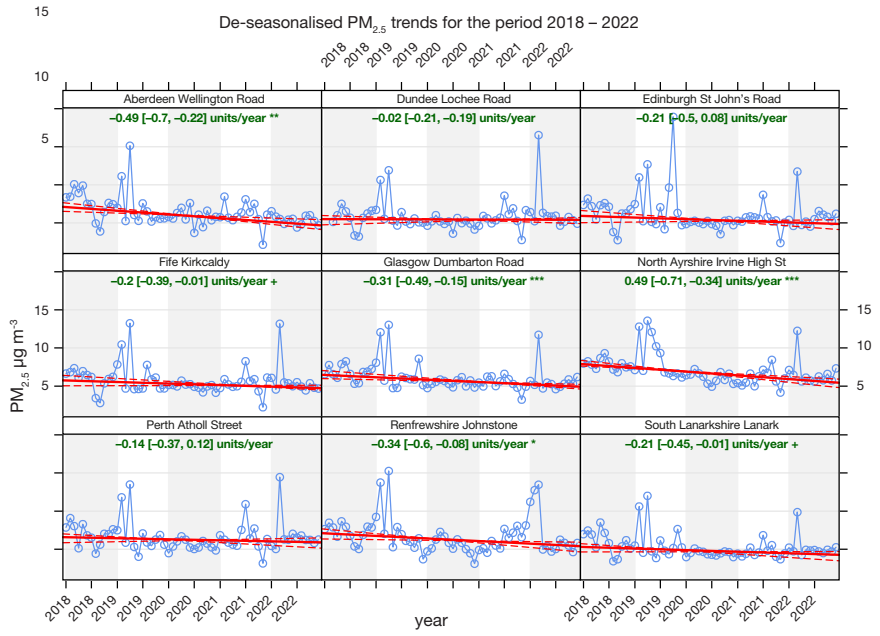

Figure 4.8

Trends in $PM_{2.5}$ Concentration at Urban traffic sites, 2018 – 2022

4.3 Ozone (O_3)

4.3.1 Rural Ozone

Three of Scotland's rural air quality monitoring stations have been monitoring ozone for 32 years, 1986 – 2022. These are Bush Estate, Eskdalemuir and Strath Vaich. Figure 4.9 shows long-term trends in de-seasonalised monthly mean ozone (O_3) concentrations at these three exceptionally long-running rural monitoring sites. Bush Estate and Eskdalemuir both show small but statistically highly significant increasing trends in monthly mean rural ozone concentrations over this period. For Strath Vaich, there has been neither an increasing or decreasing trend over the same period with concentrations generally staying the same. The charts also show a significant amount of fluctuation; this may reflect the fact that ozone is formed by reactions involving other pollutant gases, in the presence of sunlight. Thus, ozone concentrations depend substantially on weather conditions. There is also evidence that the "hemispheric background" concentration of O_3 has increased since the 1950s due to the contribution from human activities.[3]

Six sites have been in operation for over 10 years. These are the above three sites, plus Auchencorth Moss, Glasgow Waulkmillglen Reservoir and Lerwick. Trends in ozone concentration at these six sites are shown in Figure 4.10. The ten-year trend analysis shows that three sites have increasing trends in O_3 concentrations at varying levels of statistical significance. The other three sites (Bush Estate, Eskdalemuir and Strath Vaich) have slight decreasing trends; however Bush Estate and Eskdalemuir shows no statistical significance and Strath Vaich is significant to 0.05.

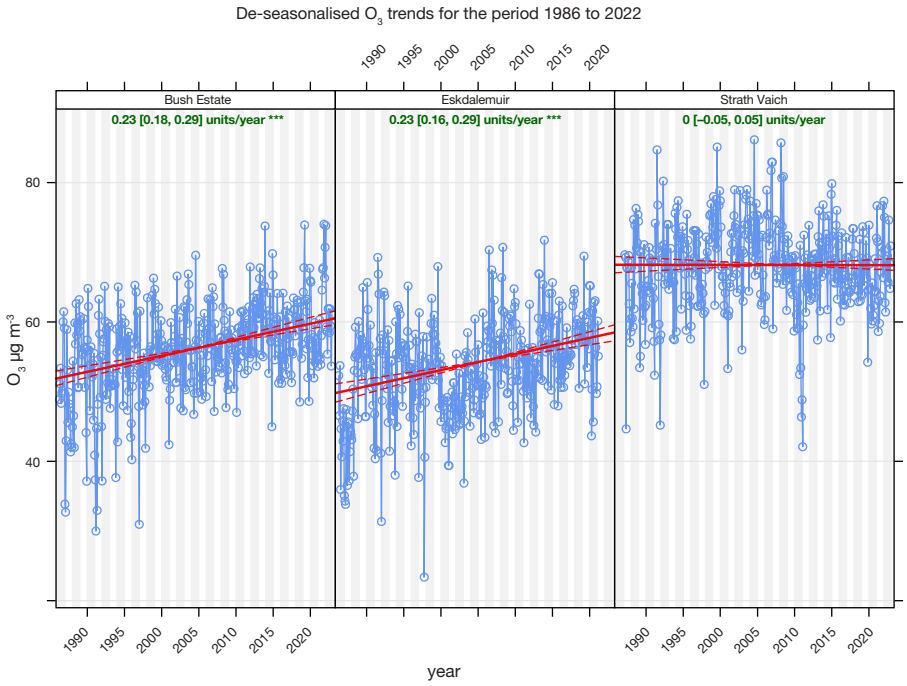

Figure 4.9

Trends in O_3 Concentrations at Long-Running Rural Sites, 1986 – 2022

[3] See the APIS webpage "Ozone" at http://www.apis.ac.uk/overview/pollutants/overview_O3.htm

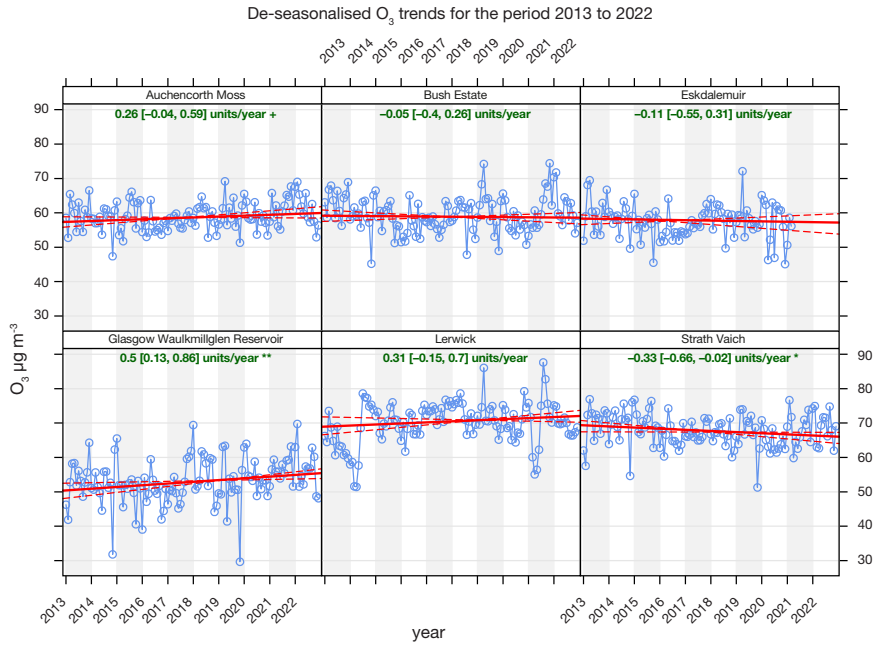

Figure 4.10

Trends in O_3 Concentrations at Six Long-Running Rural Sites, 2013 – 2022

5

Air Quality Mapping for Scotland

As part of the SAQD project, Ricardo Energy & Environment provides mapped concentrations of modelled background air pollutant concentrations on a 1 km x 1 km basis for the whole of Scotland. Modelled roadside air pollutant concentrations are provided for road links in Scotland. The air pollution maps are derived from a combination of:

1. Measurements from Scotland's network of air quality monitoring stations, and
2. Spatially disaggregated emissions information from the UK National Atmospheric Emissions Inventory (NAEI)

The maps provide estimated pollutant concentrations for the whole of Scotland. The methodology for producing the Scottish maps is based on the UK Pollution Climate Mapping (PCM) approach. This is used for producing air pollution maps for the whole of the UK.

The PCM methodology has been applied to provide pollution maps of Scotland for the Scottish Government for 2021 using measurements exclusively from Scottish air quality monitoring sites. The maps provide spatial representation of the annual mean concentrations of:

- PM_{10} (gravimetric equivalent)
- $PM_{2.5}$ (gravimetric equivalent)
- NOx and NO_2.

The air pollution measurements used to prepare the maps presented here consists of appropriately scaled PM_{10} and $PM_{2.5}$ monitoring data and automatic monitoring measurements for NO_x and NO_2 from the model year. The model also uses meteorology data from the Weather Research and Forecasting (WRF) model to create the Scotland-specific maps.

In 2009 Ricardo undertook a short study[4] on behalf of the Scottish Government which demonstrated the use of Scotland-specific air quality maps for LAQM purposes. This study recommended the use of air pollutant source apportionment data and forward-projected concentrations of air pollutants using Scotland-specific data. Updates to these Scotland-specific air pollutant source apportionment data and forward-projected concentrations have been made and are available for LAQM from a base year of 2018 at: https://www.scottishairquality.scot/data/mapping/data. Please note the available projections from a base year of 2018 are based on assumptions that were applicable prior to the Covid-19 pandemic, and as such, do not reflect short- or long-term impacts of the pandemic and associated lockdowns on emissions in 2020 and beyond.

5.1 Air Quality Maps for Scotland 2021

The details of the methodology and full results of the mapping study are provided in a separate report[5]. In this report, we summarise the main findings of this work.

5.1.1 NO_2 maps for 2021

The 2021 annual mean NO_2 concentrations for Scotland were modelled for background and roadside locations. Figure 5.1 and Figure 5.2 show modelled annual mean NO_2 concentrations in Scotland, for background and roadside locations respectively.

[4] Stevenson, K., Kent, A.J., and Stedman, J. (2010). Investigation of the possible effect of the use of Scottish specific air quality maps in the LAQM process in four selected Local Authorities. AEA Report AEAT/ENV/R/2948. https://www.scottishairquality.scot/sites/default/files/orig/publications/reports2/258100203_la_mapping_report_issue_1_final.pdf

[5] Wareham, J., Pepler, A. Stedman, J., Morris, R. and Hector, D. (2022). Scottish Air Quality Maps. Annual mean NOX, NO2, PM10 and PM2.5 modelling for 2020. https://www.scottishairquality.scot/sites/default/files/orig/assets/documents/Scottish_mapping_report_2020.html

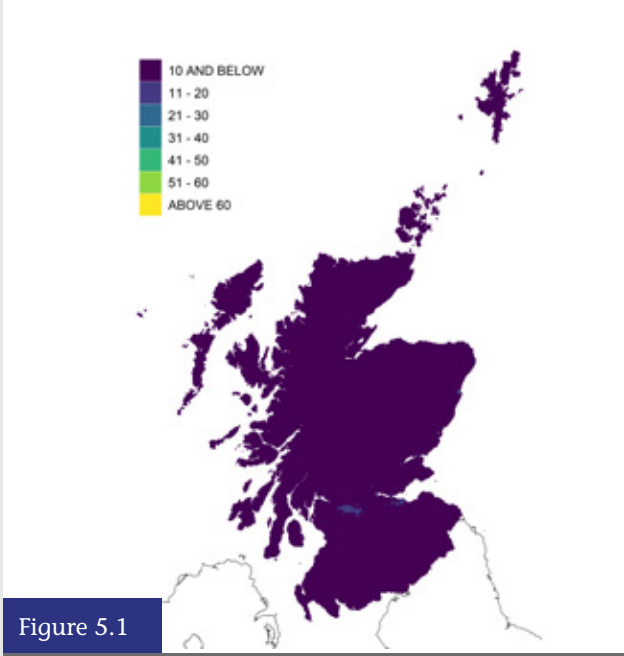

Figure 5.1

Background NO_2 map for 2021, µg m^{-3} (Scotland-specific model)

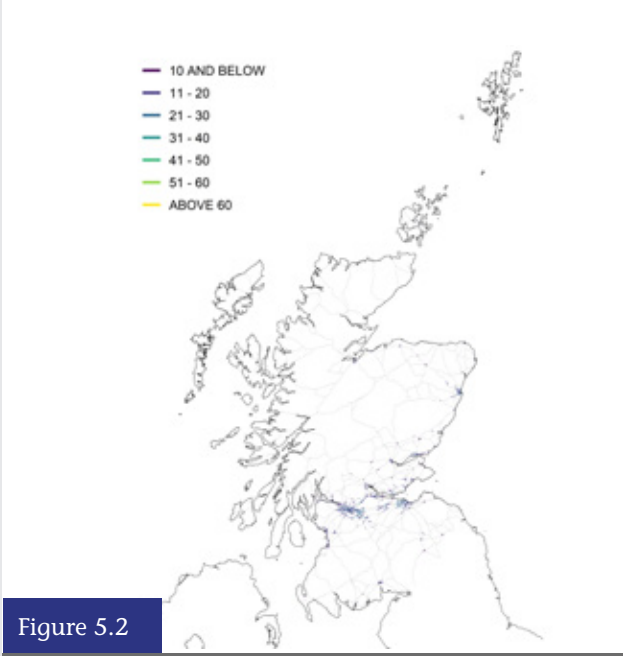

Figure 5.2

Roadside NO_2 map for 2021, µg m_{-3} (Scotland-specific model)

There were no modelled exceedances of the Scottish annual mean NO_2 objective of 40 µg m-3 at background or Roadside locations. Interactive versions of the maps showing the background and roadside annual mean NO_2 concentrations can be found in the Scottish Air Quality Mapping report for 2021 (https://www.scottishairquality.scot/sites/default/files/publications/2023-10/Scottish_mapping_report_2021.html).

5.1.2 PM_{10} Maps for 2021

2021 annual mean PM_{10} concentrations for Scotland were modelled for background and roadside locations. The modelling methodology used to calculate the annual mean PM_{10} concentration was similar to that used in previous years and used a mixture of PM_{10} monitoring data. Many of the chemical components of the PM_{10} model are not affected by the Scotland-specific changes to the UK PCM model. This includes the contribution to the total PM_{10} mass from the following components:

- secondary inorganic aerosols (SIA, e.g., sulphate, nitrate, ammonium-based particles)
- secondary organic aerosols (SOA)
- primary particles from long-range transport
- sea salt aerosol, and
- iron and calcium-rich dusts.

Maps of the modelled 2021 annual mean PM_{10} concentrations for Scotland's background and roadside locations are shown in Figures 5.3 and 5.4, respectively. The modelling indicated that there were no modelled exceedances of the Scottish annual mean PM_{10} objective of 18 µg m^{-3} at background and roadside locations.

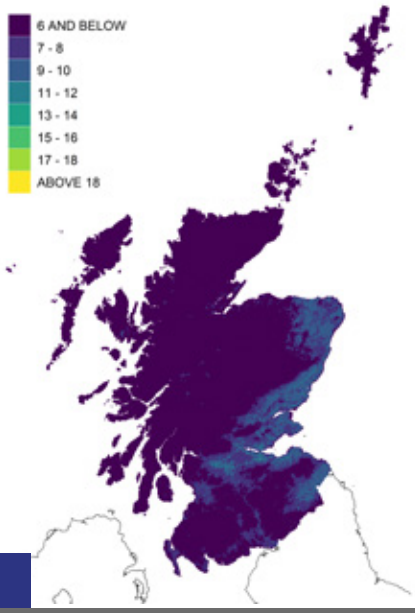

Figure 5.3

Background PM_{10} map for 2021, µg m^{-3} (Scotland-specific model)

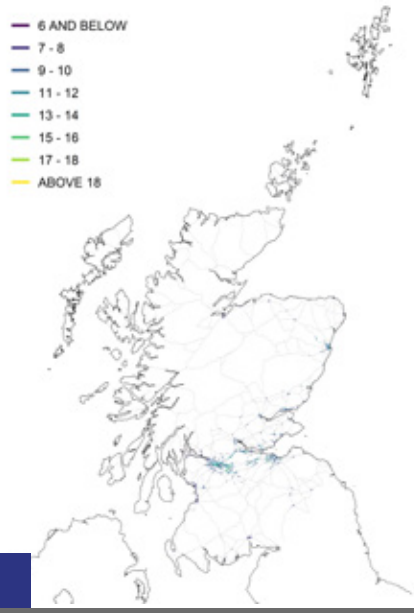

Figure 5.4

Roadside PM_{10} map for 2021, µg m^{-3} (Scotland-specific model)

5.1.3 $PM_{2.5}$ Maps for 2021

2021 annual mean concentrations of $PM_{2.5}$ were modelled for Scotland at background and roadside locations. The modelling methodology used is consistent with the PM_{10} model and further detail can be found in the 2021 UK mapping report[6]. The 2021 maps have been calibrated using measurements from sites for which co-located PM_{10} measurements are also available.

Maps of the modelled 2021 annual mean $PM_{2.5}$ concentrations for Scotland's background and roadside locations are shown in Figures 5.5 and 5.6, respectively. The modelling showed that there were no modelled exceedances of the Scottish annual mean $PM_{2.5}$ objective of 10 µg m^{-3} at both background and roadside locations.

[6] Pugsley, K. L., Stedman, J. R., Brookes, D. M., Kent, A. J., Morris, R. J., Whiting, S. L., Wareham, J. V., Goodhand, A., Pepler, A., Thorp, T. M. and Gorji, S., 2022. "Technical Report on UK Supplementary Modelling Assessment Under the Air Quality Standards Regulations 2010 for 2021." Ricardo Energy & Environment. https://uk-air.defra.gov.uk/library/reports?report_id=1086.

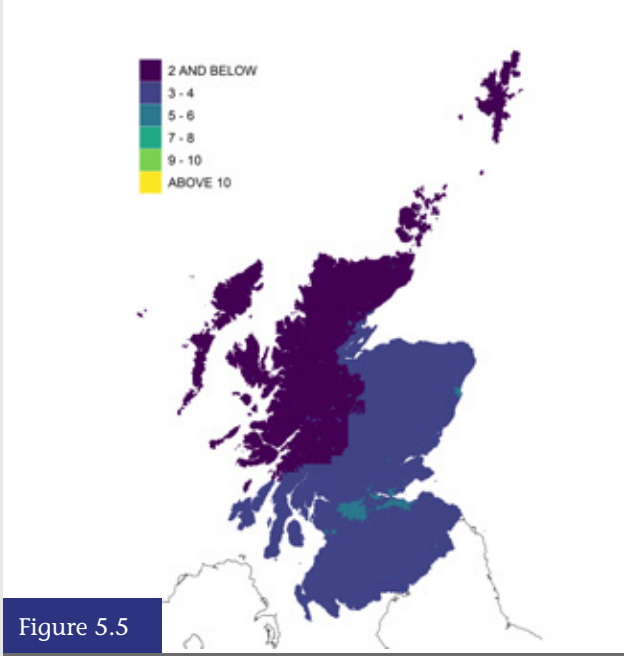

Figure 5.5

Background $PM_{2.5}$ map for 2021, µg m^{-3} (Scotland-specific model)

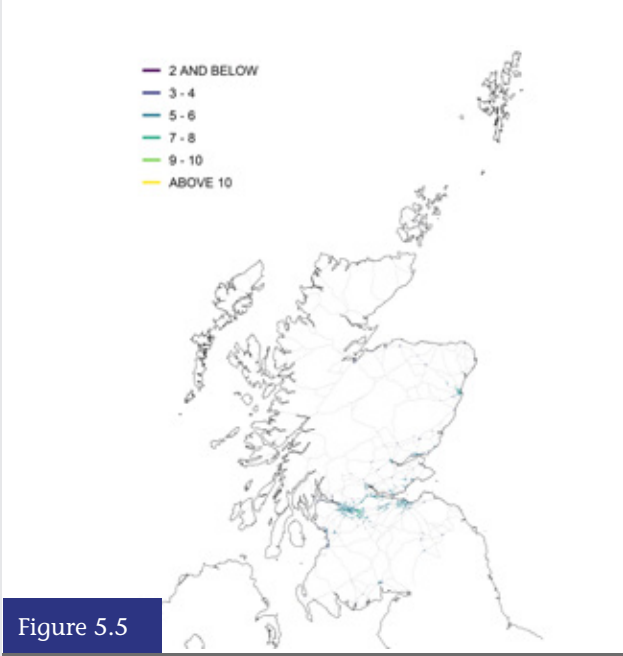

Figure 5.5

Roadside $PM_{2.5}$ map for 2021, µg m^{-3} (Scotland-specific model)

6

Covid-19 Lockdown and its Effect on Air Quality in Scotland 2020

6.1 Background

This section provides an update on the assessment of NO_2 concentrations previously undertaken for the 2021 report. The results for 2021 indicated that concentrations remained below the levels measured pre-Covid-19, however, there were still restrictions in the first half of 2021 and traffic levels had not returned to 2019 levels. In 2022 there were no longer any Covid-19 related restrictions in place in Scotland. Here the analysis looks at how NO_2 concentrations have changed since the lifting of all restrictions.

6.2 Methodology

Weather conditions have a large impact on the concentrations of air pollutants, therefore, to assess how air quality has changed over time, it is important to consider variabilities due to the weather. Fortunately, techniques have been developed that can be used to "de-weather" the data. These techniques are based on statistical models that can be used to estimate the pollutant concentrations under various meteorological conditions, and in turn to predict what the concentrations would be if the weather was always the same[7,8].

Here, the deweather R package[9], was used to build the statistical models to de-weather the data. The deweather package uses a Boosted Regression Trees approach to model air quality data. This approach enables complex relationships between variables to be easily handled.

Model inputs included the daily average concentrations from the Scottish Air Quality Database and local meteorological data (wind speed, wind direction, air temperature) from the Weather Research and Forecasting (WRF) regional scale model.

From the model outputs, the trend component can be extracted. The trend provides information on the variation in the pollutant with fixed average meteorology and can be used to investigate changes that are not due to the weather.

6.3 Results

NO_2 measurements from the same fourteen monitor sites across Glasgow and Edinburgh (seven in each location) used in the analysis for 2021 are assessed here. The locations of the monitoring sites are shown in Figure 6.1.

[7] Grange, Stuart K., and David C. Carslaw. 2019. "Using Meteorological Normalisation to Detect Interventions in Air Quality Time Series." Science of The Total Environment 653 (February): 578–88. https://doi.org/10.1016/j.scitotenv.2018.10.344.

[8] Carslaw, David C., and Paul J. Taylor. 2009. "Analysis of Air Pollution Data at a Mixed Source Location Using Boosted Regression Trees." Atmospheric Environment 43 (22-23): 3563–70. https://doi.org/10.1016/j.atmosenv.2009.04.001.

[9] https://github.com/davidcarslaw/deweather

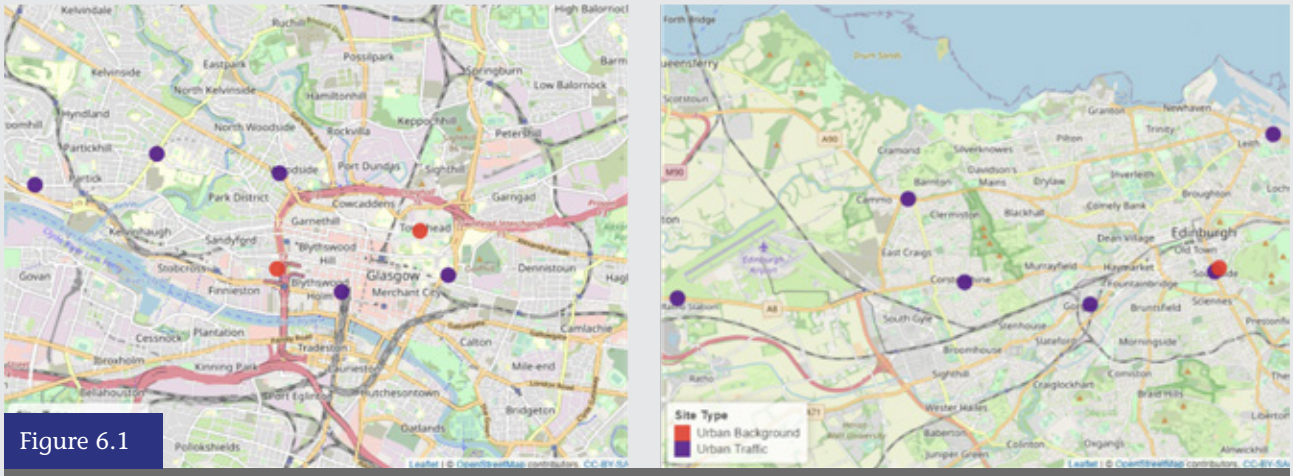

Figure 6.1

Location of the monitoring sites in Glasgow (left) and Edinburgh (right) selected for the analysis.

Annual traffic data from the Department for Transport in Glasgow and Edinburgh between 2017 to 2022 is shown in Figure 6.2. The data shows the estimated number of vehicle miles travelled for all motor vehicles, and is based on the average annual daily flow, days in the year, and length of the road[10]. The data shows a large dip in vehicle miles travelled in 2020 in both cities, followed by an increase in 2021. Traffic levels have continued to increase in 2022 to just below those observed in 2019.

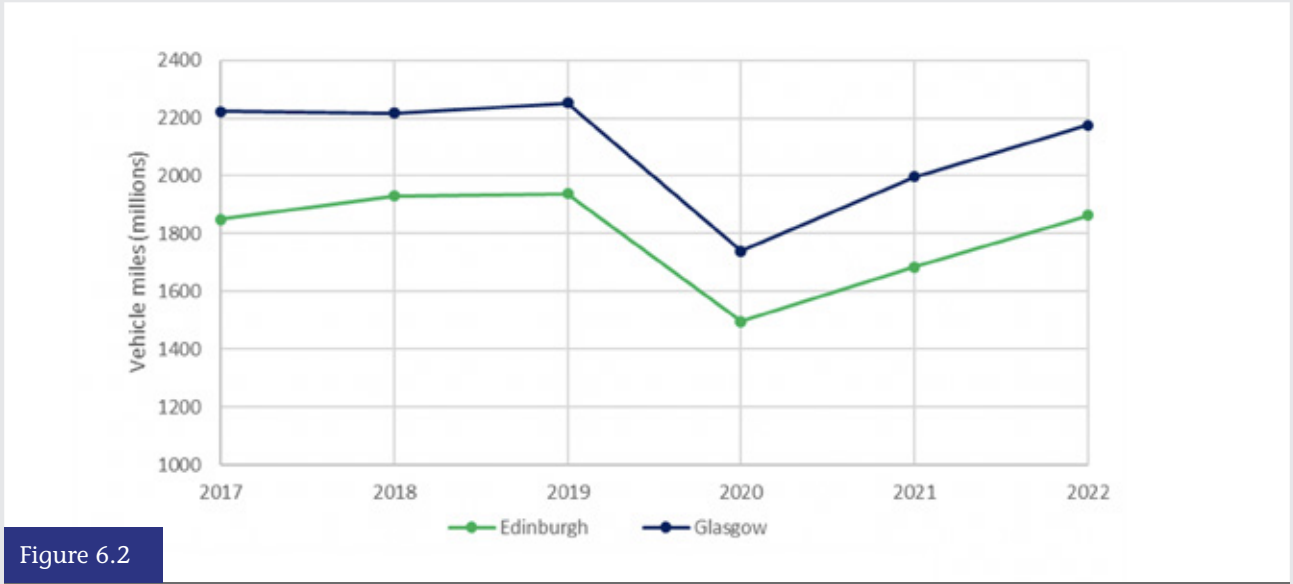

Figure 6.2

Annual vehicle miles (in millions) for Glasgow City and the City of Edinburgh local authorities, between 2017 and 2022 (source: Department for transport (https://roadtraffic.dft.gov.uk/)).

[10] https://roadtraffic.dft.gov.uk/regions/3

Figure 6.3 shows meteorologically normalised trends of NO_2 concentrations for urban traffic and urban background sites in the Glasgow area from 2017 to 2022. For all sites shown, there is a clear decrease in NO_2 concentrations coinciding with the start of the first lockdown in 2020. This is then followed by an increase in NO_2 concentrations during late summer However, for most of the sites, the NO_2 concentrations have not increased to the levels observed pre-lockdown, even when you take into consideration the downward trend pre-covid. The exception is Glasgow Anderston, an urban background site, where it can be observed that the NO2 levels in 2021 and 2022 are similar to those before lockdown. An urban background site is one that is located away from major roads; therefore it is expected to be less influenced by changes in traffic volumes when compared to urban traffic sites. Interestingly, at some sites (e.g. Glasgow Kerbside, Glasgow Dumbarton Road), further decreases in concentrations can be observed in 2022. The largest difference in concentrations of NO_2 between pre-lockdown and 2022 is observed at Glasgow Kerbside monitoring site. This site is located on Hope Street, next to Glasgow Central train station and as can be seen by Figure 6.3 has historically the highest concentrations of NO_2.

Figure 6.4 shows the average change in NO_2 concentrations during the day (over the year stated) at Glasgow Kerbside for years 2019 to 2022. Mean NO_2 concentrations during the morning rush hour (7-10 am) in 2021 are very similar to those in 2019. However, late afternoon/early evening the mean NO_2 concentrations remain lower in 2021 when compared to 2019, suggesting that traffic patterns may have changed since the lockdowns. For 2022, though the trend pattern is similar to 2021 the concentrations have dropped off significantly in the morning and afternoon to levels similar to that seen in 2020. This drop in concentrations does not correspond with the increase seen in traffic data which suggests that there has been a change in the fleet in terms of emissions produced.

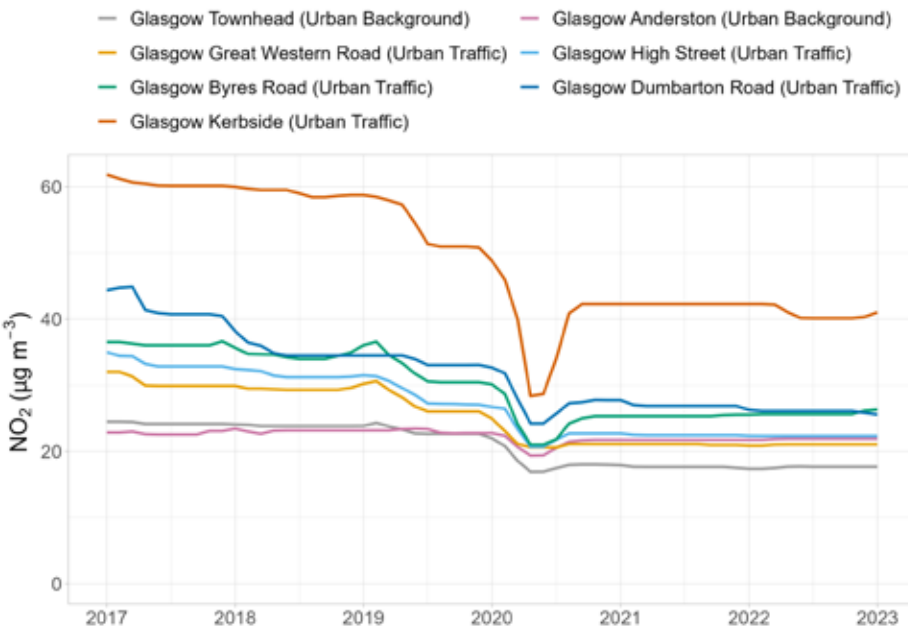

Figure 6.3

Meteorologically normalised trends of NO_2 concentrations measured at selected sites in Glasgow from 2017 to 2022.

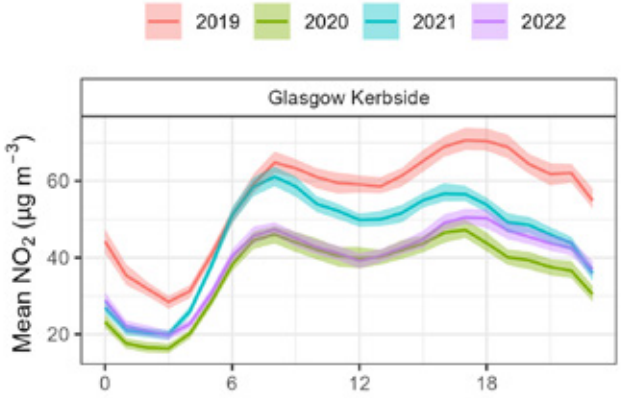

Figure 6.4

Mean NO_2 concentrations for each hour of day at Glasgow Kerbside monitoring site from 2019 – 2022. The shaded region represents the 95% confidence interval in the mean.

Meteorologically normalised trends of NO_2 concentrations for urban traffic and urban background sites in the Edinburgh area (Figure 6.5) show similar variability to the sites in Glasgow, with an initial increase after the lockdown in 2020, and concentrations remaining below 2019 levels. A further decrease in NO_2 concentrations is observed at Nicolson Street and Salamander Street in 2022. For three sites (Glasgow Road, Salamander Street and St Leonard's) the meteorologically normalised NO_2 concentrations increased only very slightly, or not at all after the first lockdown. The analysis also indicates that the sites that historically had the higher NO_2 concentrations experience the larger decreases.

It should be noted that although the NO_2 concentrations measured at Nicolson Street in 2020 appear to decrease earlier than at other sites, this is due to a gap in the measured data between January and April 2020.

Figure 6.6 shows the average change in NO_2 concentrations during the day (over the year stated) at Edinburgh St Johns Road for years 2019 to 2022. It illustrates that though daily trends have generally stayed the same over the years (i.e. peaking at rush hours in the morning and evening then dropping off significantly during the night) the 2022 concentrations are significantly lower than pre-covid (2019). Again when you consider the increase in traffic levels back to almost 2019 levels this suggests a change in the vehicle fleet and the emissions it produces.

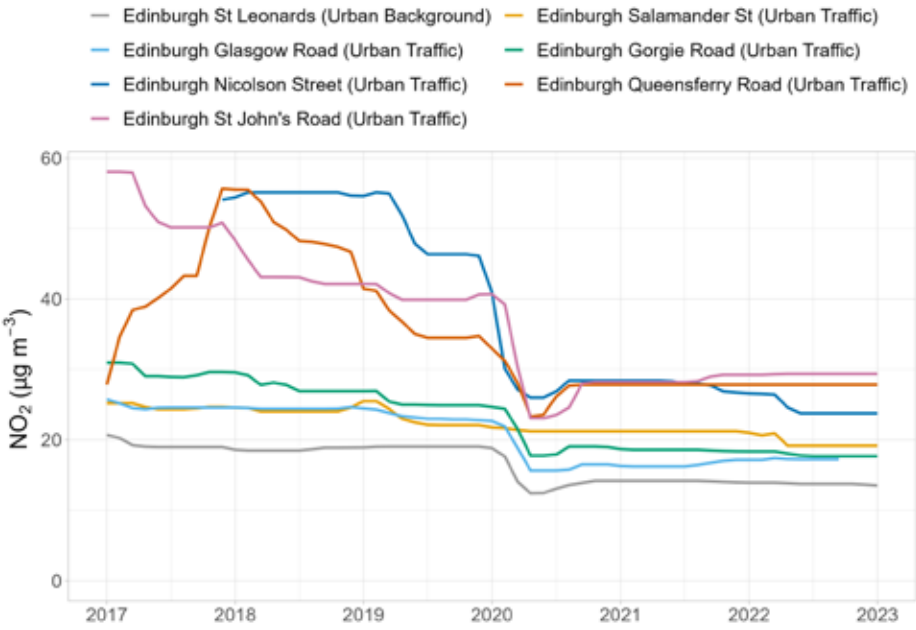

Figure 6.5

Meteorologically normalised trend of NO_2 concentrations measured at selected sites in Edinburgh from 2017 to 2022.

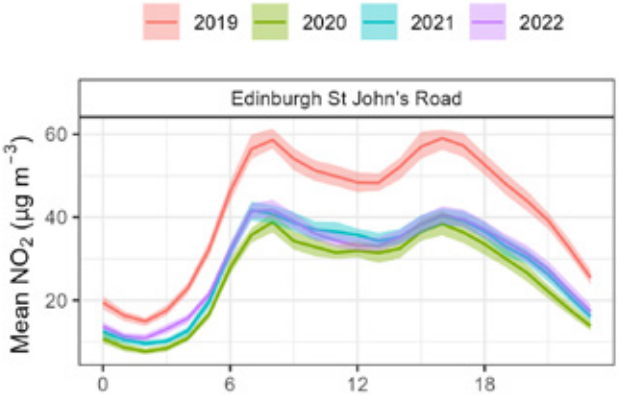

Figure 6.6

Mean NO_2 concentrations for each hour of day at Edinburgh Nicolson Street from 2019 – 2022. The shaded region represents the 95% confidence interval in the mean.

6.4 Summary

By 2022 all Covid-19 restrictions had been lifted, and traffic data from Glasgow and Edinburgh areas show that annual vehicle miles travelled in these areas continued to increase in 2022 reaching near pre-Covid levels.

The analysis of meteorologically normalised trends in NO_2 concentrations from a selection of sites in the Glasgow and Edinburgh, however, show that NO_2 concentrations have not continued to increase considerably since the initial increase after the first lockdown in 2020. Interestingly, at some sites, there have been further decreases in 2022. This suggests a change in vehicle fleet at both locations in terms of emissions produced.

7

Education

Education has been an ongoing development for air quality in Scotland. Interactive education packages have been developed through the creation of two sections that form part of the Air Quality in Scotland website. The first education website, 'Air Pollution Detectives', was created for schoolchildren in P5 to P7 (8-11 years old). The second website, 'Clear the Air', was developed in partnership with a number of secondary schools for pupils in S1 to S3 (12-15 years old).

The education packages can be accessed from the Air Quality in Scotland website (https://children.scottishairquality.scot/).

7.1 Air Pollution Detectives

Initially launched in 2011, the Air Pollution Detectives website has been continuously revised and updated. It was designed to introduce air quality issues to primary school pupils between the ages of 8 and 11. The animated, interactive webpages provide an introduction to air pollution sources and how pupils' actions can impact the air quality around them. Pupils can select individual pollutants to learn more and can take the quiz after each section to see what they have learned. The website is accompanied by a set of teachers' notes to enhance the learning experience and worksheets for pupils are provided.

Figure 7.1 shows the additional educational information that accompanies the Air Pollution Detectives website.

Figure 7.1

Air Pollution Detectives webpage

Visit the Air Pollution Detectives website at https://children.scottishairquality.scot/

7.2 Clear the Air

The Clear the Air website was developed following the success of Pollution Detectives. The webpage, as presented in Figure 7.2, provides an interactive learning experience for air quality and citizen science aimed at secondary school age and above.

Figure 7.2

Clear the Air webpage

The Clear the Air package includes a series of interactive webinars and exercises designed to be undertaken by pupils. These interactive exercises include 'What air pollution is like near me', 'Calculating your emissions to school' and a citizen science project that enables classes to monitor air quality around the school by using NO_2 diffusion tubes. Pupils are given an NO_2 diffusion tube to take home so they can monitor outside their house.

7.2.1 The Clear the Air – Air Quality Monitoring Pack

The Clear the Air monitoring pack has been designed to give pupils hands-on experience with air quality monitoring equipment and a better understanding of the underlying science. As a class or group, pupils can undertake air quality monitoring around their school grounds, or at, or near their homes. Once the results have been analysed, the monitoring data (location and measured concentration) can be uploaded via the school's private user portal so that the results can be displayed on an interactive map.

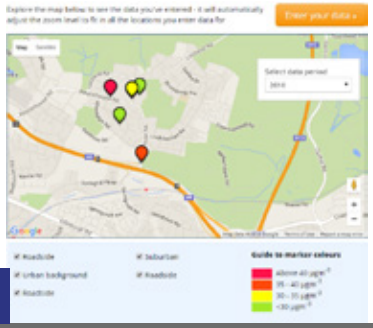

Figure 7.3

Data entry available for each school profile

The package encourages pupils to discuss the results and the factors influencing the air quality measured within the area. The Clear the Air package is supported by a teachers' pack including notes to supplement the monitoring equipment, and webinars to help introduce the concept of local air quality and how to conduct the monitoring.

Further information can be obtained at: http://cleartheair.scottishairquality.co.uk/.

8

Stay Informed

8.1 Scotland Air Pollution Forecast

A five-day forecast for each local authority in Scotland is available on the Air Quality in Scotland website. The forecasts provide a greater level of detail, which can benefit the public – particularly those with health issues. Forecasts are displayed through a summary table and a map. The five-day forecast map and summary table are available at www.scottishairquality.co.uk/latest/forecast.

8.2 Air Quality in Scotland App

The Air Quality in Scotland app gives the latest air quality levels for each site, forecasts for the day ahead and alerts when air pollution levels are forecast to increase and when you are entering an Air Quality Management Area (AQMA). The free Air Quality in Scotland app is available for most mobile devices.

The AQ Scotland App was updated in 2019 with new functionality and can be downloaded from the Apple Store and Google Play now.

The App provides:

- Easy access to the latest pollution levels from the monitoring sites
- Colour coded map showing the pollution forecasts, plus a detailed breakdown
- Approved health advice based on the pollution levels
- Information on AQMA in Scotland in the form of an interactive map
- Subscribe to free notification alerts when moderate, high and very high pollution is measured or forecast
- Subscribe to free notification alerts when you enter an AQMA

8.3 Know & Respond

Know & Respond is a free service providing alerts when pollution levels are forecast to increase (http://www.scottishairquality.scot/know-and-respond/). Users can subscribe to a specific local authority and will receive push notifications directly to their device if 'moderate' or higher air pollution is forecast each day. Users can choose to receive alerts by text, voicemail or email. Know & Respond alerts are also available via the Air Quality in Scotland app.

8.4 Email Alerts

Sign up to our email bulletins and receive summaries directly to your inbox (http://www.scottishairquality.scot/stay-informed/) . You can choose how frequently you receive them and what type of summary you are interested in.

8.5 Interactive Mapping and Analytical Tools

Visualisation and data analysis tools are available on the Air Quality in Scotland website (https://www.scottishairquality.scot/data/openair). The tools pull data from the SAQD and present it in several pre-analysed formats. These tools enable the data to be customised and filtered to meet individual requirements, such as viewing air quality in a particular area or for local authorities when preparing annual reports.

8.6 X (formerly known as Twitter)

Follow Air Quality in Scotland on X (formerly known as Twitter) (@scotairquality) for air quality forecasts and summaries of measurements from Scotland.

@scotairquality

The service enables you to stay informed about current and forecast air quality including the occurrence of air quality episodes. Health advice and information on the UK Air Quality Index should be considered in conjunction with the tweets, particularly when air pollution is elevated.

8.7 Youtube™

The Air Quality in Scotland YouTube account was initially launched to provide a platform for related videos, and it hosts the 'How To' videos for the Local Site Operator manual.

Each video is available through the YouTube website itself, but can also be accessed directly on the Air Quality in Scotland website (https://www.youtube.com/user/AirQualityScotland).

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Energy & Environment

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