2018 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the
Environment Act 1995
Local Air Quality Management

June 2018

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Executive summary: air quality in our area

Air quality in Cheshire West and Chester

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues, because areas with poor air quality are also often the less affluent areas[1,2].

The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3].

This annual status report covers monitoring results for 2017 and action that the Council is taking in a bid to improve local air quality.

In Cheshire West and Chester the main pollutants of concern are nitrogen dioxide (NO_2), particulate matter (PM) and sulphur dioxide (SO_2).

National government has set health-based objectives for a range of pollutants and, where these are not met, the local authority must declare an air quality management area (AQMA) and commit to improving local air quality through action planning. There are four designated AQMAs in the borough. Three of these, located in Chester, Ellesmere Port and Frodsham relate to exceedances of the annual mean NO_2 objective from road traffic. The fourth, in Thornton-le-Moors, was declared because of exceedances of the 15-minute mean SO_2 objective caused by industrial emissions. Details of the AQMAs and associated action plans can be found on the Council website at www.cheshirewestandchester.gov.uk/aqmanagement .

The NO_2 annual average objective is exceeded at a number of locations in the Chester city centre AQMA. Data from 2017 indicates that the objective was not exceeded at residential properties in the AQMAs in Frodsham and Ellesmere Port. A review of the latter will now be carried out. National air quality objectives for PM_{10} (particulate matter less than 10 microns in diameter) are complied with in Cheshire West and Chester. There is currently no regulatory standard applied to $PM_{2.5}$

[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010
[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006
[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

(particulate matter less than 2.5 microns in diameter) for local authorities but EU limit values have been set as there are well-documented associations with health effects. Local data suggests that $PM_{2.5}$ levels at background sites are well below the limit value.

At our long-term monitoring sites there is a discernible downwards trend in NO_2 and PM_{10} concentrations over time. Monitoring stations recording the highest levels of SO_2 have not been operational for long enough to determine significant trends.

Actions to improve air quality

Cheshire West and Chester Council has pursued a number of measures with the aim of delivering air quality improvements in the reporting year of 2017 – 2018.
Work on the Council's Low Emission Strategy (LES) has progressed well through 2017-18. A full consultation was conducted in early 2018 and the majority of responses were supportive of the strategy and its intent. A post-consultation options appraisal report has now been produced and the LES is due to be published later in the summer of 2018. The strategy covers a broad range of measures focused on modal shift, reduction of emissions from both vehicles and stationary sources and improvement areas such as electric vehicle (EV) charging infrastructure and emissions from public transport / licensed vehicles. It is anticipated that the broad range of measures contained in the LES will deliver significant improvements in local air quality over time.

In support of the aspirations of the LES, the Council has committed significant resources from the priority outcomes fund to undertake a public awareness campaign, accelerate the rollout of EV charging infrastructure, web site development and human resources. A feasibility study of EV charging across a range of local sectors was commissioned in 2017 and this work is now nearing completion.

The Council was awarded grant funding under the Clean Vehicle Technology Fund (CVTF) to upgrade a range of Euro II / III buses to Euro VI standards. Exhaust control equipment was retrofitted to four buses in late 2016 and it has been agreed that the outstanding monies will be used to retrofit a further three buses in Chester this summer. These are high frequency services running through an area with some of the highest NO_2 levels in the borough, so the retrofits will be beneficial to the AQMA.

To build on the success of the above, the Council submitted an application to the latest round of the Clean Bus Technology Fund (CBTF) in 2017 to retrofit 21 further buses with abatement technology for oxides of nitrogen (NOx). Unfortunately this application was unsuccessful.

In 2017 the Council was invited to reapply for the Low Emission Bus Scheme (LEBS), which had originally been announced in 2015. This would have seen the conversion of the entire fleet of park and ride vehicles in Chester to fully electric vehicles. Unfortunately the bid ultimately had to be withdrawn as there were insurmountable contractual issues. However, the park and ride fleet is comprised of the latest Euro VI standard vehicles.

Under a four-year programme from late 2016, 20mph zones are being introduced to some 740km of roads across the borough. While the main impetus for the speed restrictions is road safety, studies show that 20mph speed restrictions are beneficial in reducing NOx from diesel engines and PM_{10} for both diesel and petrol engines. They are also effective in reducing particulate matter due to fewer acceleration / deceleration events. The third year of the programme is due to start in summer 2018.

In early 2018 the Council was successful in securing funding under the air quality grant scheme to research the health burdens of particulate matter both within and outside extant Smoke Control Areas (SCA), and the potential benefits and practicalities of expanding the current coverage of SCAs in the borough.

The Council supported the National Clean Air Day initiative on 21 June 2018. Free travel on Chester's park and ride services was provided alongside an active social media campaign encouraging people to contribute to the improvement of local air quality.

There is broad consensus amongst Council Members that action needs to be taken to improve local air quality. In December 2016 the Council passed a Notice of Motion which states that "This Council recognises that traffic-related air pollution is a significant risk to the public's health and wellbeing, contributing to health inequalities in our borough as detailed in the Council plan."

"Therefore, this Council reaffirms its commitment to improving air quality and resolves to review current practice including emerging NICE (National Institute for Health and Care Excellence) guidelines to ensure council policies and strategies in planning, infrastructure, transport and public health reflect this advice in relation to external air quality."

"Council also confirms its commitment to the recommendations of the Health and Wellbeing Board of July 2015 regarding the impact on health from air pollution."

Conclusions and priorities

No exceedances of objectives were identified outside any existing AQMAs in 2017.

Long term monitoring data shows that there are general downwards trends in ambient NO_2 and PM_{10} across the borough. Annual mean NO_2 in the Chester area remains significantly above the objective and measures contained in the Low Emission Strategy, as well as those to be developed in the action plan for the area will be required to bring forwards compliance in coming years.

Monitoring results in the Ellesmere Port AQMA are below the air quality objective and it may be appropriate to revoke the AQMA. This will be investigated further in 2018.

In the coming year, the Council's priorities are to develop the Air Quality Action Plan for Chester; publish the Low Emission Strategy and make progress with a range of identified measures; expand the availability of electric vehicle charging points in the borough; review the status of the AQMA in Ellesmere Port; commence work on a local smoke control area study and to take advantage of funding opportunities for the adoption of air quality improvement measures.

Local engagement and how to get involved

The Council's Notice of Motion on air quality shows cross-party consensus that action needs to be taken to improve local air quality: "this Council recognises that traffic-related air pollution is a significant risk to the public's health and wellbeing, contributing to health inequalities in our borough, as detailed in the council plan. Therefore, this Council reaffirms its commitment to improving air quality and resolves to review current practice including emerging NICE guidelines to ensure council policies and strategies in planning, infrastructure, transport and public health reflect this advice in relation to external air quality. Council also confirms its commitment to the recommendations of the Health and Wellbeing Board of July 2015 regarding the impact on health from air pollution."

Note: NICE guidelines include recommendations such as including air pollution matters in strategic planning; provision of electric vehicle charging points; procurement of public sector low emission vehicles; introduction of 20mph zones and specifying standards for licensed vehicles. The Health and Wellbeing Board report endorsed the development of the Low Emission Strategy.

There are many ways that we can all help to reduce outdoor air pollution:

- Leave your car at home and walk, cycle or use public transport instead. Car drivers can be exposed to significantly more air pollution than pedestrians or cyclists using the same streets
- When choosing your next car, consider alternatives to petrol and diesel such as electric cars or hybrids. Emissions from these vehicles are much lower (or even zero) and running costs are significantly cheaper.
- Switch your car's engine off whenever you're not moving and it's safe to do so. You'll improve air quality for yourself and others.
- Unlike gas and electric, burning wood and other solid fuels produces a lot of air pollutants. If you do intend to buy a wood-burning stove, choose a Department of environment, food and rural affairs (Defra) approved model or an eco-design ready stove. Also, ensure that the wood you use meets the requirements of the 'Woodsure ready to burn' requirements.
- Keep your car regularly serviced and with the tyres correctly inflated.
- Compost your garden waste rather than burning it.
- Adopt an efficient driving style – anticipate the road ahead, change up the gears earlier and brake smoothly. It could save you a lot of money over the course of a year.

Adults and children with lung problems and adults with heart problems may be particularly affected by air pollution. Information on local air quality is available on the Council's website www.cheshirewestandchester.gov.uk/monitoringstations and further information on forecasting and health advice is available on Defra's UK-air website https://uk-air.defra.gov.uk/ .

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1 Local air quality management

This report provides an overview of air quality in Cheshire West and Chester during 2017. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant policy and technical guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by the Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England can be found in Table 22 in Appendix E.

The next scheduled LAQM report will be the 2019 ASR, which is due to be submitted by June 2019.

2 Actions to improve air quality

2.1 Air quality management areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare an Air Quality Action Plan (AQAP) within 12-18 months setting out measures it intends to put in place in pursuit of compliance with the objectives.

A summary of AQMAs declared by Cheshire West and Chester can be found in Table 1. Further information related to declared or revoked AQMAs, including maps of AQMA boundaries are available online at www.cheshirewestandchester.gov.uk/aqmanagement

Alternatively, see Appendix D: Maps of monitoring locations and AQMAs, which provides maps of air quality monitoring locations in relation to the AQMAs.

The Chester city centre AQMA, which was declared in May last year has a number of hotspots at which the annual objective of 40 micrograms per cubic metre ($\mu g/m^3$) is not met. An action plan is in the process of being developed for this area with the aim of publishing it by November 2018.

Concentrations of NO_2 at all monitoring sites in the Ellesmere Port AQMA were below the annual objective in 2017. This is consistent with recorded levels at residential properties in recent years so it would now be appropriate to determine whether there is a case for revocation of the AQMA.

AQAPs for the Frodsham and Thornton-le-Moors AQMAs were finalised in 2017, consulted upon and submitted to Defra for approval in early 2018.

As reported in last year's report, a single exceedance of the NO_2 annual objective was identified through monitoring in Christleton. Further investigations during 2017 showed that it would not be necessary to declare an AQMA for that location at present.

Table 1 Declared air quality management areas

AQMA name	**Date of declaration**	**Pollutants and air quality objectives**	**City / town**	**One line description**	**Is air quality influenced by Highways England roads?**	**Level of exceedance (maximum monitored/modelled concentration at a location of relevant exposure)**		**Action plan**		
						At declaration	**Now**	**Name**	**Date of publication**	**Link**
Whitby Road / Station Road	May-05	NO_2 annual mean	Ellesmere Port	Residential properties on parts of Whitby Rd, Station Rd and Princes Rd	No	44.5µg/m^3 (micrograms per cubic metre)	36µg/m^3	Ellesmere Port and Neston BC air quality action plan	2007	www.cheshirewestandchester.gov.uk/aqmanagement
Chester city centre	May-17	NO_2 annual mean	Chester	Inner ring road and sections of Liverpool Rd, Parkgate Rd, Hoole Way, Boughton gyratory and Watergate St	No	49.2µg/m^3	48.5µg/m^3	Chester city centre air quality action plan	Due to be completed in 2018	
Fluin Lane	Nov-15	NO_2 annual mean	Frodsham	Junction of A56 and Fluin La.	No	42.6µg/m^3	40.5µg/m^3	Frodsham air quality action plan	2018	
Thornton-le-Moors	Sep-16	SO_2 15-minute mean	Thornton-le-Moors	An area around the oil refinery at Stanlow	No	56 exceedances	36 exceedances	Thornton-le-Moors air quality action plan (draft)	2018	

☒ The Council confirms that the information on UK-Air regarding our AQMAs is up to date

2.2 Progress and impact of measures to address air quality in Cheshire West and Chester

The Council has taken forward a number of measures during the current reporting year of 2017 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.

More detail on some of these measures can be found in their respective action plans. Key completed measures are:

- The main LES document was developed in 2016-17 and went out to both internal and external consultation in early 2018. A post-consultation options appraisal on implementation of LES measures has also been produced. It is anticipated that the broad range of measures contained in the LES will deliver significant improvements in local air quality over time
- As noted in the 2017 ASR, a supplementary planning document on parking standards has been produced. This includes minimum specifications for the provision of on-site electric vehicle charging infrastructure in new developments. Full adoption of these requirements is dependent on production of the Local Plan (Part Two) which is currently out for examination pending approval later in 2018
- An electric vehicle charging point feasibility study undertaken by the Council's partner organisation Qwest, has progressed well and is due to be completed in the summer
- The borough-wide 20mph speed limit programme is progressing well with the third year of a four-year programme due to commence in the summer of 2018
- The oil refinery operator can now access SO_2 monitoring data from Thornton-le-Moors in near real-time via a website link
- A number of cycling and walking promotion initiatives are ongoing
- Consultation phases of the AQAPs for both Thornton-le-Moors and Frodsham have been completed and the reports submitted to Defra for approval

The Council expects the following measures to be completed over the course of the next reporting year:

- Implementation of the parking standards SPD requirements for electric vehicle infrastructure in new developments via the planning system. This is intended to encourage the adoption of ultra-low emission vehicles across the borough
- Implementation of a series of the raft of measures detailed in the options appraisal for the LES
- Finalisation of the feasibility study referred to above and commencement with the rollout of a programme of electric vehicle charging infrastructure across a range of sectors
- Completion of bus retrofitting work associated with the allotted CVTF award. This will improve bus emissions on a key, frequent bus service running through the Chester AQMA
- Implementation of anti-idling enforcement programme to tackle emissions from idling vehicles
- Finalisation of the AQAP for Thornton-le-Moors and completion of the de-SOx additive trial at the refinery site. Work on the sulphur recovery units at the refinery which will allow isolation of operation of the paired units for maintenance purposes thereby reducing emissions
- Development of the Council's replacement air quality website providing public access to monitoring data and reports

Cheshire West and Chester Council's priorities for the coming year are:

- Local air quality management obligations as set out above
- Publication of the LES and progress with identified measures
- Appointment of an LES officer
- Development of the AQAP for Chester city centre

- To enhance the availability of electric vehicle charging infrastructure across the borough
- Review the status of the AQAP in Ellesmere Port
- Commencement of the local smoke control area study
- To apply for and take advantage of funding opportunities that will enable the introduction of air quality improvement measures
- To produce the 2019 annual status report

The principal challenges and barriers to implementation that the Council anticipates are: the continued failure of vehicle emission standards to deliver real-world reductions in tailpipe emissions; an increased market share in diesel vehicles in recent years; vehicle idling practices; slow uptake of ultra- low emission vehicles; environmental permitting regime for industrial sources.

Defra's appraisal of last year's ASR concluded that, "The report is well structured, detailed, and provides the information specified in the Guidance. The Council will continue with a positive approach in responding to the current levels of exceedances of air quality objectives within the district." The main points for action were:

- The development of an air quality action plan for Chester City is scheduled for 2018. This should consider a re-evaluation of the source apportionment, identification of pollution hotspots, and quantification of the degree of emissions reductions required in order to meet air quality objectives, as a basis for developing a targeted set of measures for this area
- A key action is the final stages in development of the Low Emission Strategy, scheduled for 2018
- The latest monitoring has identified a single exceedance outside of the extended AQMA in Chester, and should be subject to further investigation to establish the nature and extent of the exceedance

- There have been no recent exceedances within the Ellesmere Port AQMA, thus the status of this AQMA should be reviewed to determine whether it is appropriate to be considered for revocation.

Addressing each of these points in turn:

- Production of the AQAP for Chester has been delayed but, following completion of this ASR and completion of the Low Emission Strategy, the work is being prioritised with the aim of finalising the AQAP by November 2018
- Work has progressed with the Low Emission Strategy through 2017 and early 2018, including a full public consultation exercise. The strategy is now due to be adopted and published later in the summer 2018
- Further investigations were carried out in Christleton and it has been determined that an AQMA is not required to be declared. Details of the investigations are presented in section 3.2.1 and appendix C
- Monitored NO_2 concentrations in the Ellesmere Port AQMA were all below the annual objective in 2017 so the status of this AQMA will now be reviewed to determine whether revocation as appropriate.

Whilst the measures stated above and in Table 2 will help to contribute towards compliance, the Council anticipates that further additional measures not yet prescribed will be required in subsequent years to achieve compliance and enable the revocation of Chester city centre AQMA.

Table 2 Progress on measures to improve air quality

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
1	Low emissions strategy	Policy guidance and development control	Low emissions strategy	The Council	2014 - 15	2015 -18	Adoption of strategy and implementation of measures	Borough wide reduced vehicle emissions	Draft report produced. Public consultation completed	2018	Post-consultation redraft complete. Internal delay on revision. Adoption of final LES due autumn 2018. Numerous mitigation measures included
2	Supplementary planning document (SPD) on parking standards	Policy guidance and development control	Air quality planning and policy guidance	The Council	2014	2015-17	EV charging conditions included in planning permissions	Reduced vehicle emissions	SPD complete. Local Plan part two pending	Complete	Local plan part two under examination 2018. Adoption due late 2018 / early 2019.
3	Park and ride contract renewal	Alternatives to private vehicle use	Bus based park and ride	The Council	2014 - 15	2016-21	Upgrade of buses from Euro IV to Euro VI	Reduced vehicle emissions	Contract awarded to Stagecoach. Second bid for Low Emission Bus Scheme (LEBS) funding submitted 2017	Complete	Second LEBS bid for EV buses unsuccessful
4	Park and ride. New infrastructure at Boughton Heath and Sealand Rd	Alternatives to private vehicle use	Bus based park and ride	The Council	2017 / 2018	2018 and beyond phased stages	Upgrade of existing park and ride waiting facilities to include toilets	Chester-wide reduction of vehicle emissions	Due to go out to tender summer 2018	2018 and beyond phased stages	Enhanced waiting facilities, providing a gateway to park and ride in Chester. Potential for link to EV charging rollout (see measure 5)
5	Ultra low emission vehicles accelerator	Promoting low emission transport	Procuring alternative refuelling infrastructure to promote low emission vehicles, EV recharging, gas fuel recharging	The Council	2017 / 2018	2017/18 to 2022/23	Installation of infrastructure	Borough wide reduced vehicle emissions	Feasibility study being conducted by Qwest, partner organisation. Workshops, meetings and draft reports done. Final report due summer 2018	2018 / 2019 main project delivered with ongoing support up to 2022 / 2023	Commission EV infrastructure feasibility study, awareness campaign, capital investment in electric vehicle charging infrastructure

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
6	Clean vehicle technology fund (cvtf) for eight bus engine retrofits	Vehicle fleet efficiency	Vehicle retrofitting programmes	The Council	2014	2015 / 2016 / 2018	Services in operation in Chester	Reduced emissions on services running though Chester AQMA	Four buses upgraded: two Stagecoach and two Arrowebrook	2018	Three further retrofits will be carried out in 2018/19. Defra confirmed underspend may fund additional buses (no need for emissions tests as accreditation available). 2017 CBTF bid for an extra 21 retrofits unsuccessful - eligibility criteria unclear
7	Secure cycle storage	Transport planning and infrastructure	Cycle network	The Council	2009 – 2010 and ongoing	2011-17	Increase in number cyclists.	Chester and Ellesmere Port AQMA	Complete – storage installed at Chester city centre and park and ride sites, Ellesmere Port town centre and selected railway stations.	2016 complete (and on-going, subject to future funding applications being successful)	Local sustainable transport fund (LSTF) (2011-15) and (LSTF) 2015-16 utilised. Transition year sustainable travel fund bid (2016 -17) unsuccessful. Access fund three-year bid (2017-20) unsuccessful
8	Bikeability campaign (schools and adults only schemes	Promoting travel alternatives	Promotion of cycling	The Council	Annual	Ongoing	Increase in number cyclists.	Training is delivered borough wide. Benefits for all AQMAs	Ongoing. Subject to annual project review	Ongoing	DfT / Council funded programmes ongoing – road safety team. LSTF schemes complete.
9	Let's bike	Promoting travel alternatives	Promotion of cycling	The Council	Annual	Ongoing	Increase in number cyclists.	Training delivered borough-wide. Benefits for all AQMAs	Ongoing. Subject to annual project review	Ongoing	Off-road cycle proficiency training course. Road safety team
10	Let's walk	Promoting travel alternatives	Promotion of walking	The Council	Annual	Ongoing	Improve pedestrian confidence to encourage more sustainable trips	Training is delivered borough-wide. Benefits for all AQMAs	Ongoing. Subject to annual project review	Ongoing	Child training promotes independence

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
11	Schools crossing patrols	Promoting travel alternatives	Promotion of walking	The Council	Annual	Ongoing	Improve pedestrian confidence to encourage more sustainable trips	Yes, borough-wide. Provided at hazardous school crossing points	Ongoing. Subject to annual project review	Ongoing	Supporting vulnerable road users cross the highway – when arriving and leaving educational establishments
12	Anti-idling enforcement	Traffic management	Anti-idling enforcement	The Council	2018	2018-20	Reduction of idling frequency and complaints	Borough-wide reduced vehicle emissions	Signs erected at bus stands and taxi ranks	Ongoing	Included as measure in LES. To be pursued 2018. LES finalisation.
13	Taxi and private hire age policy	Promoting low emission transport	Taxi licensing conditions	The Council	2012	2013-14	Entry and exit ages of vehicles enforced	Borough-wide reduced vehicle emissions	Complete January 2017	Complete	Transition period ended 2016. Age policy fully implemented. Potential to incentivise use of ultra low emission vehicles via LES
14	Improved park and ride signage on strategic road network (M53, M56 and A55	Alternatives to private vehicle use	Bus based Park and Ride	Highways England in partnership with the Council	2016-17	2017-18	Increase in park and ride passengers, reduce number of private single occupancy vehicles in the city centre	Reduced vehicle emissions in Chester	Complete June 2017	Complete	Provides enhanced static signage and potential variable message signs at slip roads.
15	Highway cycle improvement scheme at M53 Junction nine	Transport planning and infrastructure	Cycle network	Highways England in partnership with the Council	2016 -17	2017-18 to be constructed	Reduce traffic between the E. Port waterfront developments and town centre via AQMA.	Reduced vehicle emissions in Ellesmere Port	Detailed design stage	2017-18	Providing crossing points and shared- use footpaths between residential and employment areas and railway station

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
16	Promote sustainable travel through educational establishments and workplaces	Promoting travel alternatives	Promotion of walking	The Council, Cheshire East and Warrington	2016 -17	2017-18 to 2019-20 revenue bid	Reduction in car journeys		Bid submitted	2017-18 to 2019-20	Bid unsuccessful
17	Improved cycling and walking routes	Transport planning and infrastructure	Cycle network	The Council, Cheshire East, Warrington and Local enterprise partnership (local growth fund)	2016 - 2017	2017-18 to 2019-21	Reduction in car journeys	Reduced vehicle emissions	Detailed design stage	2017-18 to 2019-21	Capital bid successful. Enhanced off-road walking and cycling infrastructure in Ellesmere Port and Chester.
18	Chester-Broughton growth corridor – (proposed new road to the west of Chester, England and Wales alignment)	Traffic management	Strategic highway improvements, Re-prioritising road space away from cars, including access management, selective vehicle priority, bus priority, high vehicle occupancy lane	The Council (lead), Welsh government, Flintshire, Wrexham, Transport for the North, Department for Transport	2018-21	TBC	Reduced journey times, improve journey time reliability, congestion relief of the inner ring road, improved access to key employment and housing sites	Reduce congestion in AQMA. Reduced vehicle emissions	New route alignment investigation study commissioned	To be confirmed	Previous Council bid unsuccessful. Improve national, sub-regional and local connectivity; reduce current congestion pinch points, improve network reliance; and opportunities to improve access to employment and housing allocations.

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
19	Wales and borders rail franchise announcement (rail and metro). New and enhanced rail services Improved rail station facilities.	Alternatives to private vehicle use	Rail based park and ride	Welsh Government, rail franchise consortium	Oct-18	15-year contract	Increase in bus and rail passengers reduced number of private single occupancy vehicles. Increase in the number of people walking and cycling.	Reduce congestion in AQMA by private car. Reduced vehicle emissions	New tender Awarded	15 year contract	Station facilities at; Chester, Neston, Helsby and Frodsham to be enhanced. With improved rail services, providing enhanced rail services and journey time compared to private car
20	Chester-Mersey Dee, 'plugging the gap transforming cities fund' bid Improved public transport (bus, coach, rail and park and ride), cycling and walking routes.	Promoting travel alternatives	Other	The Council supported by various private sector companies, transport operators, Cheshire and Warrington LEP and Welsh government	2018	2018/19 - 2021/22	Increase in bus and rail passengers, reduced number of private single occupancy vehicles Increase in the number of people walking and cycling.	Reduce congestion in AQMAs	Bid submitted	2018/19 - 2021/22	Funding bid awaiting outcome
21	Borough-wide parking strategy	Traffic management	Other	The Council	2016-17	2017 Council adopted strategy	Rebalance parking priorities against supply and demand while promoting sustainable transport modes	Reduced vehicle emissions borough wide	Final parking strategy adopted in 2017	2017-32 15-year delivery time frame	Improved off-street enforcement measures. Promote Chester park and ride over other parking offers in Chester. Scope for incentivising EVs

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
22	20mph limits on residential streets (740km)	Traffic management	Reduction of speed limits, 20mph zones	The Council	2015	2016-20	Successful rollout of scheme over four year programme	Reduced vehicle emissions borough wide	Scheme approved January 2016. Rollout commenced late 2016	2020	Promotes smoother driving style. Emissions reduction from diesel vehicles should lead to overall emissions reduction. Third year programme due to commence summer 2018.
23	Smart and integrated ticketing across public transport in the north of England (all rail, tram and bus operators)	Promoting travel alternatives	Other	Transport for the North (TfN), Council lead on behalf of Cheshire and Warrington LEP	2017	2019-23. 2019 – major conurbations bus and light rail. 2020: minor conurbations bus and light rail. 2021: towns and trains. 2022-2023 Full rollout across the north.	Successful rollout of scheme throughout the north of England	Yes, borough-wide.	Policy, processes and back office functionality specified, with consultation	2023 roll-out across the whole of the north of England (including Cheshire West and Chester)	TfN working with the DfT, 19 local authorities, five light rail operators, three train operators and over 400 bus operators.
24	Route and branch public transport review	promoting travel alternatives	Other	The Council	2017	2018 / 2019	Increase in bus passengers, reduce number of private single occupancy vehicles	Reduced vehicle emissions borough wide	2017 Baseline review and bench marking, appraisal and options appraisal	2018 review complete with implementation of preferred options from 2019	Council project lead, working with other LAs, commercial bus operators and other providers.

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
25	Bus lane enforcement in Chester using automatic number plate recognition (ANPR)	Traffic management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, selective vehicle priority, bus priority, high vehicle occupancy lane	The Council	2017	2017 / 2018 Implemented in phased stages (subject to trial phase/period)	Increase in bus passengers, reduce number of private single occupancy vehicles	Chester-wide	Policy review and bench marking for permitted vehicle use in Chester bus lanes	From 2017 / 2018. Implemented in phased stages (subject to trial phase)	Council to review existing policy and benchmark against other LAs prior to writing any new traffic regulation orders for bus lanes.
26	Bus interchange conditions of use	Traffic management	Anti-idling enforcement	The Council	2016	2017 onwards	Compliance with conditions	Reduced vehicle emissions in Chester AQMA	2017: requirement introduced in conditions of use	Ongoing	Drivers must switch off engines unless a departure is imminent
27	Fare-free 'shopper hopper' bus service linking new Chester bus interchange to retail and leisure facilities	Alternatives to private vehicle use	Bus based Park and Ride	The Council	2017	2017 onwards (subject to annual review)	Increase in bus passengers, reduce number of private single occupancy vehicles	Reduced vehicle emissions in Chester AQMA	Ongoing, subject to annual project review	2017 onwards (subject to annual review)	The new bus interchange is located nearer the railway station creating a multi-model hub. The free bus service links the new hub to retail / leisure facilities.
28	Frodsham AQAP. Video survey of the Fluin La and Bears Paw junctions.	Traffic management	UTC, Congestion management, traffic reduction	The Council	Early 2018	Autumn 2018	Measured annual mean NO_2 concentrations in AQMA	Not applicable	Video camera survey arranged for September.	Winter / Spring 2018	The video survey is critical to informing a number of measures and reappraising the modelled assumptions

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
29	Frodsham AQAP. Explore traffic regulation order (TRO) options for height and weight restrictions for HGVs travelling through the AQMA and Church Street.	Traffic management	UTC, Congestion management, traffic reduction	The Council	2018	2018	To be determined	1 µg/m3	Work has started to explore the achievable variations for a TRO for this junction	To be determined	This measure is to further explore the possibility of restricting HGVs on Fluin Lane and or preventing left hand turn from A56 into Fluin Lane on highway safety grounds.
30	Frodsham AQAP. Undertake Bears Paw junction assessment study with view to improve junction efficiency.	Traffic management	UTC, Congestion management, traffic reduction	The Council	2018	2018	Undertake detailed survey of options to improve traffic through flow.	Low	Initial qualitative assessments confirm that widening carriageway is not an option. Junction efficiency may be gained through scrutiny of signals and timings	To be determined	This is in part subject to measure 28 above and assessing the potential to increase green time at Church Street/A56 traffic lights
31	Frodsham AQAP. Origin and destination survey to identify and liaise with commercial users of the route.	Freight and delivery management	Route management plans/ strategic routing strategy for HGVs	The Council	Complete	Autumn 2018	Completion of survey	Yes, along Fluin Lane	Surveys can be costed from the B5152 and B5153 to determine which companies are using Church Street and Fluin Lane so they can be targeted.	End of 2018	This measure will use an origin and destination survey to enable targeting of specific companies using Fluin Lane on a frequent basis and will feed into the awareness raising measure.

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
32	Thornton-le-Moors AQAP Remove sulphur compounds in process	Environmental permits	Measures to reduce pollution through IPPC permits going beyond BAT	Essar refinery	2017	2018 to be confirmed	SO_2 measured at CCU stack	Reduction in 15- min exceedances to less than 35 per year. Potential air quality benefit is thought to be medium (in the range of 25-40%)	Trial in progress	2018 (TBC)	Essar are carrying out a trial of a 'de-SOx' additive on the catalytic cracking unit.
33	Thornton-le-Moors AQAP. Schedule maintenance / repair on sulphur critical plant to suit the weather	Environmental permits	Other	Essar refinery	Ongoing	Ongoing	SO_2 measured at local AQ monitoring stations	Negligible	Measure in use	Ongoing	Essar uses weather data to plan activities.
34	Thornton-le-Moors AQAP. Isolation of sulphur recovery units (SRU) to allow independent operation	Environmental permits	Other	Essar refinery	2017	Q1 2018	Sour gas flaring	Negligible	To be installed in 2018 turnaround (TA)	Q1 2018	This allows one SRU to be shut down for maintenance while keeping the other online.
35	Thornton-le-Moors AQAP. Fuel gas scrubbing and fuel substitution	Environmental permits	Other	Essar refinery	2017	Q1 2018	Sulphur content in refinery fuel gas	Negligible	To be installed in 2018 TA	Q1 2018	Essar are investing in additional fuel gas desulphurisation. Natural gas supply to boilers has already been introduced

Measure number	Measure	EU category	EU classification	Organisations involved and funding source	Planning phase	Implementation phase	Key performance indicator	Reduction in pollutant / emission from measure	Progress to date	Estimated / actual completion date	Comments / barriers to implementation
36	Thornton-le-Moors. Address fugitive emissions	Environmental permits	Other	Essar	Ongoing	Ongoing	SO2 measured at local AQ monitoring stations	Negligible	Medium pressure (MP) superheater to be replaced in 2018 TA	Q1 2018	Fugitive emissions are addressed as they are identified, e.g. MP superheater will be replaced as it is approaching end of life.
37	Thornton-le-Moors AQAP. Air quality monitoring	Public information	Via the Internet	The Council	Ongoing	Ongoing	Real-time data published on website	Nil	Ongoing	Ongoing	Results published on CWAC website, updated hourly. Currently posted daily due to system fault. Replacement system to be commissioned 2018
38	Thornton-le-Moors AQAP. Real-time data provision to operator (with trigger capability)	Public information	Via the Internet	The Council / Essar	Q3 2017	October – December 2017	Establishment of data sharing	Negligible	Trial from June to August 2017	Fully implemented Jan 2018	Trial completed. Supports measure 33 above. Further monitoring station (Elton) to be added to trial

2.3 $PM_{2.5}$ – Local authority approach to reducing emissions and/or concentrations

As detailed in policy guidance LAQM.PG16 (Chapter 7), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases. Based on national estimates, the public health outcomes framework indicates that the fraction of mortality attributable to particulate matter in Cheshire West and Chester is 5.2% which is equivalent to some 161 premature deaths. This figure rises to 285 per year when the effects of NO_2 are taken into account. Reductions in air pollution can therefore deliver significant improvements in local health outcomes.

The Council does not monitor $PM_{2.5}$ as it is not currently a requirement of LAQM. However, PM_{10} (particulate matter with an aerodynamic diameter of 10µm (micrometres) or less) is recorded at three monitoring stations in the borough and, as $PM_{2.5}$ is a subset of PM_{10}, it is possible to estimate the probable local levels by considering the ratio of the two fractions of particulate matter, as detailed in the technical guidance LAQM.TG16. Applying the nationally derived correction ratio of 0.7 to local data suggests that local $PM_{2.5}$ levels at background sites lie in the range 8.4 to 14.7$\mu g/m^3$ (micrograms per cubic metre), which is well below the national annual mean objective of 25$\mu g/m^3$ (to be met by 2020). In recognition of the close association between particulates and health, these figures may be used as a benchmark against which to gauge local improvements over time. There is an EU target value of 15% reduction at background urban locations between 2010 and 2020. Although this is not a requirement placed on local authorities, our long-term PM_{10} monitoring suggests that there has been a reduction of 14% in $PM_{2.5}$ between 2010 and 2017, which is on course to achieve the target.

National policy guidance assumes that local authorities will consider how to address $PM_{2.5}$ alongside other pollutants and that few standalone $PM_{2.5}$ measures will need to be chosen unless they are needed to address a very specific local problem. So action to reduce PM_{10} and NO_2 would usually contribute to the reductions in $PM_{2.5}$. The Council is not, therefore, expected to be required to carry out additional local review and assessment (including monitoring).

The Council is taking the following measures to address $PM_{2.5}$: Measures listed in Table 2 above will contribute in general to improvements in levels of $PM_{2.5}$. A significant amount of effort has been made to produce a low emission strategy (LES) for the Borough which will tackle NO_2, PM_{10} and $PM_{2.5}$. It is focused on reducing emissions from road vehicles and supporting more sustainable modes of transport with the ambition of improving the health of residents and reducing the number of deaths that arise every year attributable to poor air quality. The action toolbox, Table A.1 in LAQM.TG16 lists a range of measures that can be implemented to tackle $PM_{2.5}$ and many of these are incorporated into the draft LES. Examples include:

- Smoke control areas are in place in a number of the Borough's urban areas and the LES includes a measure focused on exploring the feasibility of expanding SCAs and publicising health concerns related to domestic burning. A local study of SCAs and health impacts will be commenced in 2018
- The Council has a policy to reduce speed limits from 30mph to 20mph on residential roads, particularly around schools, one of the benefits of which is to reduce emissions through the encouragement of smoother driving styles.
- A reduction in vehicle idling will deliver an immediate improvement in air quality throughout the borough but particularly in urban centres where there is a high concentration of vehicles. The LES includes a measure for the Council to use powers available to it to control idling.
- The hackney carriage / private hire vehicle age policy contained within the Council's licensing policy ensures vehicles entering the system must be under five years old and will not be licensed after they have reached 10 years old; or 15 years old in the case of wheelchair accessible vehicles. In the Chester AQMA, all hackney carriages must be new at first registration. This rolling programme delivers a gradual improvement in vehicle emission standards over time. In order to further enhance this, the LES includes a measure looking at the incentivisation for the adoption of ULEVs in the taxi and private hire fleets.

The Environmental Protection team has a close working relationship with the Director of Public Health and will continue to work collaboratively to determine how air quality can be prioritised across a wide range of policy areas as well identifying specific measures to address $PM_{2.5}$.

3 Air quality monitoring data and comparison with air quality objectives and national compliance

3.1 Summary of monitoring undertaken

This section sets out what monitoring has taken place and how it compares with national objectives.

3.1.1 Automatic monitoring sites

The Council undertook automatic (continuous) monitoring at seven sites during 2017. In May 2017 a new continuous monitoring station was commissioned close to the new Chester bus interchange development. Table 5, Appendix A shows the details of all automatic monitoring sites.

NO_2, NO (nitric oxide) and NOx (oxides of nitrogen) were measured using chemiluminescent analysers at five sites. These comprise three roadside sites: the newly established site (CBI) at the bus interchange in Chester and the roadside sites at Boughton in Chester and Whitby Road in Ellesmere Port (BO and WH); and the two background sites in Frodsham and Thornton-le-Moors (FMH and TLP). NO_2 was also monitored at roof-top level using the Opsis differential optical absorption spectrometer (DOAS) system at the Ellesmere Port urban background site (LR-JG).

Sulphur dioxide (SO_2) was measured using UV fluorescence at monitoring stations in Elton (ELT), Frodsham FMH, Thornton-le-Moors (TLP), and also in Ellesmere Port (LR-JG) using DOAS, as above.

PM_{10} was measured at four sites; two of which, Frodsham (FMH) and Ellesmere Port (LR-JG), use tapered element oscillating microbalances (TEOMs), and two of which, Thornton-le-Moors (TLP) and CBI employ beta attenuation monitors (BAMs).

Note: local authorities do not have to report annually on the following pollutants: 1,3 butadiene, benzene, carbon monoxide and lead, unless local circumstances indicate there is a problem. These pollutants were assessed in detail in earlier rounds of LAQM and it was concluded that there would be no need to declare AQMAs for them. National monitoring results are available at https://uk-air.defra.gov.uk/ , although there are no national network sites actually within the borough of Cheshire West and Chester.

Maps showing the location of the monitoring sites are provided in Appendix D: Maps of monitoring locations and AQMAs. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

3.1.2 Non-automatic monitoring sites

The Council undertook non- automatic (passive) monitoring of NO_2 at 69 sites during 2017. Table 6, Appendix A shows the details of these sites. Of the suite of tube sites in use during the 2016 calendar year, one NO_2 diffusion tube site was discontinued and 17 new sites were established during 2017. Three of the new sites are positioned at residential receptors in Christleton close to the A41. These were established to investigate the nature and extent of a potential exceedance recorded in last year's ASR. A further three were established in and around the new bus interchange that opened in May 2017, and two were established close to the junction between the A41, A55, Caldy Valley Road and Whitchurch Road in Boughton. Site TA, on the A51 in Littleton, was re-established following discussions with a local Councillor.

Maps showing the location of the monitoring sites are provided in Appendix D.

All tubes are prepared and analysed by Gradko International Ltd. Gradko's performance in the 'AIR-PT' NO_2 proficiency testing scheme scored 100% satisfactory rating for all rounds in 2017. Further details on quality assurance/quality control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (for example, annualisation and/or distance correction), are included in Appendix C.

3.2 Individual pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, annualisation (in instances where the period of monitoring was less than nine months) and distance correction. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen dioxide (NO_2)

Table 7 in Appendix A compares the ratified and adjusted monitored NO_2 annual mean concentrations for the past five years with the air quality objective of 40µg/m^3.

Note, results in this table show the levels of NO_2 at the point of monitoring and do not take account of distance to relevant receptors.

For diffusion tubes, the full 2017 dataset of monthly mean values, including distance corrections, is provided in Appendix B (Table 12).

Diffusion tubes are collocated with the automatic stations at Boughton, Chester (BO); the bus interchange in Chester (CBI) and Whitby Road, Ellesmere Port (WH). The latter is a triplicate set, the results from which are submitted to Defra annually to contribute to the calculation of national bias adjustment factors.

In 2017, NO_2 at the real-time monitoring station CBI was 40μg/m^3 and at WH in Ellesmere Port it was 36μg/m^3. Results for all other automatic monitoring stations were comfortably below the annual objective. It should be noted, however, that real-time monitoring stations are not necessarily in worst-case locations because of siting constraints.

Exceedances of the annual mean objective were recorded at a number of relevant locations on 2017, all of which lie within existing AQMAs. As no exceedances were recorded outside of AQMAs, there is no need to declare or extend AQMAs. As noted in last year's ASR, a potential exceedance was identified on the A41 in Christleton (site MCC). In 2017, results from this diffusion tube site and the three newly established tubes (CM, CP3 and W23) were below the national objective (39.5μg/m^3, 30.8μg/m^3 27.5μg/m^3 and 27μg/m^3 respectively). Although the result for MCC is close to the objective, it is not exceeding and, in light of the level of monitoring results for previous years, it was concluded during discussions with the LAQM helpdesk that it would not be necessary to move to declaration of an AQMA at this time. The location will, however, be kept under review.

In 2017, 15 sites were above the annual objective and a further 14 were within 10% of this figure.

Table 8, in Appendix A, compares the ratified continuous monitored NO_2 hourly mean concentrations for the past five years with the air quality objective of 200μg/m^3 (not to be exceeded more than 18 times per year). No exceedances of the hourly mean have been recorded in 2017. As stated in the LAQM.TG16 technical guidance, annual mean results from diffusion tubes may indicate a likely exceedance of the hourly objective if the annual mean is over 60μg/m^3. In 2017 no diffusion tube results were above 60$\mu g/m^3$ (the highest being 48.9$\mu g/m^3$ at a relevant receptor) so it is highly unlikely that the hourly objective is exceeded anywhere in the borough.

Long term trends of NO_2 monitoring results are shown in the graphs Figure 1 to Figure 4. For the majority of sites there is a discernible downwards trend reflecting general improvements in NO_2 concentrations over time. It is also clear from comparison of the graphs that the sites with the highest NO_2 are all in Chester. [Note: the data shown in these graphs has been bias adjusted and annualised where necessary, but hasn't been corrected for distance from kerb.]

A time series graph of local NO_2 monitoring compared with that from the national automatic urban and rural network (AURN) site is shown in Figure 23.

Diffusion tubes were deployed at 69 locations across the borough in 2017. The majority of these, 52, are within the Chester, Ellesmere Port and Frodsham AQMAs. Results presented in Table 12 in Appendix B have been annualised (where necessary), adjusted for bias using Defra's national factor, and corrected for distance to relevant exposure (where necessary). The full dataset of monthly averages for 2017 is also displayed. Details of quality control and any adjustments that have been applied are given in Appendix C.

As discussed above, there were no recorded annual means in excess of 60$\mu g/m^3$ at any of the diffusion tube monitoring locations and it is therefore unlikely that there were any exceedances of the hourly mean objective at any of these sites in 2017. After distance correction, eight tubes were above the annual objective of 40$\mu g/m^3$, although all were below 50$\mu g/m^3$.

Diffusion tube levels, as a whole, when compared to 2016 results, are generally slightly lower. Following distance correction, in 2016, 12 tubes were above the objective and a further 12 were within 10% of it following distance correction, compared to eight above the objective and ten within 10% in 2017.

All eight sites that exceeded the annual objective in 2017 are within the extended Chester AQMA declared in May 2017: C11, C36, CBI, OW, PG, RM, T6 and WG. All the remaining sites across the borough, including those within the Ellesmere Port and Frodsham AQMAs, were below the objective. This also includes site MCC on the A41 in Christleton which returned an annual mean of 39.5$\mu g/m^3$. Traffic standing at temporary traffic lights immediately adjacent to this tube location was present more frequently between April and October 2017 due to emergency roadworks. As noted above, discussions with the LAQM Helpdesk concluded that it is not necessary to move to declaration of an AQMA for this location at this time.

Several sites across the borough achieved compliance with the objective level only after application of bias adjustment and/or distance correction, and ten sites were within 10% of the objective following these corrections.Of these ten, seven were within the Chester AQMA (BE, BJ, LVS, NIN, OB, SA and UN), two were within the Frodsham AQMA (FH and FJ) and the last is the one at MCC, discussed previously. None of the tubes within the Ellesmere Port AQMA either exceeded the objective nor were within 10% of it. The highest level within this AQMA was 34.3μg/m^3 recorded at SR. The status of the Ellesmere Port AQMA is intended to be reviewed during 2018.

Of the 17 new sites established in 2017, only CBI, located within the footprint of Chester's new bus interchange that opened in May 2017, exceeded the national objective. This site is already within the Chester AQMA. Of the other 16, none were within 10% of the objective.

Monitoring locations adjacent to the M6 motorway in Allostock returned annual results of 28.3μg/m^3 at site AP (southbound) and 17.7μg/m^3 at site AHH (northbound). Works to transform the M6 into a 'smart motorway' along this stretch, with the intended introduction of regular traffic onto the hard shoulders, thus reducing the distance to the receptors at both locations, had not been completed by the end of the year.

3.2.2 Particulate matter (PM_{10})

Table 9 in Appendix A compares the ratified and adjusted PM_{10} annual mean concentrations for the past five years with the air quality objective of 40µg/m^3. In 2017, PM_{10} was below the annual mean objective at all sites. It has not therefore been necessary to declare any AQMAs in respect of PM_{10}. The result for the newly established roadside site, CBI (sited within an AQMA), at the bus interchange in Chester was significantly higher than the background sites. However, the annual mean of 21μg/m^3 is still well below the objective of 40μg/m^3. With the exception of the LR monitoring station, all data has been independently ratified.

Table 10 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past five years with the air quality objective of 50µg/m^3, not to be exceeded more than 35 times per year. The 24-hour mean objective was not exceeded at any monitoring station in the borough during 2017.

Long term trends in annual PM_{10} monitoring are shown in Figure 5. It can be seen that there is a general downwards trend in PM_{10} concentrations over time. Figure 6 shows the number of exceedances of the 24-hour mean objective since 2012. Although the number of exceedances is low, and has generally reduced over time, there were eight such occurrences at the new CBI monitoring station in 2017. However, as the monitoring station was operational prior to completion of the bus interchange, the majority of these were associted with construction activities in the vicinity.

A time series graph of local PM_{10} monitoring compared with that from the national AURN network site is shown in Figure 24. The elevated readings at the bus interchange site are readily discernible in the plot.

3.2.3 Particulate matter ($PM_{2.5}$)

The Council does not monitor $PM_{2.5}$ as it is not currently a requirement of LAQM. However, as $PM_{2.5}$ is a constituent fraction of PM_{10}, it is possible to estimate the probable local levels by considering the ratio of the two fractions of particulate matter, as detailed in the technical guidance LAQM.TG16. Applying the nationally derived correction ratio of 0.7 to local PM_{10} data suggests that local $PM_{2.5}$ levels at background sites lie in the range 8.4 to 14.7, which is well below the national annual mean objective of 25µg/m^3.

3.2.4 Sulphur dioxide (SO_2)

Table 11 in Appendix A compares the ratified, automatically monitored SO_2 concentrations for 2017 with the three health-based air quality objectives for SO_2.

In 2017 there were 36 occasions, spread over 14 days, when the 15-minute obbjective of 266µg/m^3 was exceeded in the village of Thornton-le-Moors (monitoring site TLP), and nine such occasions (over three days) in the village of Elton (monitoring site ELT). The objective allows for 35 exceedances in a calendar year so this remains non-compliant in Thornton-le-Moors. TLP lies within the AQMA and ELT is outside, less than a kilometre from the eastern edge of the AQMA.

The hourly mean standard was exceeded just once in Thornton-le-Moors and not at all in other monitoring stations. As there is an annual exceedance allowance of 24 hourly periods, the objective was not exceeded.

The 24-hour standard was complied with at all monitoring stations during 2017.

Figure 7 shows long term trends in SO_2 using the 99.9th percentile values for each monitoring station. Since the last ASR, SO_2 monitoring has ceased at Frodsham (FMH). The graph also shows data for two other former monitoring stations (HE, SG), the details for which can be found in the 2015 updating and screening assessment. For most sites the monitoring period has not been long enough to determine an overall trend. However, at LR-JG in Ellesmere Port, the 99.9th percentiles have remained relatively static over time and are comfortably below the national objective. Unlike other local real-time monitoring stations, data for LR-JG is unratified and therefore has provisional status.

Figure 25 shows how local monitoring sites compare with regional AURN sites. The scale and frequency of SO_2 readings at Thornton-le-Moors and Elton contrast notably with other monitoring sites in the region, reflecting their industrial nature.

4 Planning application review

The land-use planning system is recognised to play an integral part in improving air quality. This requires close co-operation between the Planning department and environmental protection officers.

The Council's Environmental Protection team regularly reviews applications with respect to potential air quality and other environmental impacts.

The annual status report provides an opportunity to keep a record of such applications to provide a picture of where changes in air quality may occur in the future. The information presented is also useful to identify where combined impacts of several developments may become important.

It should be noted that the Council adopted a parking standards supplementary planning document (SPD) in March 2017, and that in accordance with this Environmental Protection regularly recommends conditions requiring that electric vehicle recharging points be installed for all new residential developments (houses or flats) where dedicated off-road parking is provided, and new or amended commercial developments that propose ten or more new parking spaces. Conditions requiring electric vehicle charging points were included by planning officers in approximately half of cases they were recommended, although of these, the vast majority (>75%) were non-residential applications. A selection of permitted developments for which the Environmental Protection team suggested provision of electric vehicle charging points are shown in Table 3.

In addition, several applications required submission of formal air quality assessments, either for the impact of that development on human health, or by introducing new receptors within an AQMA. These are listed in Table 4.

Conditions requiring control of dust during demolition and construction phases of approved development are also regularly recommended and are almost always included by planning officers. Due to the large number of applications that this applies to, these have not been listed.

Table 3 Selected planning applications with EV charging points recommended

Planning reference	Description	Type	Comments	Status
17/00952/FUL	Development of truck and vehicle stop facility on A41, Broxton	Full application	Provision of two EV charging points recommended, included by Planning	Approved
17/01257/FUL	Development of ten dwellings, Milton Green	Full application	Provision of one EV charging point per dwelling recommended, not included by Planning	Approved
17/01588/FUL	Development of five apartments, Chester	Full application	Provision of at least one EV charging point recommended, not included by Planning	Approved
17/01676/FUL	Development of one dwelling following demolition of existing, Chester	Full application	Provision of one EV charging point recommended, not included by Planning	Approved
17/02313/FUL	Development of five light industrial units, Ellesmere Port	Full application	Provision of one EV charging point recommended, included by Planning	Approved
17/02413/FUL	Redevelopment of petrol filling station, Whitley	Full application	Provision of one EV charging point recommended, condition requiring investigation of suitability of electrical supply for such included by Planning	Approved
17/02442/FUL	Development of one dwelling, Lostock Gralam	Full application	Provision of one EV charging point recommended, not included by Planning	Approved
17/02582/OUT	Development of 20,000m^2 commercial/industrial unit	Outline application	Provision of at least one EV charging point recommended, included by Planning	Approved
17/02583/OUT	Development of 6,000m^2 commercial/industrial units	Outline application	Provision of at least one EV charging point recommended, included by Planning	Approved
17/02851/FUL	Development to extend existing car park by 75 spaces, Neston	Full application	Provision of at least three EV charging points recommended, included by Planning	Approved
17/03110/FUL	Development of two dwellings, Wincham	Full application	Provision of one EV charging point per dwelling recommended, not included by Planning	Approved
17/03993/FUL	Development of five apartments, Northwich	Full application	Provision of one EV charging point per dwelling recommended, included by Planning	Approved
17/05047/FUL	Development of one dwelling following demolition of existing, Barrow	Full application	Provision of one EV charging point recommended, not included by Planning	Approved

Table 4 Other planning applications with air quality considerations

Planning Reference	Description	Type	Comments	Status
17/00246/WAS	Erection of biomass plant and control room, Ellesmere Port	Waste application	Recommended refusal due, in part, to a lack of information on air quality	Awaiting decision
17/01211/FUL	Extensions and conversion of existing Public House to 15 self-contained flats and installation of biomass boiler , Ellesmere Port	Full application	Recommended refusal due to location within a smoke control area	Withdrawn
17/01678/S73	Variation to increase height of the stack from 20m to 33m at Tata Chemicals, Lostock Gralam	Variation application	Revised air quality assessment submitted with all sources and receptors included. No objection on air quality grounds. Conditions suggested regarding annual limits on amount of waste processed, and odour	Approved (subsequent application 17/05478/S73 to increase stack to 52m withdrawn)
17/01912/S73	Variation of condition to increase annual operational hours for 32 standby generators to 1,500 hrs per annum at Encirc glass manufacturing facility, Elton	Variation application	Condition included limiting operation to 1,500hrs per annum, and limiting emission rate for NOx to 250mg/m^3 per engine	Approved
17/02173/FUL (linked to 17/02174/FUL below)	Conversion of existing club 20 bedsits/flats and erection of two storey building to rear to create three bedsits/flats, immediately adjacent to Ellesmere Port AQMA	Full application	Air quality assessment predicted no increases of NO_2 levels within AQMA, condition recommended EV charge points (not included by Planning)	Approved
17/02184/FUL (linked to 17/02173/FUL above)	Conversion of existing ground floor space into a food retail outlet, single storey infill extension and internal alterations, immediately adjacent to Ellesmere Port AQMA	Full application	Air quality assessment predicted no increases of NO_2 levels within AQMA, condition recommended EV charge points (not included by Planning)	Approved
17/02400/FUL	Development of nine dwellings, Northwich	Full application	Air quality assessment concluded mechanical ventilation be installed to protect at least one dwelling from NO_2 levels above annual objective level, suggested as a condition	Awaiting decision
17/02453/OUT	Development of 509 dwellings, Chester	Outline application	Awaiting confirmation of suitability of traffic assessment from Highways as this will form the basis of the air quality assessment	Awaiting decision

Planning Reference	Description	Type	Comments	Status
17/03386/FUL	Demolition of existing Stagecoach bus depot and redevelopment of the site for 321 units of purpose-built student accommodation, Chester	Full application	Demolition of bus depot partially within Chester AQMA. Facade of new development also within the AQMA, but AQ assessment demonstrated that closest new receptors would not be subjected to NO_2 levels above annual objective. No objection	Approved
17/04018/FUL	Change of use of restaurant to three ground-floor residences within AQMA, Chester	Full application	Condition suggested requiring non-opening windows and mechanical ventilation, but not included by Planning	Approved
17/04800/FUL	Biomass boiler assisted living development, Northwich	Full application	Air quality assessment demonstrated no breach of national objectives likely. No objection	Awaiting decision
17/03989/OUT	Development of up to 370 dwellings, Sproston, near Middlewich (application site straddles border between Cheshire West and Cheshire East)	Outline application	Majority of existing receptors in Cheshire East: no comments made on potential impacts on Middlewich AQMA. Air quality assessment demonstrates that impact on receptors in Cheshire West likely to be negligible, as is impact on future receptors. Condition recommends EV charge points	Awaiting decision
17/04464/FUL	Change of use to a hotel within AQMA, Chester	Full application	Conditions included requiring no ventilation from facade adjacent to road, and installation of one EV charge point	Approved
17/05201/OUT	Development of up to 1,400 dwellings and facilities, Chester	Outline application	Air quality assessment submitted, no comments yet made	Awaiting decision

Appendix A: Monitoring results

Table 5 Details of automatic monitoring sites

Site code	Site name	Site type	X grid reference	Y grid reference	Pollutants monitored	In AQMA?	Monitoring technique	Distance to relevant exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet height (m)
BO	Boughton	Roadside	341864	366444	NO_2	Yes	Chemiluminescent	25.0	3.0	1.0
CBI	Chester	Roadside	340645	366802	NO_2 PM_{10}	Yes	Chemiluminescent BAM	5.1	6.6	1.6
ELT	Elton	Industrial	345642	375522	SO_2	No	UV-fluorescent	0	not applicable	2.0
FMH	Frodsham	Urban background	352445	378031	NO_2, PM_{10}	No	Chemiluminescent TEOM	24.0	7.0	2.5
LR-JG	Central library	Urban background	340258 339947	376602 375889	NO_2 SO_2 PM_{10}	No	DOAS / TEOM	10.0	not applicable	11.0
WH	Whitby Rd	Roadside	340197	376363	NO_2	Yes	Chemiluminescent	15.0	2.5	3.5
TLP	Thornton-le-Moors	Industrial	344103	374330	NO_2 SO_2 PM_{10}	Yes	Chemiluminescent UV-fluorescent BAM	38.0	not applicable	2.5

Notes:

(1) 0m if the monitoring site is at a location of exposure (for example, installed on the facade of a residential property)

Table 6 Details of non-automatic monitoring sites

Site ID	Site name	Site type	X grid reference	Y grid reference	Pollutants monitored	In AQMA?	Distance to relevant exposure (m) [(1)]	Distance to kerb of nearest road (m) [(2)]	Tube collocated with a continuous analyser?	Height (m)
AHH	Allostock holly	Other	373255	371475	NO_2	No	0	68	No	2
AP	Pine Cottage	Roadside	373386	371500	NO_2	No	0	34	No	1.8
BE	Bedward Row	Roadside	340239	366418	NO_2	Chester	0.5	2.4	No	2.4
BJ	Backpackers / jade	Roadside	341401	366512	NO_2	Chester	0.5	2.5	No	2.4
BO	Boughton RTA	Roadside	341864	366444	NO_2	Chester	25	2	Yes	2.5
BZ	The Bars / Zion Tabernacle	Roadside	341161	366460	NO_2	Chester	0	3.4	No	2.2
C11	11 Christleton Road	Roadside	341915	366427	NO_2	Chester	0	1	No	2
C36	Christleton Road (36)	Roadside	342000	366374	NO_2	Chester	0.5	1.5	No	2.5
C75	Christleton Road (75)	Roadside	342056	366354	NO_2	Chester	0.5	2	No	2.5
CAN	Canal Street	Roadside	340375	366730	NO_2	Chester	1	1.5	No	2.4
CBI	Chester bus interchange	Other	340645	366802	NO_2	Chester	5.1	6.6	Yes	1.6
CFL	Church Street (lower)	Roadside	351762	377862	NO_2	No	4.8	1	No	2.2
CIN	City Road (north)	Roadside	341219	366768	NO_2	No	1.5	3	No	2.5
CIS	City Road (south)	Roadside	341219	366692	NO_2	No	0.5	4	No	2.1
CM	Christleton Mill apartments	Roadside	343761	365528	NO_2	No	0	5	No	2.2
CP3	Canal Place (3)	Roadside	343970	365295	NO_2	No	4	2.3	No	2.4
CVR	Caldy Valley Road	Roadside	342930	365901	NO_2	No	3.5	3	No	2.1
EB	Boughton Edgeley	Roadside	341658	366487	NO_2	Chester	0	2	No	2.5
FGS	Foregate St	Roadside	340859	366388	NO_2	Chester	>50	1	No	2.2

Site ID	Site name	Site type	X grid reference	Y grid reference	Pollutants monitored	In AQMA?	Distance to relevant exposure (m) [(1)]	Distance to kerb of nearest road (m) [(2)]	Tube collocated with a continuous analyser?	Height (m)
FH	High Street (72)	Roadside	352146	378139	NO_2	Frodsham	0.2	2	No	2.5
FJ	Fluin junction	Roadside	352171	378140	NO_2	Frodsham	0.5	2	No	2.5
FM	Fluin La (Manor Farm)	Roadside	352189	378094	NO_2	Frodsham	0.3	2	No	2.5
FT	Fluin Lane (terrace)	Roadside	352176	378105	NO_2	Frodsham	0.2	1.7	No	2
GE	George Street (S)	Roadside	340657	366730	NO_2	Chester	1	5	No	2.4
GI	St Giles	Roadside	341951	366396	NO_2	Chester	3	3	No	2.5
GSW	Gorse Stacks	Roadside	340700	366687	NO_2	Chester	1	1.6	No	2.1
GT	George Street (10)	Roadside	340611	366747	NO_2	Chester	0	1.9	No	2.6
HB	Hoole Lane - Boughton	Roadside	341605	366527	NO_2	Chester	3	1.2	No	2.4
HW	Hoole Way	Roadside	340881	366826	NO_2	Chester	1	1.9	No	2.4
IC	Ingham Close	Roadside	342068	366332	NO_2	Chester	2	2	No	2
KR	King St. Rudheath	Roadside	368432	372988	NO_2	No	4.5	2.2	No	2
LH	Lincoln House	Roadside	341126	366540	NO_2	Chester	3	2	No	3
LI2	Liverpool Road	Roadside	340354	367034	NO_2	Chester	7	2.5	No	2.2
LU	Lumley Place	Roadside	340838	366215	NO_2	Chester	0	9.4	No	2.1
LVR	Love St residential	Roadside	340980	366315	NO_2	Chester	0	1.8	No	2.2
LVS	Love St school	Roadside	340990	366317	NO_2	Chester	8	1.8	No	2.2
MCC	Christleton (Mill Cott)	Roadside	343785	365502	NO_2	No	0.5	2.4	No	2
NIN	Nicholas St (north)	Roadside	340284	366199	NO_2	Chester	0	3	No	2.3

Site ID	Site name	Site type	X grid reference	Y grid reference	Pollutants monitored	In AQMA?	Distance to relevant exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a continuous analyser?	Height (m)
NIS	Nicholas St (south)	Roadside	340329	366114	NO_2	Chester	0	4.3	No	2.2
NS	Newsagent Station Rd	Roadside	340406	376724	NO_2	Ellesmere Port	2	4	No	2
OB	Boughton (105)	Roadside	341633	366510	NO_2	Chester	0.6	2.5	No	2.5
OF	St Oswald’s - fountains	Roadside	340453	366853	NO_2	Chester	11	4.8	No	3
OP	Oulton Place		340636	366770	NO_2	Chester	0	1.6	No	2.1
OW	St Oswald’s Way	Roadside	340623	366823	NO_2	Chester	2.3	2.3	No	2.3
PA	Parkgate Road (19)	Roadside	340313	367014	NO_2	Chester	2.4	0.8	No	2.4
PG	Parkgate Road (5)	Roadside	340322	366989	NO_2	Chester	0.2	1.8	No	2
RM	Rock Mount	Roadside	340291	367108	NO_2	Chester	0	3.8	No	2.2
RR	Richfield Recruitment	Roadside	340180	376338	NO_2	Ellesmere Port	3	2.1	No	2.5
SA	Samaritans	Roadside	340364	366929	NO_2	Chester	0.2	2.5	No	2.5
SF	Station Road flats (Chester)	Roadside	341238	366976	NO_2	No	0	3.2	No	2.2
SM	St Martins Way	Roadside	340224	366599	NO_2	Chester	1.2	2.2	No	2.4
SR	Station Road (Ellesmere Port)	Roadside	340435	376790	NO_2	Ellesmere Port	0	1.6	No	2.5
ST	St Anne's Place	Roadside	340794	366778	NO_2	Chester	18.4	0	No	2.2
SV2	South View Road (lamp-post 2)	Roadside	339836	366620	NO_2	No	0.4	1.5	No	1.9
SV3	South View Road (lamp-post 3)	Roadside	339859	366620	NO_2	No	0.6	1.6	No	2
SZ	Specialized	Roadside	341819	366475	NO_2	Chester	0.5	2	No	2.5
T11	Tarvin Road (11)	Roadside	341931	366458	NO_2	Chester	2.7	1.5	No	2.1

Site ID	Site name	Site type	X grid reference	Y grid reference	Pollutants monitored	In AQMA?	Distance to relevant exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a continuous analyser?	Height (m)
T44	Tarvin Road (44)	Roadside	342085	366446	NO_2	Chester	3.5	1	No	2.5
T6	Tarvin Road (6)	Roadside	341926	366446	NO_2	Chester	0.2	2	No	2
TA	Tarvin Road (Littleton)	Roadside	344519	366898	NO_2	No	7.5	2	No	2
TB	The Bars	Roadside	341202	366470	NO_2	Chester	2	1	No	2.5
TE	Temple Bar, Frodsham Street		340739	366504	NO_2	Chester	0	1.8	No	2
UN	Upper Northgate St (44)	Roadside	340357	366960	NO_2	Chester	0.2	3	No	2.2
W23	Whitchurch Road, Christleton (23)	Roadside	343728.6	365561	NO_2	No	3	5	No	2.5
WCR	Whitchurch Road, Chester (58)	Roadside	342951	366029	NO_2	No	7.2	1.5	No	2
WG	Watergate St	Roadside	340217	366209	NO_2	Chester	0.2	1.5	No	2
WGW	Watergate - walls	Roadside	340165	366198	NO_2	Chester	0	2.2	No	2.2
WH	Whitby Road	Roadside	340196	376363	NO_2	Ellesmere Port	32	1.2	Yes	3.5
WXP	Wrexham Road	Roadside	339641	363499	NO_2	No	>50	8	No	3

Notes:

(1) 0m if the monitoring site is at a location of exposure (for example, installed on/adjacent to the facade of a residential property)

(2) N/A if not applicable.

Table 7 Annual mean NO_2 monitoring results

Site ID	Site type	Monitoring type	Valid data capture for monitoring period (%) [(1)]	Valid data capture 2017 (%) [(2)]	NO_2 Annual mean concentration (µg/m^3) [(3)]				
					2013	2014	2015	2016	2017
WH	Roadside	Automatic	99.4	99.4	**41**	**41**	**40**	**40**	36
LR-JG	Urban background	Automatic	74.3	74.3	23	22	20	22	20
BO	Roadside	Automatic	97.3	97.3	33	32	30	29	27
FMH	Urban background	Automatic	99.3	99.3		19	15	16	14
TLP	Industrial	Automatic	96.3	96.3			16	16	13
CBI	Roadside	Automatic	99.5	64.3					**40**
AHH	Other	Diffusion tube	100	100				21.5	17.7
AP	Roadside	Diffusion tube	83	83	36.2			31.2	28.3
BA	Roadside	Diffusion tube			**41.9**	**41.3**			
BA2	Roadside	Diffusion tube					28.8		
BE	Roadside	Diffusion tube	100	100	**43.8**	**41.9**	38.3	**40.2**	37.5
BJ	Roadside	Diffusion tube	100	100	39.3	38.3	37.5	39.0	38.7
BO	Roadside	Diffusion tube	92	92	34.7	32.5	30.5	30.5	29.2
BZ	Roadside	Diffusion tube	92	92					27.3
C11	Roadside	Diffusion tube	92	92	**46.4**	**45.4**	**43.0**	**43.3**	**43.0**
C36	Roadside	Diffusion tube	83	83	**55.9**	**54.1**	**50.6**	**51.5**	**50.8**
C75	Roadside	Diffusion tube	100	100	31.5	29.0	27.7	30.4	26.9
CA	Roadside	Diffusion tube			35.7				
CAN	Roadside	Diffusion tube	75	33					25.1
CBI	Other	Diffusion tube	100	58					**44.6**
CC	Roadside	Diffusion tube			22.9				

Site ID	Site type	Monitoring type	Valid data capture for monitoring period (%) (1)	Valid data capture 2017 (%) (2)	NO_2 Annual mean concentration (µg/m^3) (3)				
					2013	2014	2015	2016	2017
CD	Roadside	Diffusion tube			32.3				
CE	Roadside	Diffusion tube			14.7	14.5			
CFL	Roadside	Diffusion tube	100	100	33.1	31.9	29.4	31.3	30.4
CFU	Roadside	Diffusion tube			27.4				
CIN	Roadside	Diffusion tube	83	83				29.1	29.5
CIS	Roadside	Diffusion tube	75	75				30.9	28.0
CM	Roadside	Diffusion tube	100	25					30.8
CN	Kerbside	Diffusion tube			29.4				
CP	Kerbside	Diffusion tube			33.5				
CP3	Roadside	Diffusion tube	100	25					31.9
CVC	Roadside	Diffusion tube			36.9				
CVR	Roadside	Diffusion tube	72	58					30.3
CY	Roadside	Diffusion tube			35.0				
DL	Rural	Diffusion tube			13.7				
EB	Roadside	Diffusion tube	100	100	38.1	36.7	34.2	34.8	34.5
FB	Roadside	Diffusion tube			32.3				
FC	Roadside	Diffusion tube			33.3				
FGS	Roadside	Diffusion tube	92	92				31.7	27.2
FH	Roadside	Diffusion tube	92	92	**40.3**	**41.9**	39.7	**44.2**	39.4
FJ	Roadside	Diffusion tube	100	100	**44.7**	**42.6**	**41.3**	**42.2**	**40.5**
FM	Roadside	Diffusion tube	100	100	36.8	36.6	32.9	36.5	33.2
FT	Roadside	Diffusion tube	100	100		36.3	33.9	34.9	34.2
FV	Roadside	Diffusion tube			20.6	21.4	21.3		

Site ID	Site type	Monitoring type	Valid data capture for monitoring period (%) [(1)]	Valid data capture 2017 (%) [(2)]	NO_2 Annual mean concentration (µg/m^3) [(3)]				
					2013	2014	2015	2016	2017
FW	Roadside	Diffusion tube			20.8	19.1			
FX	Kerbside	Diffusion tube			37.3				
GD	Roadside	Diffusion tube			37.5	34.1	32.3	33.9	
GE	Roadside	Diffusion tube	75	75			27.4	24.8	26.9
GI	Roadside	Diffusion tube	92	92	36.8	35.4	32.6	34.8	33.4
GR	Roadside	Diffusion tube			26.0				
GSW	Roadside	Diffusion tube	67	67			27.5	27.8	33.3
GT	Roadside	Diffusion tube	100	100					26.1
HB	Roadside	Diffusion tube	100	100	38.5	37.7	33.6	33.7	32.9
HC	Roadside	Diffusion tube			**43.4**	**42.2**	35.9		
HSN	Roadside	Diffusion tube				36.1	32.3		
HT	Roadside	Diffusion tube			23.5	22.9			
HW	Roadside	Diffusion tube	83	83	**41.8**	**41.2**	37.8	39.9	36.0
IC	Roadside	Diffusion tube	83	83	38.2	37.1	37.3	38.5	36.7
IS	Industrial	Diffusion tube			21.6				
KR	Roadside	Diffusion tube	92	92	37.6	35.0	33.6	35.2	33.9
LH	Roadside	Diffusion tube	83	83	**43.1**	38.0	37.0	38.4	39.2
LI2	Roadside	Diffusion tube	100	100	38.9	37.8	35.5	39.4	39.7
LN	Roadside	Diffusion tube			31.0				
LP	Roadside	Diffusion tube			31.7				
LU	Roadside	Diffusion tube	92	92					27.9
LVR	Roadside	Diffusion tube	92	92				**40.8**	35.9
LVS	Roadside	Diffusion tube	100	100				39.1	36.0

Site ID	Site type	Monitoring type	Valid data capture for monitoring period (%) [(1)]	Valid data capture 2017 (%) [(2)]	NO_2 Annual mean concentration (µg/m^3) [(3)]				
					2013	2014	2015	2016	2017
LW	Roadside	Diffusion tube			31.0				
M15	Roadside	Diffusion tube			30.4				
M55	Roadside	Diffusion tube			25.4				
MC	Roadside	Diffusion tube			20.5				
MCC	Roadside	Diffusion tube	75	75		**41.8**	38.1	**44.5**	**40.8**
MN	Roadside	Diffusion tube			33.4				
NA	Roadside	Diffusion tube			33.8	31.1			
NB	Roadside	Diffusion tube			25.6				
NIN	Roadside	Diffusion tube	100	100				39.1	39.8
NIS	Roadside	Diffusion tube	92	92				22.6	28.6
NS	Roadside	Diffusion tube	100	100	38.5	39.4	35.9	36.2	35.0
NT	Roadside	Diffusion tube			32.5	28.6			
OB	Roadside	Diffusion tube	100	100	**47.2**	**43.2**	**40.7**	**41.2**	39.8
OF	Roadside	Diffusion tube	83	83	36.4	37.4	35.7	38.8	35.3
OG	Roadside	Diffusion tube			**43.8**				
OP		Diffusion tube	92	92					28.3
OW	Roadside	Diffusion tube	83	83	**46.1**	**42.0**	**43.2**	**51.0**	**51.8**
PA	Roadside	Diffusion tube	83	83	**42.2**	**41.8**	**41.1**	**42.3**	**42.7**
PC	Roadside	Diffusion tube			32.3				
PG	Roadside	Diffusion tube	100	100	**49.5**	**48.0**	**42.2**	**46.9**	**46.0**
PM	Roadside	Diffusion tube			31.6				
QS	Roadside	Diffusion tube			37.1	30.4	26.8		
RL	Roadside	Diffusion tube			30.1				

Site ID	Site type	Monitoring type	Valid data capture for monitoring period (%) [(1)]	Valid data capture 2017 (%) [(2)]	NO_2 Annual mean concentration (µg/m^3) [(3)]				
					2013	2014	2015	2016	2017
RM	Roadside	Diffusion tube	83	83	**46.8**	**45.6**	39.9	**43.1**	**41.3**
RR	Roadside	Diffusion tube	100	100	**42.2**	**42.1**	39.1	39.9	36.8
SA	Roadside	Diffusion tube	100	100	**43.6**	**42.1**	38.5	39.8	36.9
SB	Roadside	Diffusion tube			34.1	31.8			
SCN	Roadside	Diffusion tube			26.8	22.5			
SCS	Roadside	Diffusion tube			34.6	34.5	30.8		
SF	Roadside	Diffusion tube	75	75					32.3
SL	Roadside	Diffusion tube			17.0	17.6			
SM	Roadside	Diffusion tube	100	100	30.1	30.9	29.5	32.1	27.7
SR	Roadside	Diffusion tube	100	100	39.8	38.4	35.7	36.5	34.3
ST	Roadside	Diffusion tube	83	83					**44.6**
SV2	Roadside	Diffusion tube	8	8					N/A[(4)]
SV3	Roadside	Diffusion tube	100	33					24.8
SZ	Roadside	Diffusion tube	92	92	**41.8**	39.0	36.8	36.3	36.4
T11	Roadside	Diffusion tube	92	92					32.0
T25	Roadside	Diffusion tube			32.1	30.6			
T44	Roadside	Diffusion tube	92	92	**48.0**	**46.1**	**41.5**	**42.8**	**40.2**
T6	Roadside	Diffusion tube	92	92	**58.4**	**53.0**	**49.1**	**50.3**	**45.5**
T67	Roadside	Diffusion tube			33.0				
T97	Roadside	Diffusion tube			33.8				
TA	Roadside	Diffusion tube	100	58					**47.4**
TB	Roadside	Diffusion tube	83	83	**42.9**	**41.2**	**40.1**	38.7	36.0
TE	Roadside	Diffusion tube	100	100					21.7

Site ID	Site type	Monitoring type	Valid data capture for monitoring period (%) (1)	Valid data capture 2017 (%) (2)	NO_2 Annual mean concentration (µg/m^3) (3)				
					2013	2014	2015	2016	2017
TG	Roadside	Diffusion tube			32.1	32.8	31.7		
UN	Roadside	Diffusion tube	100	100	**43.5**	**41.1**	38.5	**40.1**	36.8
W23	Roadside	Diffusion tube	100	25					29.2
WCR	Roadside	Diffusion tube	100	58					**41.1**
WG	Roadside	Diffusion tube	100	100	**47.1**	**44.9**	**41.3**	**43.5**	**42.8**
WGW	Roadside	Diffusion tube	100	100	**44.8**	38.8	33.6	37.1	33.3
WH	Roadside	Diffusion tube	92	92	36.6	36.3	34.7	34.4	32.3
WT	Roadside	Diffusion tube			**43.2**	39.7	39.5		
WV	Kerbside	Diffusion tube			32.1				
WW	Roadside	Diffusion tube			33.7	32.1	28.6		
WXP	Roadside	Diffusion tube	83	83				20.1	17.4

☒ **Diffusion tube data has been bias corrected**

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 one-hour mean objective are shown in **bold and underlined.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (if monitoring was carried out for six months, the maximum data capture for the full calendar year is 50%).

(3) Means for diffusion tubes have been corrected for bias. All means have been annualised as per Boxes 7.9 and 7.10 in LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(4) Annual mean not reported as data capture was for a single month.

Note, results in the above table show the levels of NO_2 at the point of monitoring and do not take account of distance to relevant receptors.

Figure 1 Long-term trends in NO_2 at real-time sites

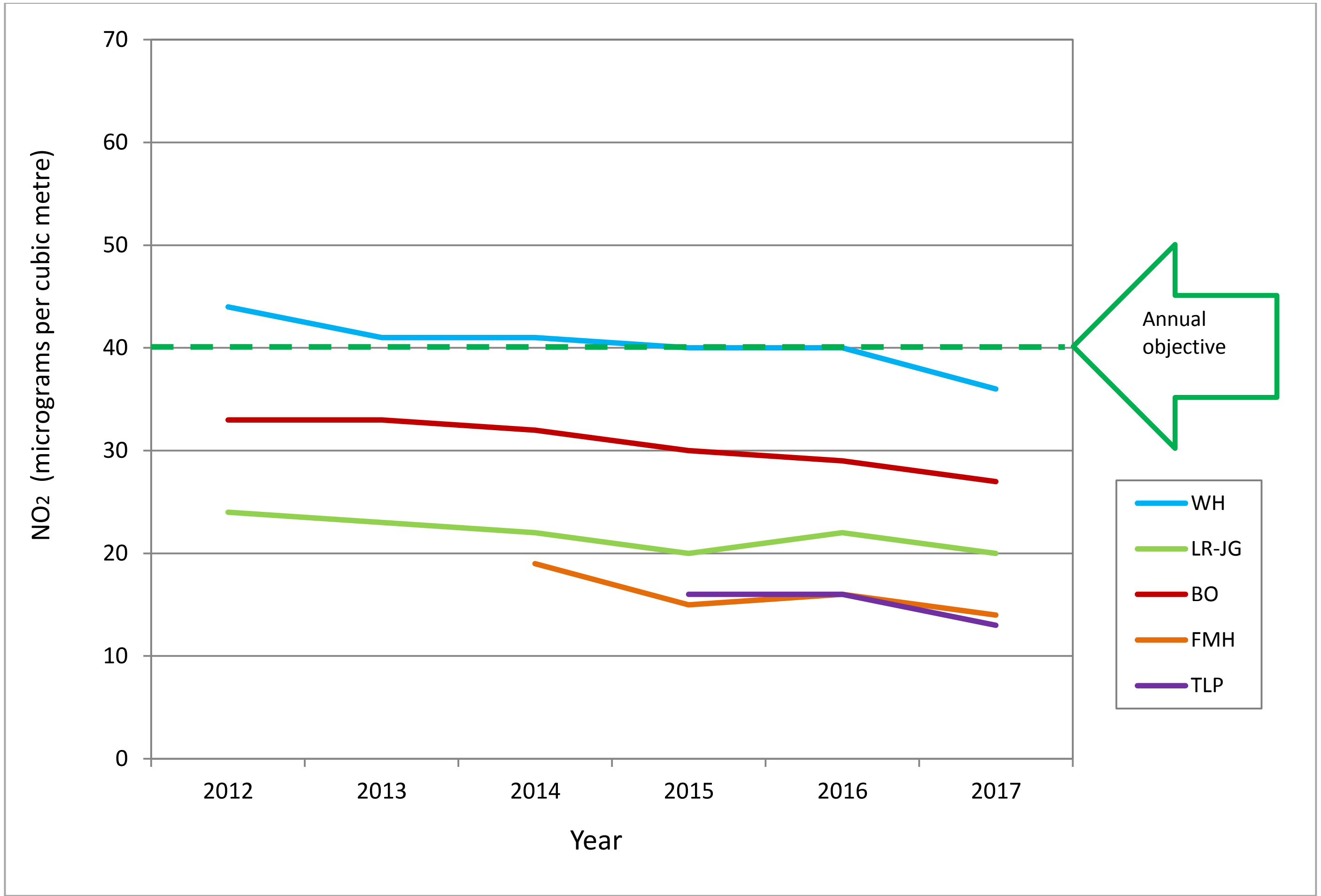


Figure 2 Long-term trends in NO_2 at Chester diffusion tube sites

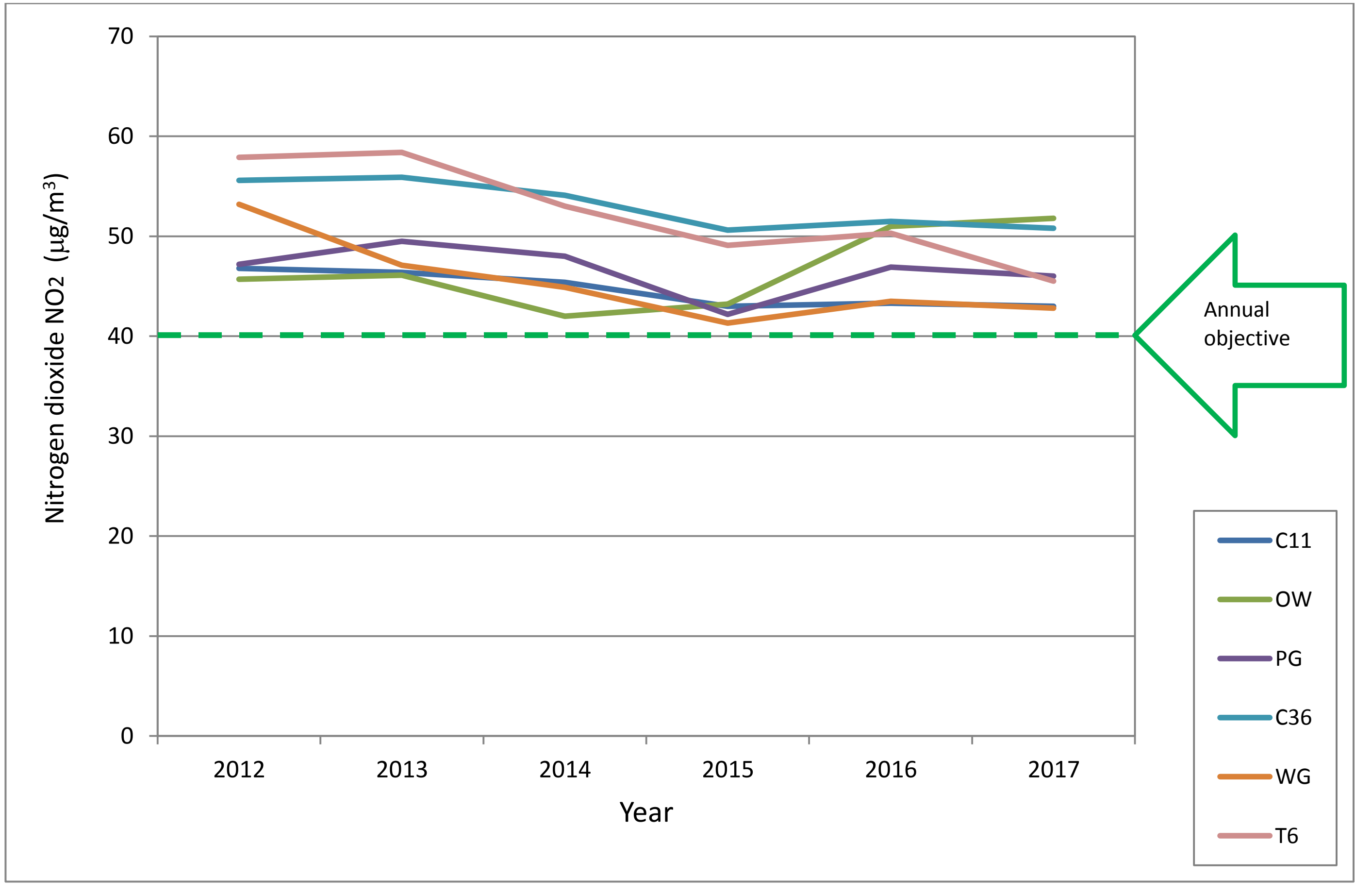


Figure 3 Long-tern trends in NO_2 at Ellesmere Port diffusion tube sites

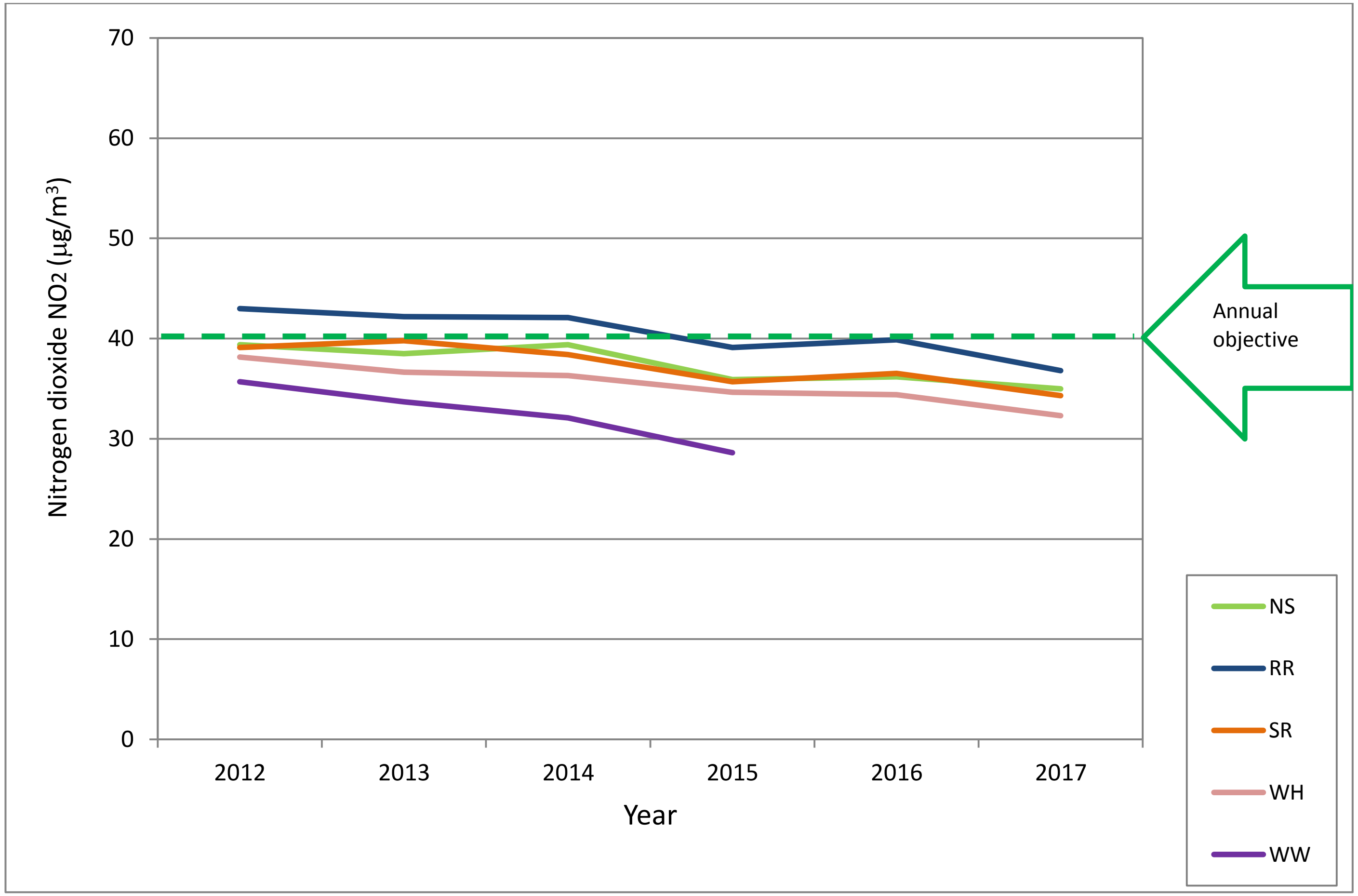


Figure 4 Long-term trends in NO_2 at Frodsham diffusion tube sites

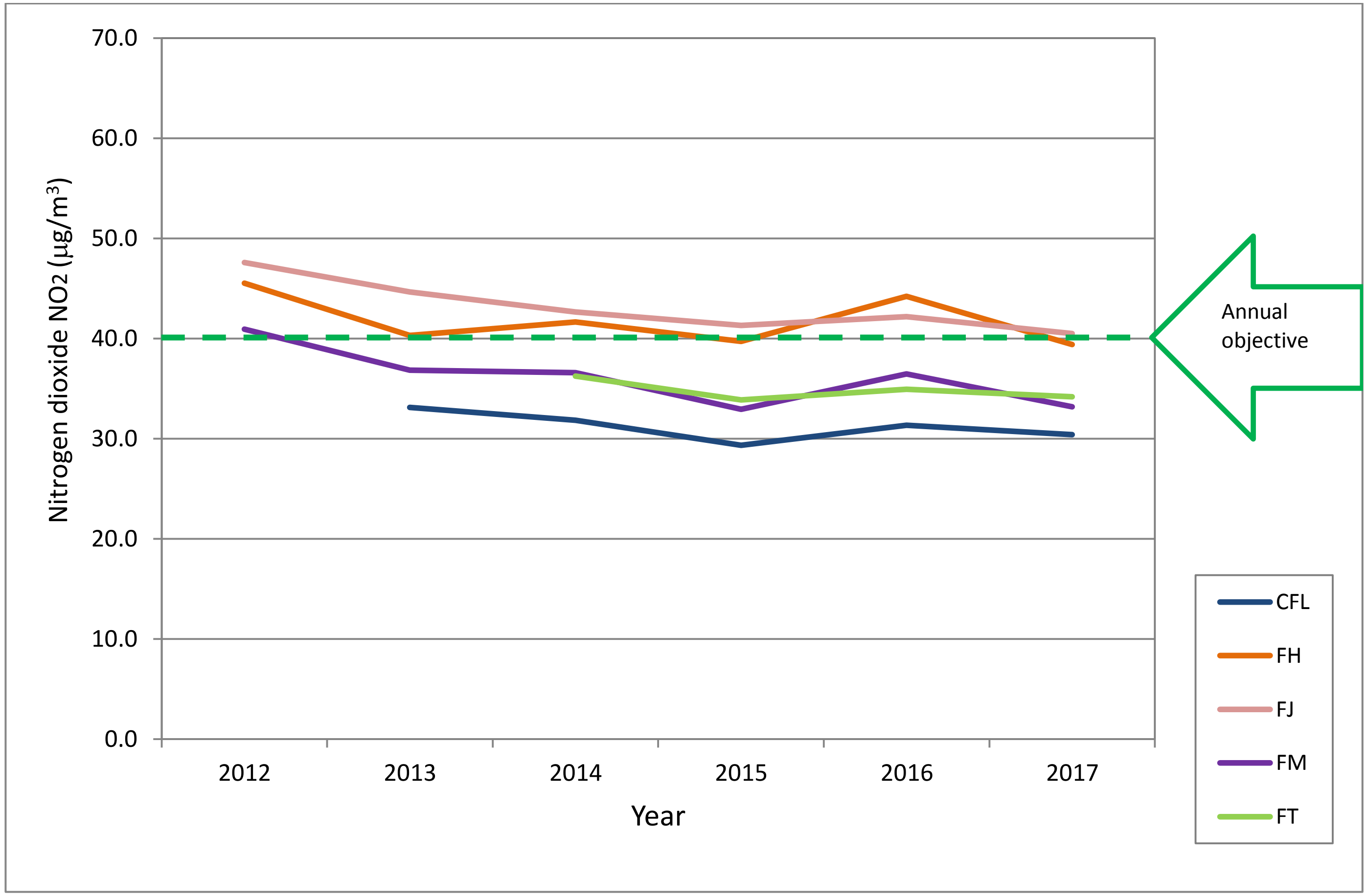


Table 8 One-hour mean NO_2 monitoring results

Site ID	Site type	Monitoring type	Valid data capture for monitoring period (%) (1)	Valid data capture 2017 (%) (2)	NO_2 1-hour means > 200µg/m^3 (3)				
					2013	**2014**	**2015**	**2016**	**2017**
BO	Roadside	Automatic	97.3	97.3	0	0	0	0	0
CBI	Roadside	Automatic	99.5	64.3					0
FMH	Urban background	Automatic	99.3	99.3		0 (99.8)	0	0	0
LR-JG	Urban background	Automatic	74.3	74.3	0	0	0	0	0
TLP	Industrial	Automatic	96.3	96.3			0	0	0
WH	Roadside	Automatic	99.4	99.4	0	0	0	0	0

Notes:

Exceedances of the NO_2 1-hour mean objective (200µg/m^3 not to be exceeded more than 18 times a year) are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (if monitoring was carried out for six months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

Table 9 Annual mean PM_{10} monitoring results

Site ID	Site type	Valid data capture for monitoring period (%) [(1)]	Valid data capture 2017 (%) [(2)]	PM_{10} Annual mean concentration ($\mu g/m^3$) [(3)]				
				2013	2014	2015	2016	2017
CBI	Roadside	94.0	60.8					21
FMH	Urban background	95.2	95.2		15	15	14	13
LR	Urban background	74.4	74.4	18	16	13	12	12
TLP	Industrial	94.5	94.5			15	16	13

☒ Annualisation has been conducted where data capture is <75%

Notes:

Exceedances of the PM_{10} annual mean objective of $40\mu g/m^3$ are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (if monitoring was carried out for six months, the maximum data capture for the full calendar year is 50%).

(3) All means have been annualised, as per Boxes 7.9 and 7.10 in LAQM.TG16, where valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Figure 5 Long-term trends in PM_{10} at real-time sites

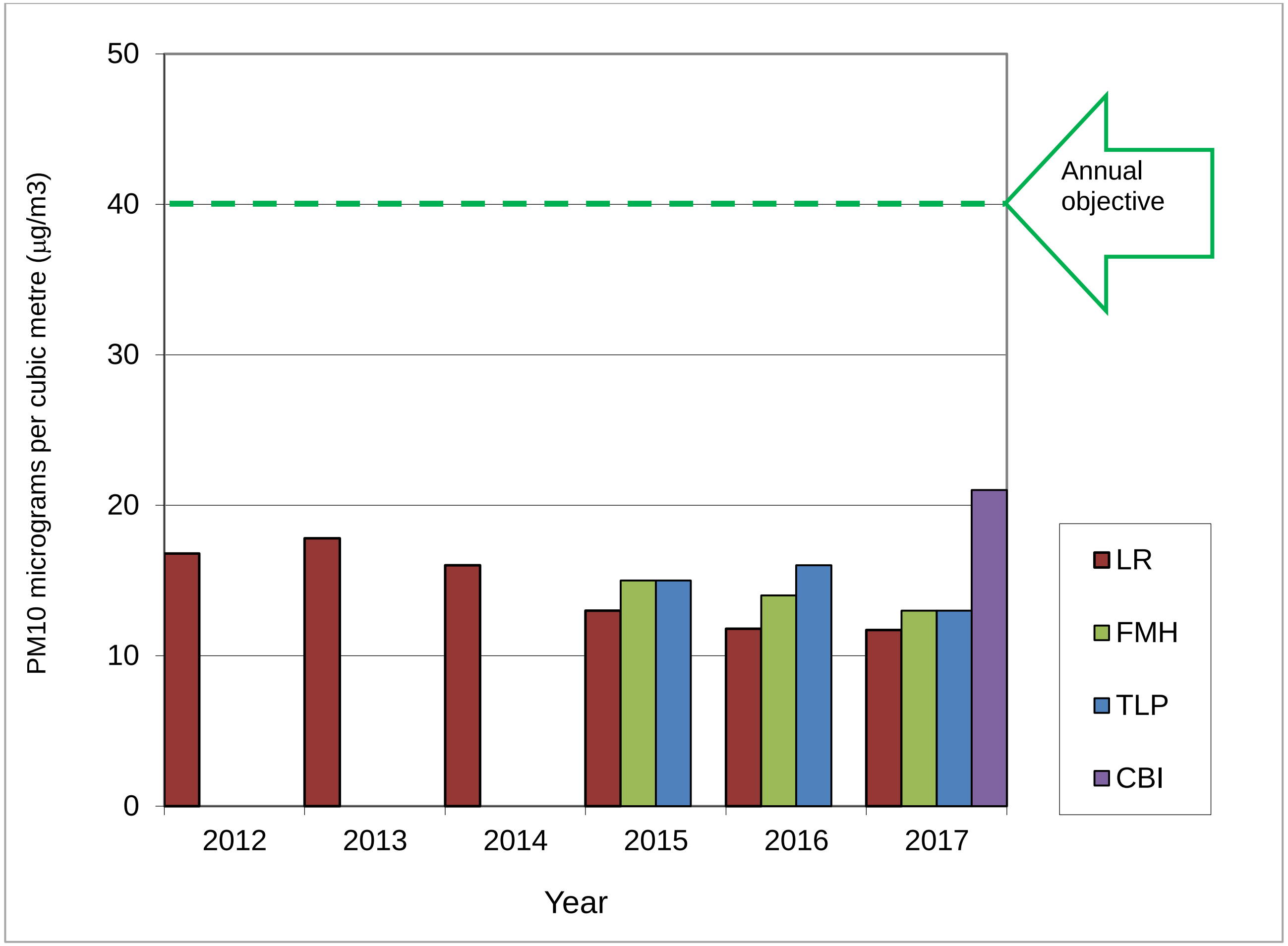


Table 10 24-hour mean PM_{10} monitoring results

Site ID	Site type	Valid data capture for monitoring period (%) (1)	Valid data capture 2017 (%) (2)	PM_{10} 24-hour means > 50µg/m³ (3)				
				2013	2014	2015	2016	2017
LR	Urban background	74.2	74.2	6	1	0	0	0
FMH	Urban background	95.2	95.2	-	0	1	0	0
TLP	Industrial	94.5	94.5	-	-	0 (22)	0	2
CBI	Roadside	94.0	60.8	**-**	**-**	**-**	**-**	8

Notes:

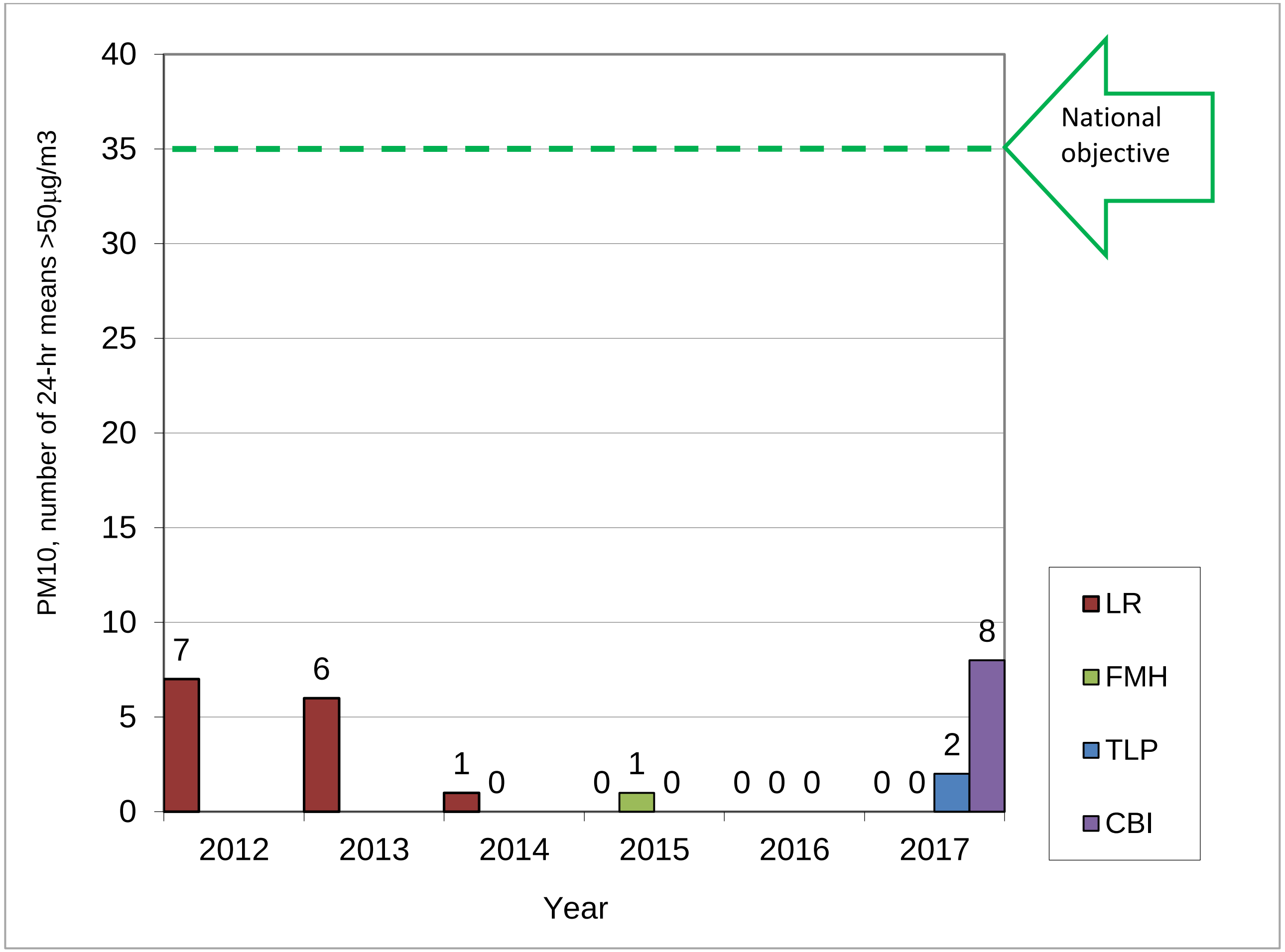
Exceedances of the PM_{10} 24-hour mean objective (50µg/m³ not to be exceeded more than 35 times a year) are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (if monitoring was carried out for six months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

Figure 6 Trends in the number of 24-hour mean PM_{10} results greater than 50µg/m^3



Note: Objective allows 35 exceedances of 50µg/m^3 per year

Table 11 SO_2 monitoring results

Site ID	Site type	Valid data capture for monitoring period (%) [1]	Valid data capture 2017 (%) [2]	Number of exceedances 2017 (percentile in bracket) [3]		
				15-minute objective (266 µg/m^3)	Hourly objective (350 µg/m^3)	24-hour objective (125 µg/m^3)
ELT	Industrial	94.9	94.9	9	0	0
LR-JG	Urban background	73.6	73.6	0 (68.7)	0 (37.8)	0 (15.3)
TLP	Industrial	92.2	92.2	**36**	1	0

Notes:

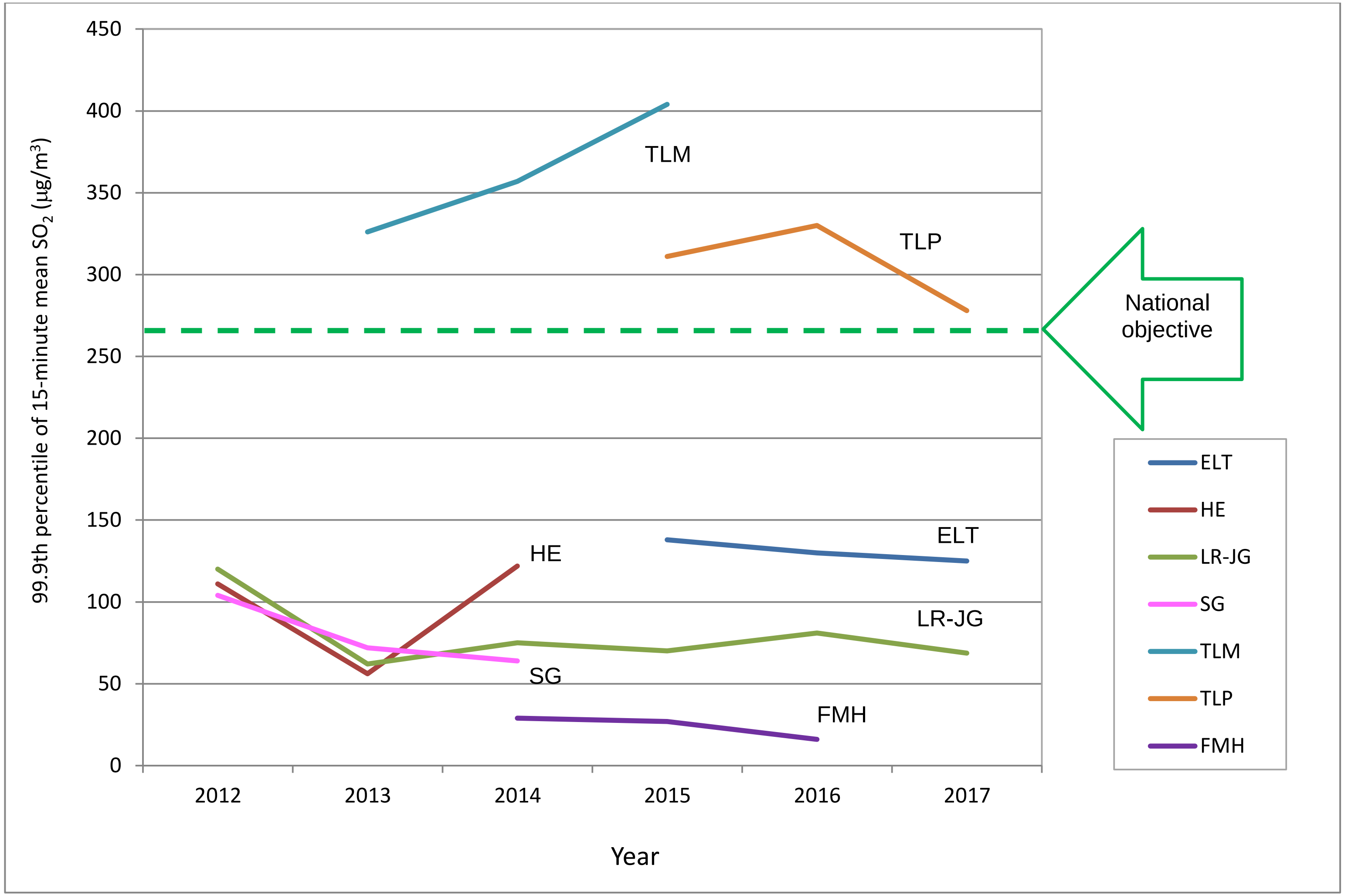
Exceedances of the SO_2 objectives are shown in **bold** (15-min mean = 35 allowed a year, hourly mean = 24 allowed a year, 24-hour mean = three allowed a year)

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (if monitoring was carried out for six months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the relevant percentiles are provided in brackets.

Figure 7 Long-term trends in SO_2 at real-time sites



Appendix B: Full monthly diffusion tube results for 2017

Table 12 NO_2 monthly diffusion tube results – 2017

Site ID	**NO_2 mean concentrations ($\mu g/m^3$)**														
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual mean**		
													Raw data	**Bias adjusted (0.89 factor) and annualised (1)**	**Distance corrected to nearest exposure (2)**
AHH	34.2	17.8	21.9	15.7	22.3	16.0	16.1	16.0	19.7	18.4	20.1	20.8	19.9	17.7	17.7
AP	39.3	32.9	missing	missing	22.5	28.5	33.1	29.6	25.9	31.4	43.1	31.6	31.8	28.3	28.3
BE	55.0	48.8	42.6	48.1	40.1	38.9	34.0	34.9	35.8	35.3	44.6	47.4	42.1	37.5	36.6
BJ	52.5	43.6	47.3	47.8	37.8	34.7	34.3	34.6	35.0	41.3	58.8	53.9	43.5	38.7	38.7
BO	42.8	39.3	36.1	33.0	27.9	27.2	26.9	24.9	void	30.6	37.1	35.2	32.8	29.2	29.2
BZ	missing	36.6	36.8	30.6	30.9	26.9	24.0	24.7	28.1	29.2	36.7	32.8	30.7	27.3	27.3
C11	55.7	50.6	53.6	51.5	47.1	49.8	42.8	void	42.7	39.3	50.3	48.0	48.3	43.0	**43.0**
C36	70.8	60.4	57.6	56.7	void	56.5	46.9	47.1	52.8	void	61.3	60.8	57.1	50.8	**48.9**
C75	42.6	35.1	35.3	28.8	30.4	24.2	24.8	20.9	27.0	28.7	33.2	31.7	30.2	26.9	26.9
CAN	-	-	-	-	-	-	-	-	22.4	27.2	31.2	missing	26.9	25.1	25.1
CBI	-	-	-	-	-	39.4	43.6	41.1	43.6	40.1	57.9	51.3	45.3	44.6	**44.6**
CFL	42.7	36.7	34.9	32.9	33.2	34.5	28.9	26.7	32.4	33.9	38.9	33.7	34.1	30.4	25.5
CIN	39.4	37.7	38.8	33.9	27.8	26.5	25.2	23.3	missing	missing	36.2	42.7	33.1	29.5	28.1
CIS	missing	missing	36.3	25.6	28.5	26.0	missing	22.3	28.9	33.0	44.0	38.8	31.5	28.0	28.0
CM	-	-	-	-	-	-	-	-	-	36.8	41.3	36.8	38.3	30.8	30.8
CP3	-	-	-	-	-	-	-	-	-	35.5	45.1	38.4	39.7	31.9	27.5

Site ID	NO_2 mean concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean		
													Raw data	Bias adjusted (0.89 factor) and annualised (1)	Distance corrected to nearest exposure (2)
CVR	-	-	-	-	-	27.8	30.6	missing	missing	30.0	40.6	33.5	32.5	30.3	26.6
EB	49.2	43.5	41.6	40.8	32.8	34.5	28.4	32.3	34.3	37.5	46.4	44.2	38.8	34.5	34.5
FGS	33.2	27.6	26.4	25.5	30.3	27.9	27.2	29.1	33.1	missing	40.0	36.2	30.6	27.2	27.2
FH	54.7	59.4	48.8	41.7	41.6	38.9	36.6	void	41.8	41.7	41.5	39.6	44.2	39.4	38.9
FJ	47.5	50.2	49.7	50.6	40.3	42.6	44.2	39.0	41.0	43.5	50.0	47.8	45.5	40.5	39.3
FM	48.2	44.1	44.1	37.6	40.4	35.1	32.6	27.9	32.2	31.0	40.2	33.9	37.3	33.2	32.7
FT	43.3	38.7	41.2	40.4	34.4	35.9	38.1	32.6	35.0	36.4	45.8	39.4	38.4	34.2	34.2
GE	36.6	25.3	missing	20.4	23.8	37.3	28.5	28.2	36.0	35.4	missing	missing	30.2	26.9	26.4
GI	47.1	41.9	38.8	39.3	32.5	31.5	32.7	missing	34.8	32.3	41.2	40.8	37.5	33.4	33.4
GSW	34.0	23.9	missing	20.5	missing	59.4	34.8	35.8	missing	39.1	missing	45.0	36.6	33.3	31.7
GT	32.9	29.3	24.5	19.6	22.3	31.1	25.3	23.3	30.5	36.2	37.0	39.6	29.3	26.1	26.1
HB	49.1	39.5	41.4	30.5	31.0	32.6	32.9	29.1	31.7	40.2	43.9	42.3	37.0	32.9	28.4
HW	missing	48.3	52.5	missing	41.1	37.7	33.6	24.2	35.1	38.6	52.9	40.9	40.5	36.0	34.3
IC	53.2	44.9	44.3	44.1	34.2	37.6	missing	32.4	37.3	38.3	45.5	missing	41.2	36.7	33.1
KR	55.3	41.1	40.0	35.7	35.9	31.2	31.4	33.5	34.7	10.1	44.7	35.8	38.1	33.9	28.2
LH	48.9	43.0	44.4	55.3	37.5	missing	void	34.0	31.0	36.1	58.8	51.5	44.1	39.2	34.2
LI2	53.2	50.0	49.1	43.3	40.0	40.5	36.6	36.2	36.9	40.3	55.8	53.6	44.6	39.7	31.3
LU	39.8	36.0	36.9	31.0	26.0	27.9	25.4	27.9	26.1	30.1	missing	38.2	31.4	27.9	27.9
LVR	48.4	missing	47.9	49.4	38.7	42.3	29.4	29.0	35.3	31.4	55.4	37.2	40.4	35.9	35.9
LVS	50.9	36.4	47.3	53.3	31.7	31.1	38.5	36.0	33.6	35.6	43.7	47.4	40.5	36.0	36.0

Site ID	NO_2 mean concentrations (µg/m^3)														
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual mean**		
													Raw data	**Bias adjusted (0.89 factor) and annualised (1)**	**Distance corrected to nearest exposure (2)**
MCC	55.8	51.5	missing	missing	47.7	43.1	42.3	43.6	44.6	40.2	missing	43.8	45.8	40.8	39.5
NIN	52.2	43.4	48.7	54.6	35.5	41.2	40.9	26.8	40.2	38.1	64.6	50.0	44.7	39.8	39.8
NIS	35.2	28.4	27.0	missing	23.7	28.5	27.8	41.3	32.4	28.5	41.2	39.9	32.2	28.6	28.6
NS	44.2	42.6	39.9	39.5	36.2	40.0	35.2	33.1	35.2	39.6	43.6	42.4	39.3	35.0	33.1
OB	52.5	49.9	47.6	43.5	41.3	44.1	40.6	38.9	42.2	37.9	48.5	50.0	44.7	39.8	38.5
OF	45.1	46.5	41.4	37.0	37.0	39.8	33.5	38.1	37.5	40.4	missing	missing	39.6	35.3	35.3
OP	32.2	missing	28.5	25.2	23.2	31.7	27.0	28.8	32.8	36.0	43.9	40.8	31.8	28.3	28.3
OW	68.7	67.5	60.1	55.7	47.9	59.3	missing	51.5	45.1	missing	66.3	60.0	58.2	51.8	**46.2**
PA	54.0	53.9	54.7	41.2	44.1	missing	missing	34.1	42.1	44.4	56.9	54.1	48.0	42.7	35.1
PG	58.7	56.4	62.9	48.7	45.7	51.0	37.8	44.0	44.5	47.7	65.6	57.3	51.7	46.0	**46.0**
RM	64.9	59.1	missing	void	51.2	40.5	34.8	34.9	43.0	32.7	54.2	49.2	46.4	41.3	**41.3**
RR	46.5	45.3	44.7	40.4	41.6	38.7	38.0	34.8	37.1	34.4	46.4	48.4	41.4	36.8	32.9
SA	54.4	52.5	51.7	35.6	40.5	37.5	25.9	30.9	38.1	36.6	44.6	48.7	41.4	36.9	36.9
SF	missing	46.4	44.0	missing	35.7	32.2	28.6	24.4	31.9	missing	40.8	42.1	36.2	32.3	32.3
SM	45.4	29.7	36.2	32.5	31.1	23.6	22.8	22.4	28.9	29.0	36.8	35.2	31.1	27.7	27.7
SR	49.7	40.8	41.7	41.3	33.2	37.2	36.2	30.9	31.9	35.2	43.7	41.2	38.6	34.3	34.3
ST	43.6	missing	50.7	52.2	48.8	50.2	38.5	43.8	45.5	void	66.7	61.5	50.2	44.6	25.8
SV2	-	-	-	-	-	-	-	-	30.0	missing	missing	missing	30.0	N/A	N/A
SV3	-	-	-	-	-	-	-	-	25.1	26.0	34.8	30.5	29.1	24.8	23.9
SZ	52.8	46.4	41.3	48.4	void	34.6	33.4	31.1	37.8	34.4	49.9	39.6	40.9	36.4	35.3

Site ID	NO_2 mean concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean		
													Raw data	Bias adjusted (0.89 factor) and annualised (1)	Distance corrected to nearest exposure (2)
T11	43.9	40.9	41.5	31.0	void	21.8	28.5	27.0	29.2	33.1	42.4	55.8	35.9	32.0	28.3
T44	56.0	59.9	void	35.6	42.9	42.2	37.1	35.0	43.2	43.6	53.4	48.2	45.2	40.2	32.4
T6	75.0	56.1	63.3	44.8	void	49.1	41.5	42.4	41.7	48.9	60.1	39.9	51.2	45.5	**45.5**
TA	-	-	-	-	-	43.7	41.2	40.0	48.8	44.7	64.8	53.8	48.2	47.4	34.2
TB	50.4	50.3	42.1	missing	34.3	44.0	32.9	40.9	31.8	34.6	42.7	missing	40.4	36.0	31.5
TE	31.5	24.1	23.9	16.3	22.9	24.5	20.3	21.6	23.9	25.0	27.8	30.6	24.4	21.7	21.7
UN	57.4	53.2	46.7	30.6	37.1	38.2	32.2	33.0	36.5	37.0	45.0	49.0	41.3	36.8	36.8
W23	-	-	-	-	-	-	-	-	-	31.8	42.7	34.6	36.4	29.2	27.0
WCR	-	-	-	-	-	39.1	35.8	35.3	42.7	42.0	49.8	47.3	41.7	41.1	30.8
WG	56.8	54.5	45.8	50.8	45.7	51.3	44.2	39.0	43.1	37.8	59.1	49.7	48.1	42.8	**42.8**
WGW	44.9	39.4	40.0	46.9	39.0	32.2	34.1	21.0	34.3	31.0	46.7	40.0	37.5	33.3	33.3
WH av	43.4	missing	41.0	36.0	35.9	34.7	31.7	30.7	33.5	34.3	40.6	36.8	36.2	32.3	32.3
WXP	32.3	27.9	22.6	14.4	18.4	16.3	13.8	13.7	18.1	18.3	missing	missing	19.6	17.4	17.4

☐ Local bias adjustment factor used ☒ Annualisation has been conducted where data capture is <75%

☒ National bias adjustment factor used ☒ Where applicable, data has been distance corrected for relevant exposure

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 one-hour mean objective are shown in **bold and underlined.**

(1) See appendix C for details on bias adjustment and annualisation.

(2) Distance corrected to nearest relevant public exposure.

Appendix C: Supporting technical information / air quality monitoring data QA/QC

Monitoring data reported in the 2017 ASR identified a single exceedance of the NO_2 annual mean at a residential receptor in Christleton, which lies outside the Chester AQMA. To investigate the matter further and determine the nature and potential extent of any possible exceedance, three additional diffusion tube monitoring sites were established in 2017. Results for all the additional tubes were comfortably below the objective. The long-term tube (MCC) returned a result of 39.5μg/m^3, which is just below the threshold of 40μg/m^3. Following discussions with the LAQM helpdesk, taking into account both current and historic monitoring results, it was agreed that there would be no requirement to declare an AQMA at present but that the site should be kept under review for at least another year (i.e. 2018).

Quality control procedures

Council staff follow a set of internal QA/QC procedure notes relating to the use of diffusion tubes for the purpose of air quality monitoring. These cover key stages in the monitoring process including storage, deployment, record keeping and management of NO_2 diffusion tube data.

Data ratification, bias adjustments and distance corrections

Automatic gas monitoring

In-house staff perform fortnightly span and zero calibrations on the chemiluminescent analysers at the BO, CBI and WH roadside sites, and four-weekly span and zero calibrations on the remaining chemiluminescent and UV-fluorescent analysers, using BOC spectra-seal certified gas standards. The resultant span and offset values are used in the ratification of datasets. Automated internal zero checks are run overnight daily. Data from different sites is compared on a regular basis for the purposes of QA/QC. Data management and ratification is performed by an independent contractor, AQDM Ltd. This includes production of weekly, quarterly and annual summaries as well as ad hoc notifications of any exceedance episodes where necessary. The ratification process also involves comparison against national network sites to identify regional patterns and trends. In 2017 the analysers were serviced and calibrated at six-monthly intervals by Easy Technical Services Ltd (LR and LR-JG) and Enviro Technology Services plc (all other sites).

Automatic particulate monitoring

PM_{10} monitoring data recorded by the BAM analysers at Thornton-le-Moors (TLP) and Chester bus interchange (CBI) has been adjusted by the factor (0.96618), to give the indicative gravimetric equivalent figure.

The volatile correction model (VCM) was used to correct TEOM monitoring data to produce a gravimetric equivalent figure for each site.

Short-term to long-term data adjustment (annualisation)

Monitoring studies should ideally be in situ for at least a year in order to compare the results against the annual mean objectives. Monitoring sites with less than nine months' worth of data should be annualised using short-term to long-term adjustments as set out in section 7.171 of LAQM.TG16. A number of sites required annualisation in 2017. The calculated adjustment factor, Ra, in Table 13 to

Table 18 has been applied, where relevant, to the results in Table 12 above.

Table 13 Annualisation factor 2017 (location GSW)

Site	Site type	Annual mean 2017 (Am)	Period mean 2017 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	17.55	17.09	1.027
Stoke centre	Urban background	25.65	25.46	1.007
Warrington	Urban background	21.04	20.53	1.025
Wirral	Background	17.39	17.46	0.996
Wrexham	Background	16.47	15.55	1.059
			Average (Ra)	1.023

Table 14 Annualisation factor 2017 (locations WCR, CBI, TA)

Site	Site type	Annual mean 2017 (Am)	Period mean 2017 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	17.55	15.36	1.143
Stoke centre	Urban background	25.65	24.30	1.055
Warrington	Urban background	21.04	19.39	1.085
Wirral	Background	17.39	16.56	1.050
Wrexham	Background	16.47	13.75	1.198
			Average (Ra)	1.106

Table 15 Annualisation factor 2017 (location CVR)

Site	Site type	Annual mean 2017 (Am)	Period mean 2017 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	17.55	16.55	1.060
Stoke centre	Urban background	25.65	25.26	1.015
Warrington	Urban background	21.04	20.75	1.014
Wirral	Background	17.39	17.72	0.981
Wrexham	Background	16.47	14.25	1.156
			Average (Ra)	1.045

Table 16 Annualisation factor 2017 (location SV3)

Site	Site type	Annual mean 2017 (Am)	Period mean 2017 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	17.55	17.95	0.978
Stoke centre	Urban background	25.65	28.28	0.907
Warrington	Urban background	21.04	22.10	0.952
Wirral	Background	17.39	18.39	0.946
Wrexham	Background	16.47	16.46	1.001
			Average (Ra)	0.957

Table 17 Annualisation factor 2017 (locations W23, CM, CP3)

Site	Site type	Annual mean 2017 (Am)	Period mean 2017 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	17.55	19.34	0.907
Stoke centre	Urban background	25.65	29.50	0.869
Warrington	Urban background	21.04	24.06	0.875
Wirral	Background	17.39	19.60	0.887
Wrexham	Background	16.47	16.89	0.975
			Average (Ra)	0.903

Table 18 Annualisation factor 2017 (location CAN)

Site	Site type	Annual mean 2017 (Am)	Period mean 2017 (Pm)	Ratio (Am/Pm)
Liverpool Speke	Urban background	17.55	15.95	1.101
Stoke centre	Urban background	25.65	25.78	0.995
Warrington	Urban background	21.04	20.01	1.051
Wirral	Background	17.39	16.82	1.034
Wrexham	Background	16.47	15.66	1.052
			Average (Ra)	1.047

Diffusion tube bias adjustment factors

A triplicate set of diffusion tubes is collocated with the sampling inlet of the real-time analyser WH on Whitby Road, Ellesmere Port. Data from this exercise is used for checking diffusion tube precision and accuracy against real-time results in both a local comparison and to contribute to the national bias adjustment programme. Bias adjustment factors derived from collocation studies undertaken at various locations across the country are available on the Defra website.

Results from 34 national collocation studies, which use the 20 percent triethanolamine (TEA) in water preparation are shown in Table 19 below. The national bias adjustment factor for 2017 is 0.89. The local comparison of diffusion tubes against the real-time data is shown in Table 20, below. The local bias adjustment factor for 2017 is 0.99.

Discussion of choice of bias factor to use

The overall accuracy and precision of the local study was good, as was real-time data capture. There were 11 periods of good precision for the triplicate tubes, with all three tubes shown as missing in February. The monitoring station WH is situated within a street canyon so the bias adjustment may not be applicable to sites with a more open aspect. Taking these points and the factors stated in section 7.175 of LAQM.TG16 into account, it has been decided to use the national bias adjustment factor (0.89) for the adjustment of all diffusion tube data as it is likely to be more statistically reliable.

It should be noted, however, that this approach may underestimate the concentrations at some sites. At WH, for example, the real-time result was 36μg/m^3 and the locally adjusted diffusion tube result would have been 35.9μg/m^3, whereas application of the national factor gives a reading of just 32.3μg/m^3. There may have been merit, therefore, to use the local factor for sites with canyon-like characteristics and the national factor at the remainder.

Distance correction

LAQM.TG16 recommends that distance correction to relevant exposure be applied to all annual mean tube results (following annualisation and bias adjustment) that exceed the objective level of 40μg/m^3, and that it should also be considered for locations where results are within 10% of the objective, that is above 36μg/m^3, to account for uncertainties.

For completeness, distance corrections have been applied to all locations where the diffusion tube is separated from the relevant exposure, not just those that fit the aforementioned criteria. Distance corrections, made using the multiple tube calculator within version 4.2 of the Bureau Veritas 'NO_2 fall-off with distance calculator' (March 2018), have been applied to annual results at the following locations: BE, C36, CFL, CIN, CP3, CVR, FH, FJ, FM, GE, GSW, HB, HW, IC, KR, LH, LI2, MCC, NS, OB, OW, PA, RR, ST, SV3, SZ, T11, T44, TA, TB, W23 and WCR. An extract of the distance calculator is shown in Table 21 and the adjusted data in Table 12.

Tube location SV2 would also have had distance correction applied had data capture been sufficient for calculation of an annual mean.

Consideration was given to applying distance correction to the annual result for tube location CBI. However, it was considered that as the separation distance between CBI and the road is greater than the distance between the facade of the nearest relevant exposure and the kerb of the same road at diffusion tube location OW, distance correction should not be applied to CBI. This approach was put to the LAQM helpdesk, who agreed that, in this circumstance, diffusion tube OW will be used to represent relative exposure at the facade of the residential building after distance correction has been applied.

Table 19 National bias adjustment factor (v0318)

Analysis	Method	Year	Site	Local authority	Length of study	Tube mean (Dm)(μg/m^3)	Auto mean (Cm)(μg/m^3)	Bias (%)	Tube precision	Bias factor (Cm/Dm)
Gradko	20% TEA* in water	2017	UB	Bracknell Forest	11	19	16	23.0%	G	0.81
Gradko	20% TEA in water	2017	R	Bracknell Forest	12	47	39	21.7%	G	0.82
Gradko	20% TEA in water	2017	R	Brighton and Hove	11	51	50	1.6%	G	0.98
Gradko	20% TEA in water	2017	R	Wokingham	11	39	37	4.6%	G	0.96
Gradko	20% TEA in water	2017	UC	Southampton	11	31	29	5.3%	G	0.95
Gradko	20% TEA in water	2017	R	Preston	12	31	26	23.3%	G	0.81
Gradko	20% TEA in water	2017	R	Monmouthshire	9	42	33	26.6%	G	0.79
Gradko	20% TEA in water	2017	R	Cheshire West	11	36	36	1.4%	G	0.99
Gradko	20% TEA in water	2017	UI	Crawley	12	28	28	-1.2%	G	1.01
Gradko	20% TEA in water	2017	R	King's Lynn	12	29	25	16.0%	G	0.86
Gradko	20% TEA in water	2017	R	Bath	12	45	45	-0.2%	G	1.00
Gradko	20% TEA in water	2017	R	Nottingham	12	38	41	-6.6%	G	1.07
Gradko	20% TEA in water	2017	R	Lancaster	12	35	32	9.7%	G	0.91
Gradko	20% TEA in water	2017	R	Thurrock	12	54	52	3.3%	S	0.97
Gradko	20% TEA in water	2017	R	Thurrock	11	35	33	7.0%	G	0.93
Gradko	20% TEA in water	2017	R	Thurrock	9	33	29	14.3%	G	0.87
Gradko	20% TEA in water	2017	UB	Thurrock	11	30	28	8.0%	S	0.93
Gradko	20% TEA in water	2017	R	Dudley	12	50	50	0.8%	G	0.99
Gradko	20% TEA in water	2017	UB	Dudley	12	24	19	26.6%	G	0.79
Gradko	20% TEA in water	2017	R	City of Lincoln	12	42	31	33.2%	G	0.75
Gradko	20% TEA in water	2017	R	Gedling	12	35	31	10.1%	G	0.91
Gradko	20% TEA in water	2017	R	Gateshead	12	36	37	-2.7%	G	1.03
Gradko	20% TEA in water	2017	R	Gateshead	12	29	25	17.5%	G	0.85
Gradko	20% TEA in water	2017	R	Gateshead	12	34	35	-5.3%	G	1.06
Gradko	20% TEA in water	2017	R	LB Hounslow	12	65	54	22.2%	G	0.82
Gradko	20% TEA in water	2017	R	LB Hounslow	12	59	53	10.6%	G	0.90
Gradko	20% TEA in water	2017	B	LB Hounslow	11	28	30	-6.0%	G	1.06
Gradko	20% TEA in water	2017	R	LB Hounslow	11	43	34	28.8%	G	0.78
Gradko	20% TEA in water	2017	B	LB Hounslow	9	38	33	14.9%	G	0.87
Gradko	20% TEA in water	2017	R	LB Hounslow	11	52	42	24.4%	G	0.80
Gradko	20% TEA in water	2017	UB	Liverpool	11	20	17	15.2%	G	0.87
Gradko	20% TEA in water	2017	R	North Ayrshire	12	26	21	23.2%	G	0.81
Gradko	20% TEA in water	2017	R	S. Gloucestershire	12	25	23	10.3%	G	0.91
Gradko	20% TEA in water	2017	KS	Marylebone Rd Intercomparison	12	101	79	28.6%	G	0.78
				Overall Factor (34 studies)				**Use**		**0.89**

*TEA = triethanolamine

Table 20 Calculation of local bias adjustment

Period	Start date	End date	Tube 1 µg/m-3	Tube 2 µg/m-3	Tube 3 µg/m-3	Triplicate mean	Standard deviation	Coefficient of variation (CV)	95% CI of mean	Automatic method: Period mean	Automatic method: Data capture (% DC)	Data quality check: Tubes precision check	Data quality check: Analyser data capture check
1	05/01/2017	01/02/2017	45.1	43.3	41.9	43.4	1.6	4	3.9	43.5	97.7	Good	Good
2	01/02/2017	01/03/2017								40.3	99.7		Good
3	01/03/2017	29/03/2017	38.3	42.3	42.5	41.0	2.3	6	5.8	42.5	99.6	Good	Good
4	29/03/2017	26/04/2017	36.5	36.1	35.3	36.0	0.6	2	1.5	34.0	99.6	Good	Good
5	26/04/2017	31/05/2017	35.0	36.7	36.0	35.9	0.8	2	2.1	33.0	99.3	Good	Good
6	31/05/2017	29/06/2017	35.2	35.1	33.7	34.7	0.8	2	2.1	28.7	99.9	Good	Good
7	29/06/2017	04/08/2017	30.3	32.8	31.9	31.7	1.3	4	3.2	28.3	97.5	Good	Good
8	04/08/2017	31/08/2017	30.0	30.8	31.3	30.7	0.6	2	1.6	29.1	99.5	Good	Good
9	31/08/2017	28/09/2017		33.1	34.0	33.5	0.6	2	5.7	30.9	99.9	Good	Good
10	28/09/2017	02/11/2017	33.2	37.8	32.0	34.3	3.1	9	7.6	34.7	99.8	Good	Good
11	02/11/2017	06/12/2017	38.9	39.9	43.1	40.6	2.2	5	5.4	42.8	99.5	Good	Good
12	06/12/2017	03/01/2018	36.2	36.2	37.8	36.8	0.9	3	2.3	45.8	99.4	Good	Good
It is necessary to have results for at least two tubes in order to calculate the precision of the measurements										Overall survey -->		Good precision	Good overall DC

Site Name/ ID: Whitby Road, WH

Precision: 11 out of 11 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)	
without periods with CV larger than 20%	
Bias calculated using 11 periods of data	
Bias factor A	0.99 (0.92-1.06)
Bias B	1% (-6% to 8%)
Diffusion tubes mean:	36 µg/m-3
Mean CV (precision):	4
Automatic Mean:	36 µg/m-3
Data capture for periods used:	99%

Accuracy (with 95% confidence interval)	
With all data	
Bias calculated using 11 periods of data	
Bias factor A	0.99 (0.92-1.06)
Bias B	1% (-6% to 8%)
Diffusion tubes mean:	36 µg/m-3
Mean CV (precision):	4
Automatic mean:	36 µg/m-3
Data capture for periods used:	99%

Table 21 Calculation of distance from roads correction

Site code	**Distance (m)**		**NO_2 Annual mean concentration (µg/m^3)**		
	Monitoring site to kerb	**Receptor to kerb**	**Background**	**Monitored at site**	**Predicted at receptor**
BE	2.4	2.9	18.4	37.5	36.6
C36	1.5	1.9	14.3	50.8	**48.9**
CFL	1.0	5.8	16.4	30.4	25.5
CIN	3.0	4.5	15.8	29.5	28.1
CP3	2.3	6.3	13.7	31.9	27.5
CVR	3.0	6.5	11.6	30.3	26.6
FH	2.0	2.2	17.7	39.4	38.9
FJ	2.0	2.5	17.7	40.5	39.3
FM	2.0	2.3	17.7	33.2	32.7
GE	5.0	6.0	18.4	26.9	26.4
GSW	1.6	2.6	18.4	33.3	31.7
HB	1.2	4.2	15.8	32.9	28.4
HW	1.9	2.9	18.4	36.0	34.3
IC	2.0	4.0	14.3	36.7	33.1
KR	2.2	6.7	12.7	33.9	28.2
LH	2.0	5.0	15.8	39.2	34.2
LI2	2.5	9.5	14.2	39.7	31.3
MCC	2.4	2.9	13.7	40.8	39.5
NS	4.0	6.0	18.1	35.0	33.1
OB	2.5	3.1	15.8	39.8	38.5
OW	2.3	4.6	18.4	51.8	**46.2**
PA	0.8	3.2	14.2	42.7	35.1
RR	2.1	5.1	18.1	36.8	32.9
ST	0.1	18.4	18.4	44.6	25.8
SV3	1.6	2.0	12.6	24.8	23.9
SZ	2.0	2.5	15.8	36.4	35.3
T11	1.5	4.2	15.8	32.0	28.3
T44	1.0	4.5	14.3	40.2	32.4
TA	2.0	9.5	11.2	47.4	34.2
TB	1.0	3.0	15.8	36.0	31.5
W23	5.0	8.0	13.7	29.2	27.0
WCR	1.5	8.7	14.3	41.1	30.8

Appendix D: Maps of monitoring locations and AQMAs

Figure 8 Location of automatic monitoring station BO in Chester

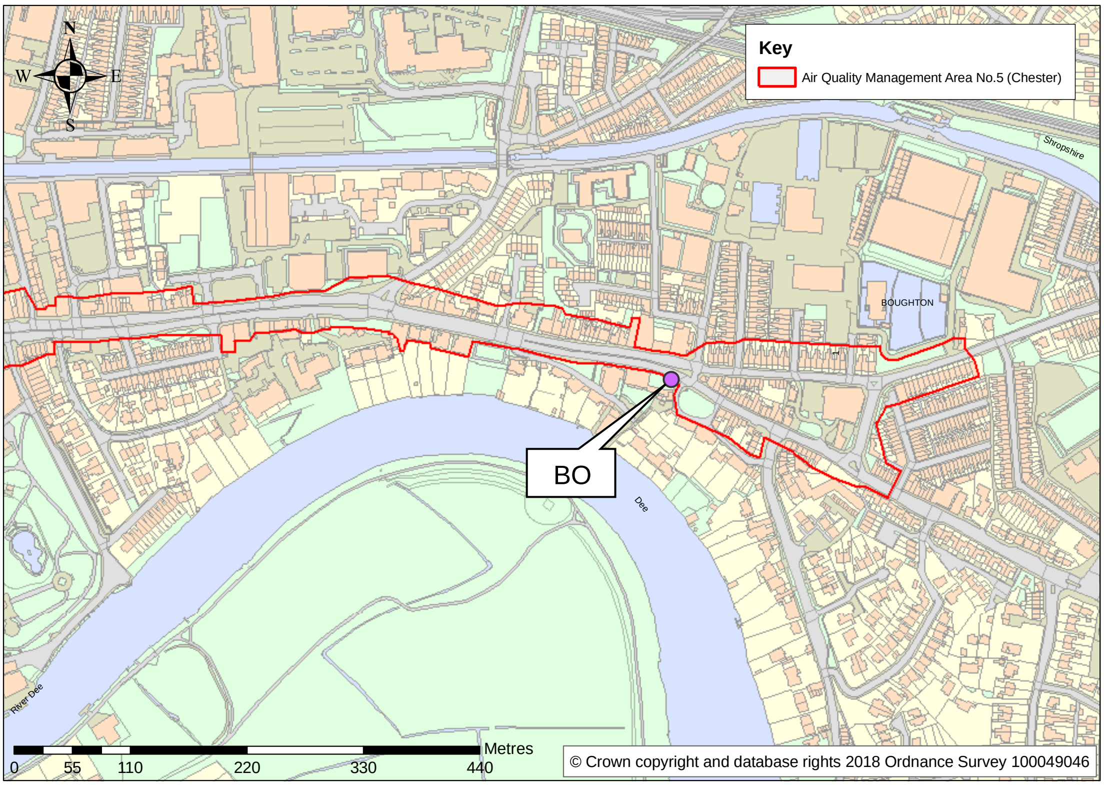


Figure 9 Location of automatic monitoring station CBI in Chester

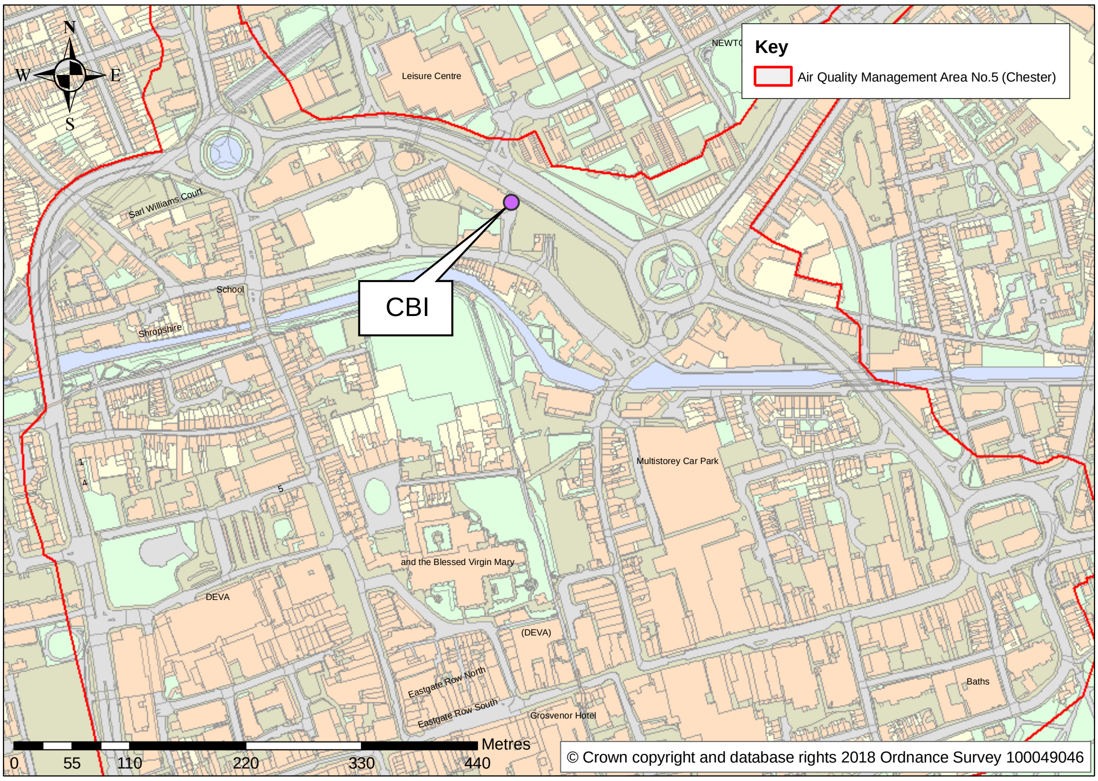


Figure 10 Location of automatic monitoring stations in Ellesmere Port

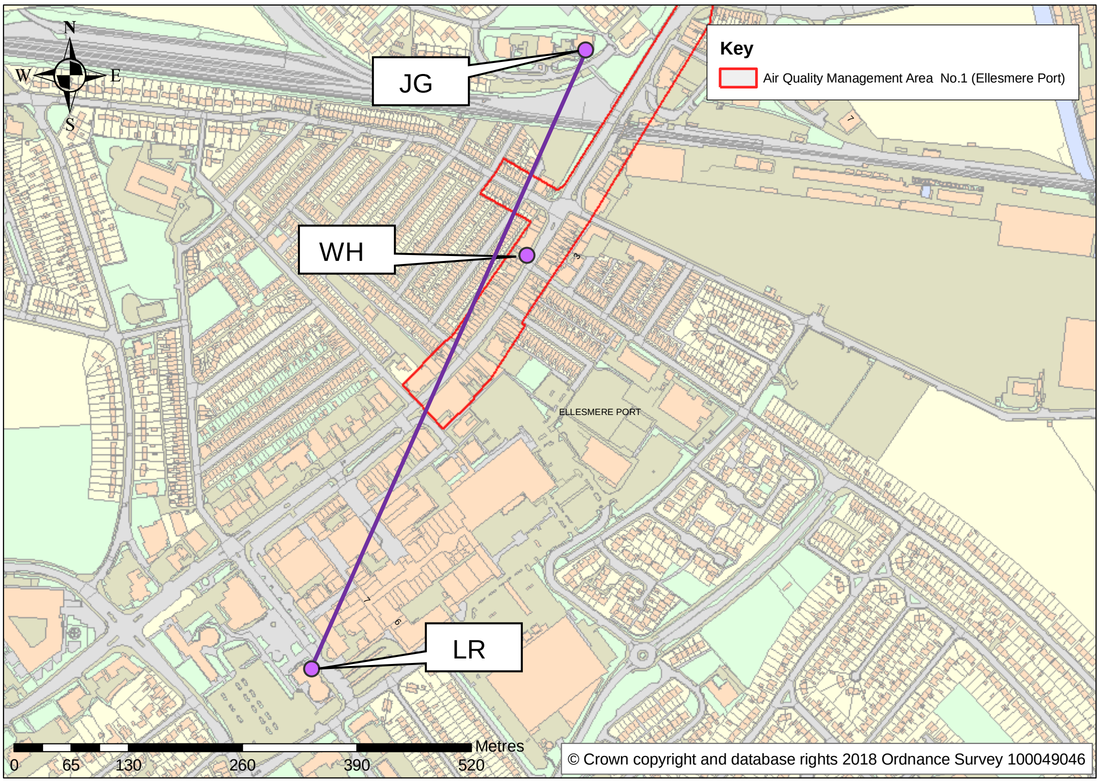


Figure 11 Location of automatic monitoring station in Frodsham

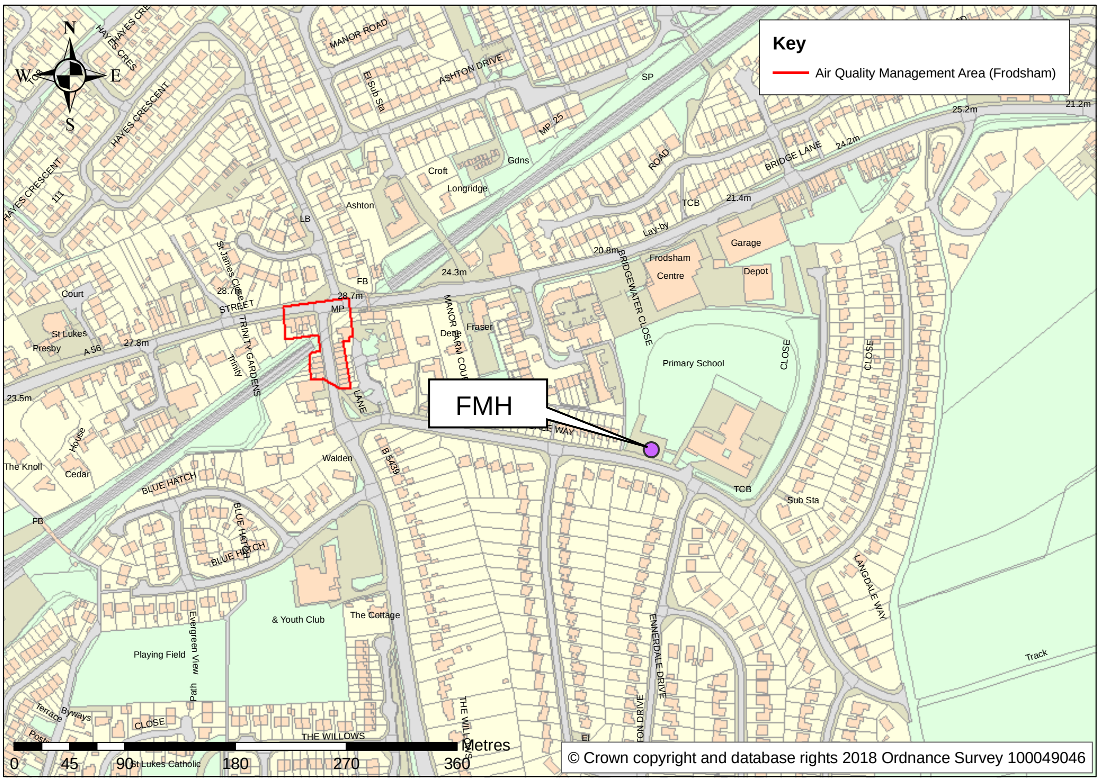


Figure 12 Location of automatic monitoring station in Thornton-le-Moors

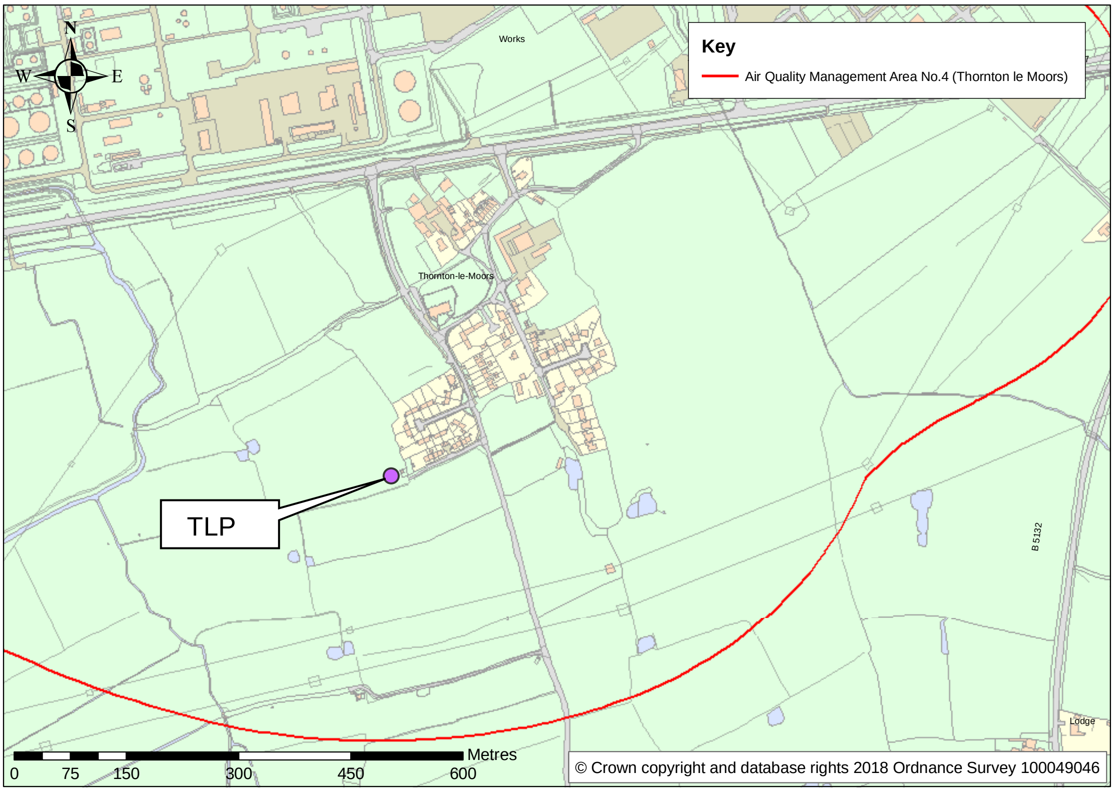


Figure 13 Location of automatic monitoring station in Elton

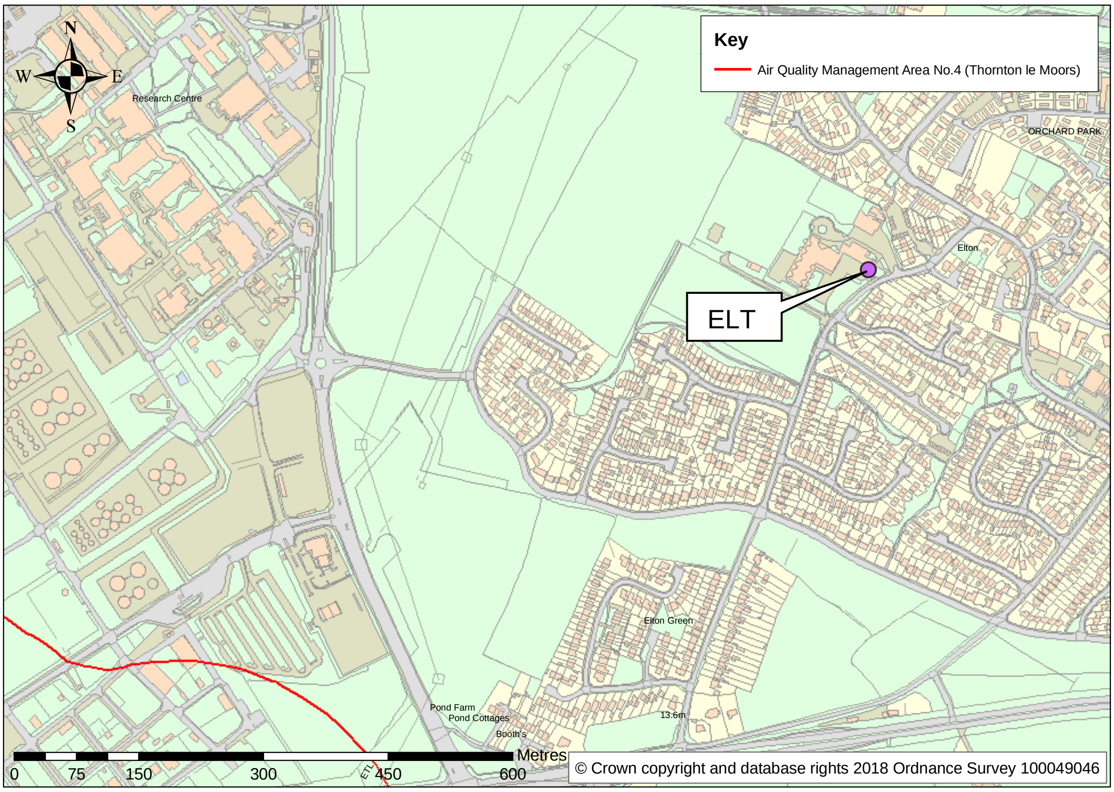


Figure 14 Locations of diffusion tubes in Chester

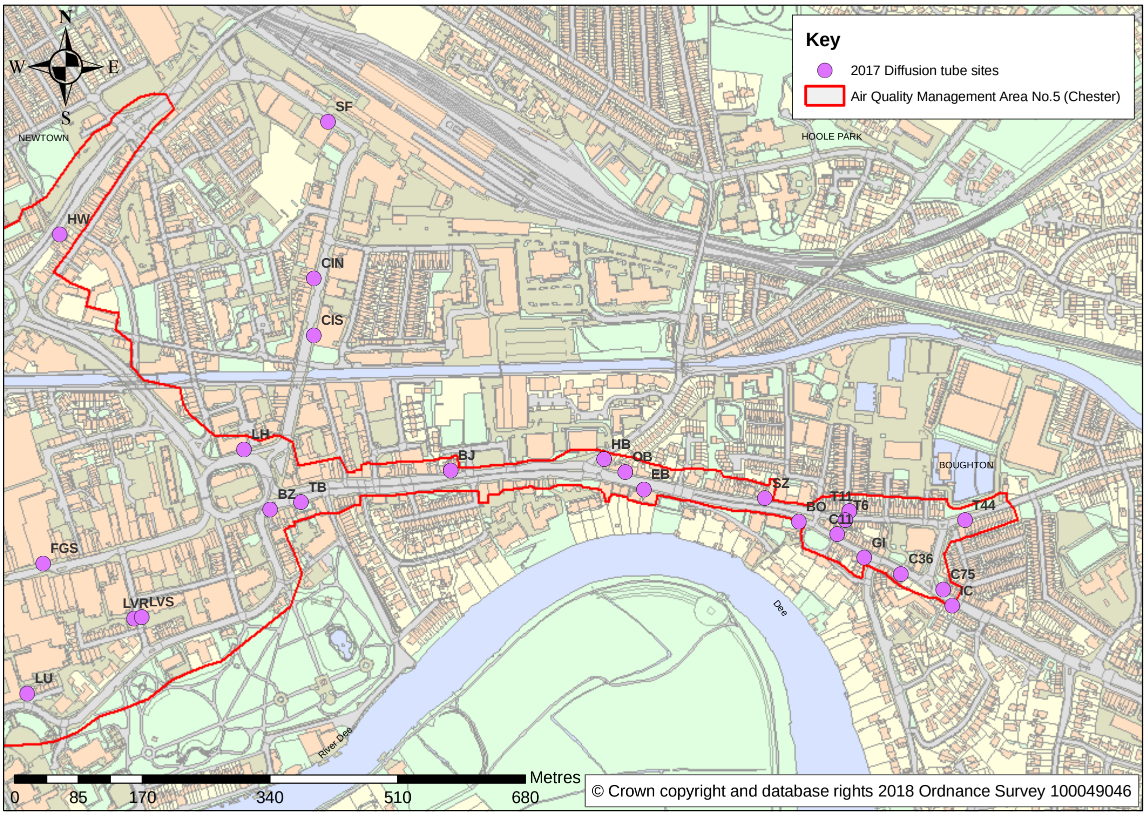


Figure 15 Locations of diffusion tubes in Chester

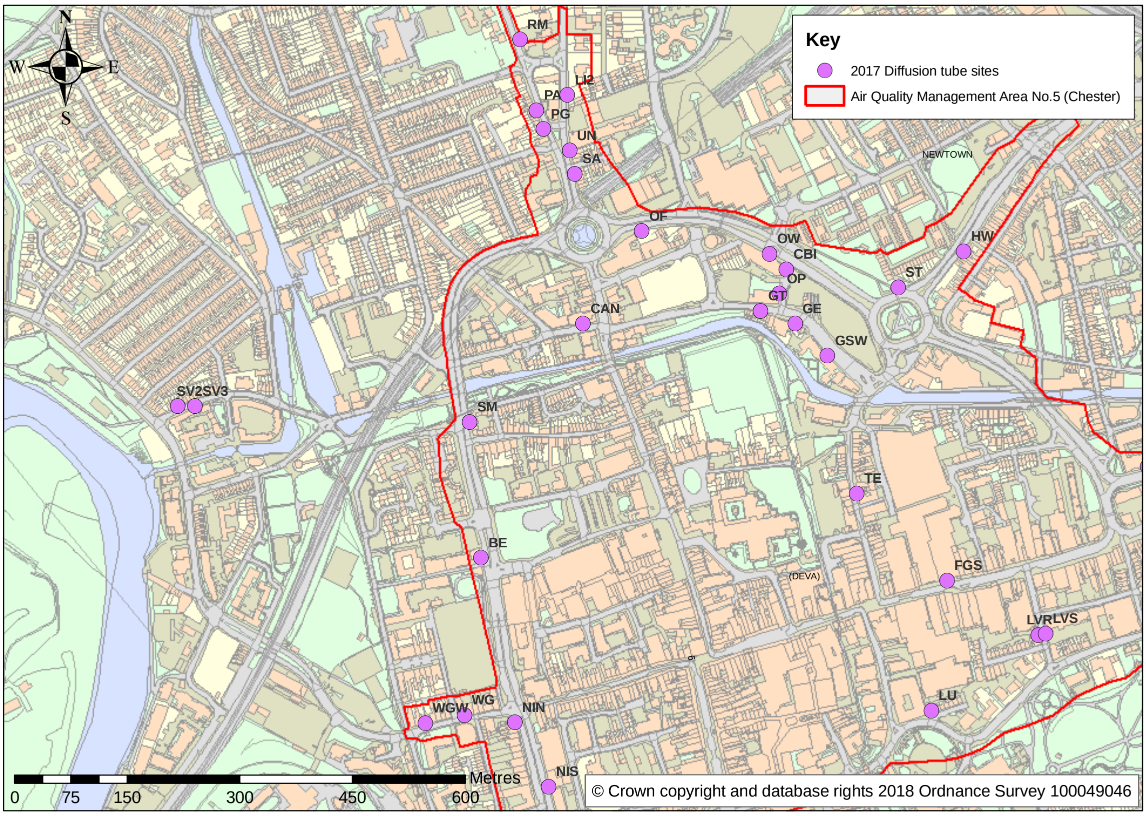


Figure 16 Location of diffusion tube in Chester

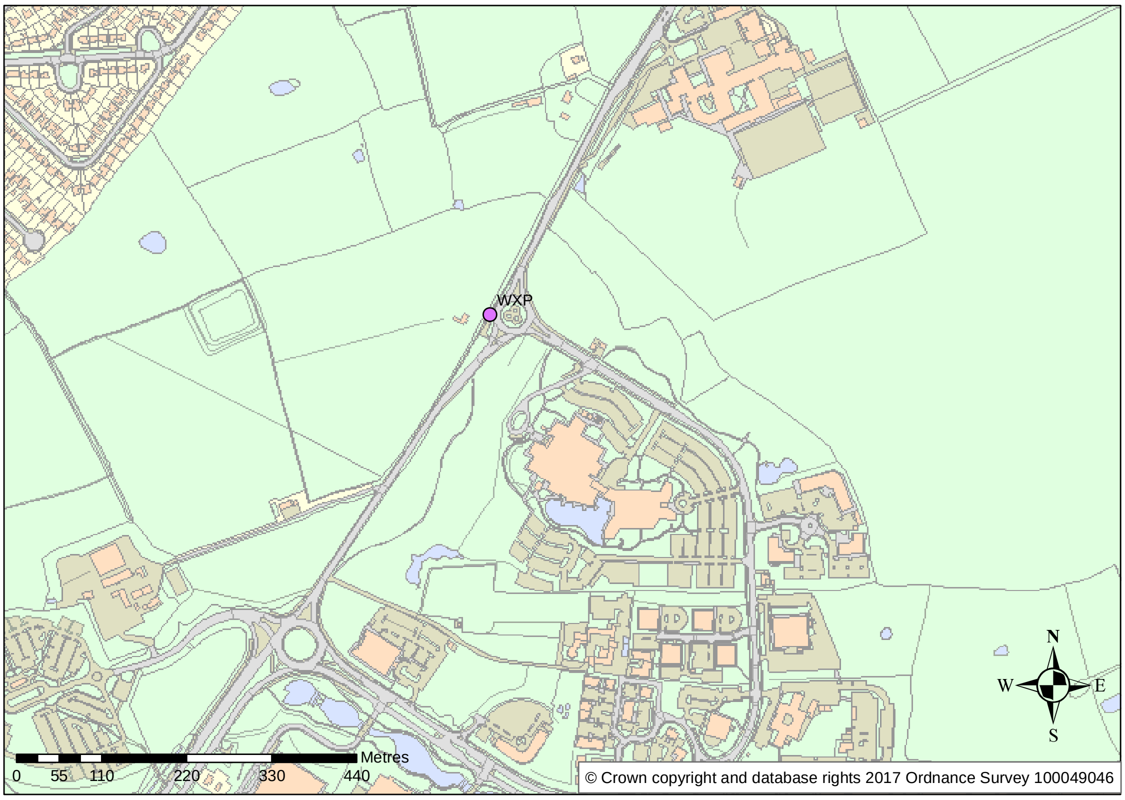


Figure 17 Location of diffusion tubes in Ellesmere Port

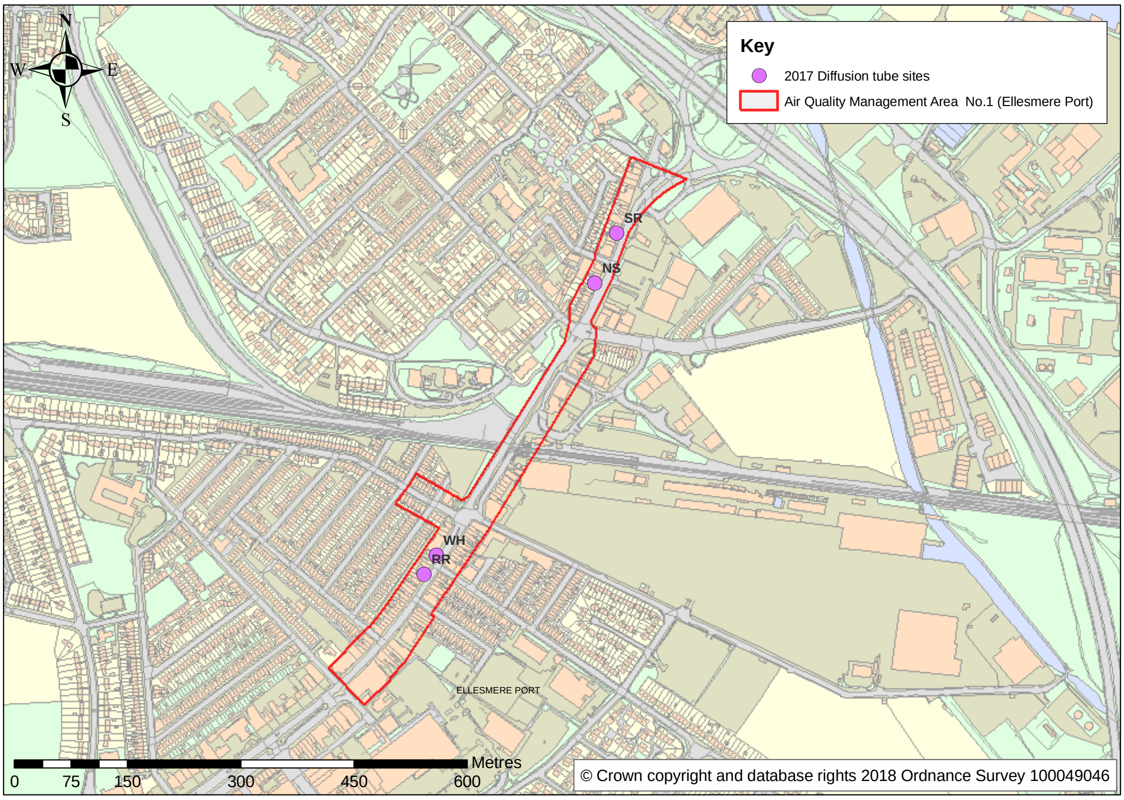


Figure 18 Location of diffusion tubes in Frodsham

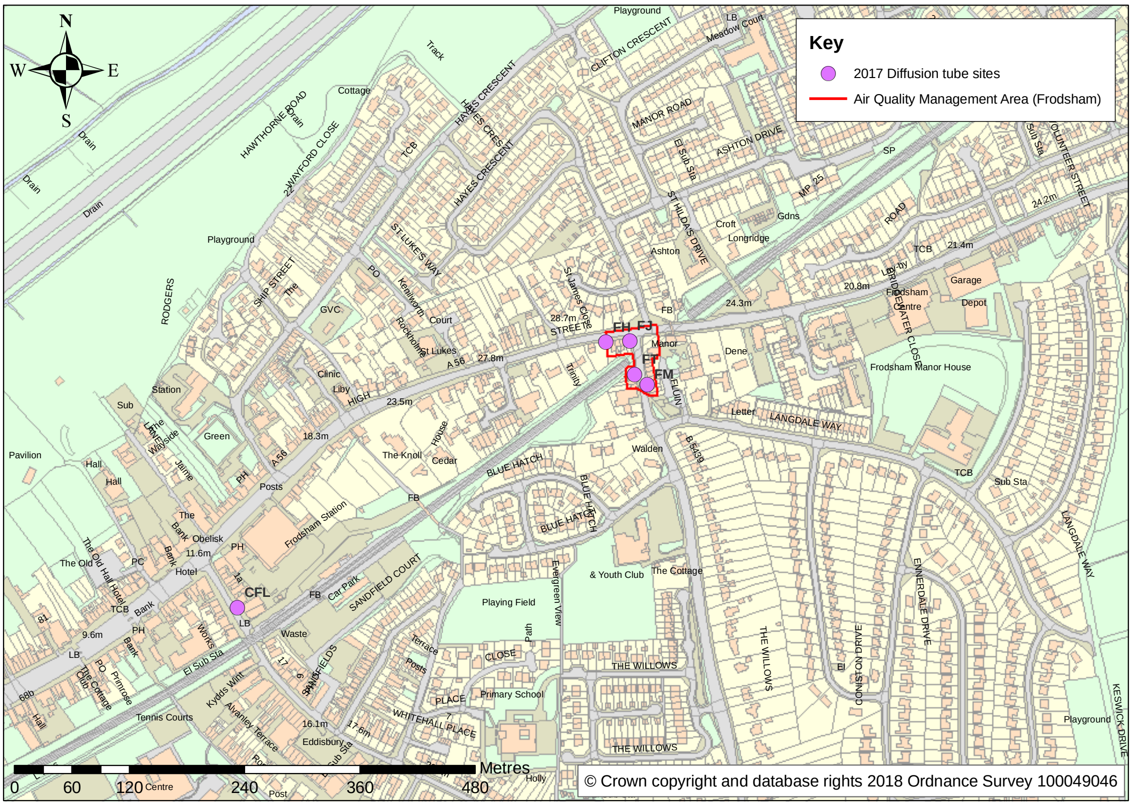


Figure 19 Location of diffusion tubes in Christleton / Boughton

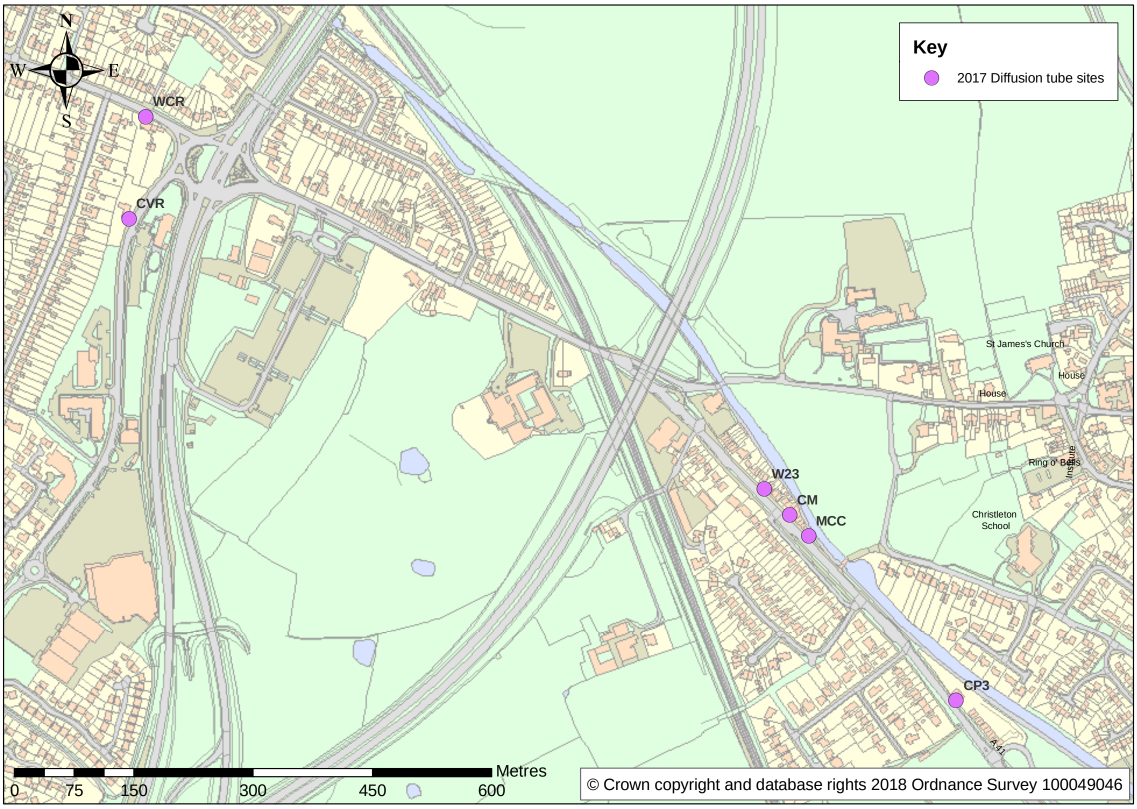


Figure 20 Location of diffusion tube in Littleton

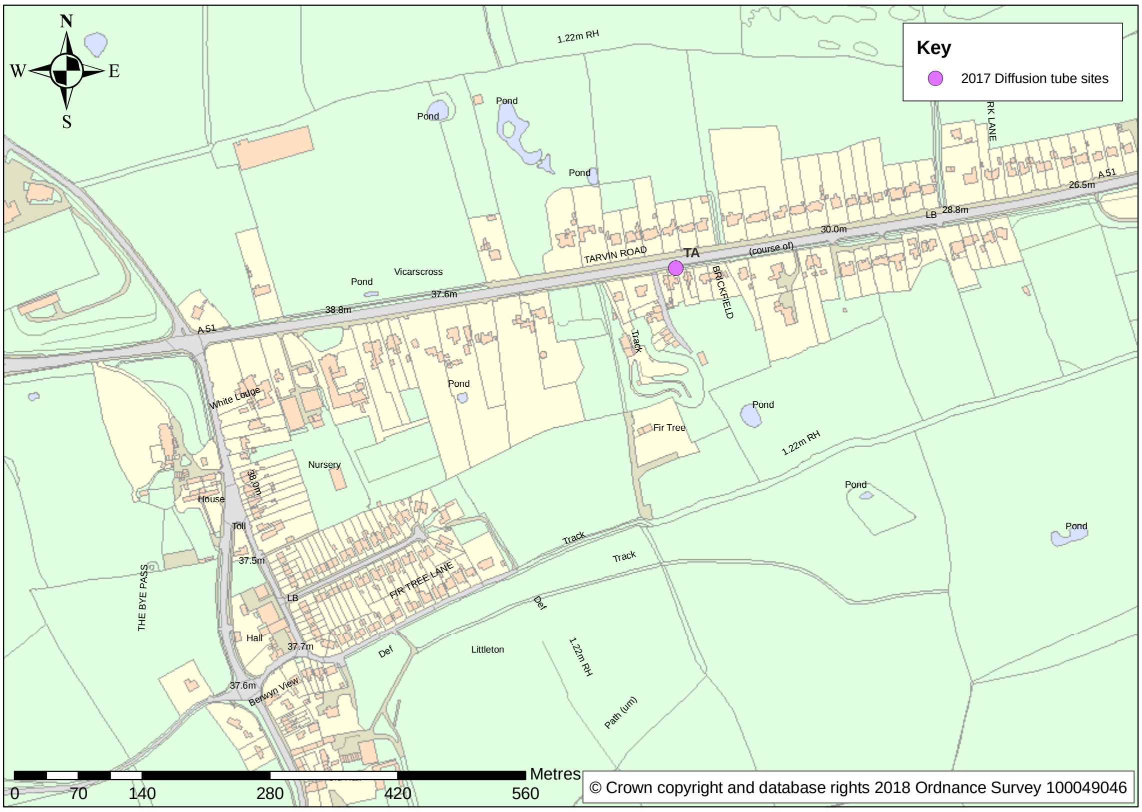


Figure 21 Location of diffusion tube in Rudheath

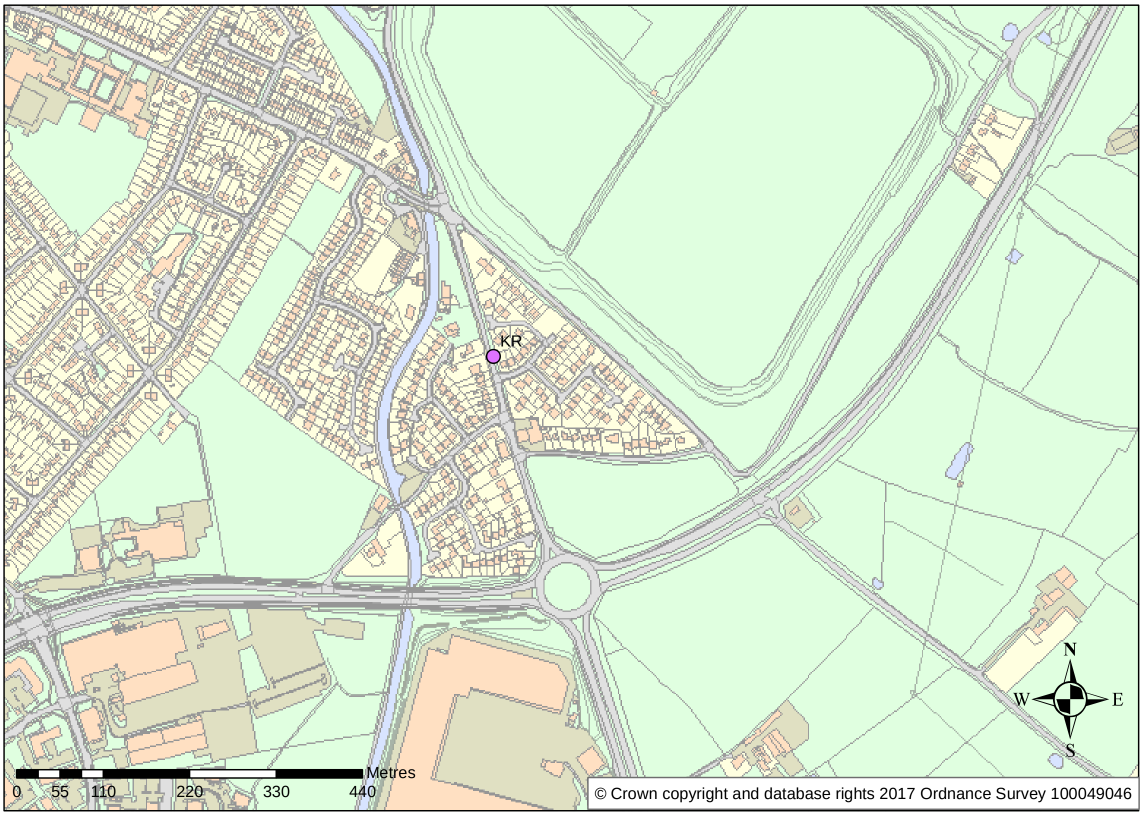
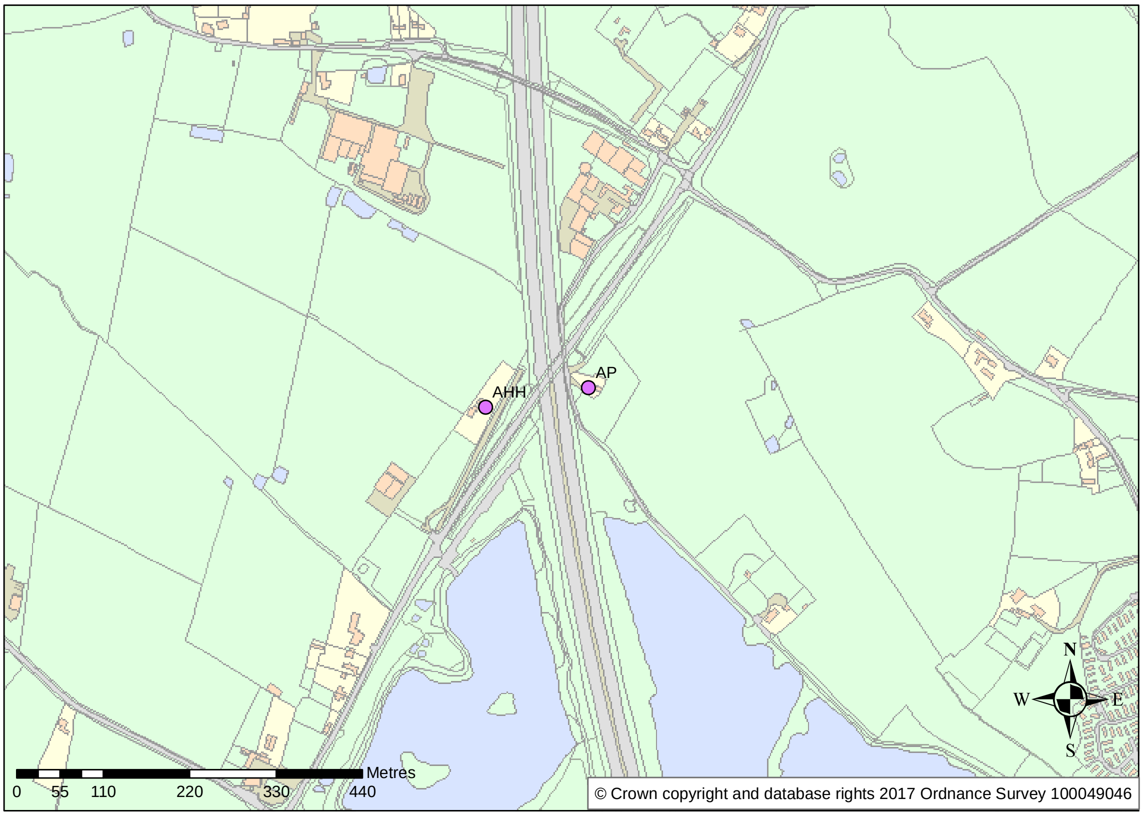


Figure 22 Location of diffusion tubes in Allostock



Appendix E: Summary of air quality objectives in England

Table 22 Air quality objectives in England

Pollutant	**Air quality objective**[4]	
	Concentration	**Measured as**
Nitrogen dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40 µg/m^3	Annual mean
Particulate matter (PM_{10})	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
	40 µg/m^3	Annual mean
Sulphur dioxide (SO_2)	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

[4] The units are in micrograms of pollutant per cubic metre of air (µg/m^3).

Appendix F: Inter-site comparisons

Figure 23 Inter-site hourly NO_2 comparisons 2017 (AQDM Ltd.)

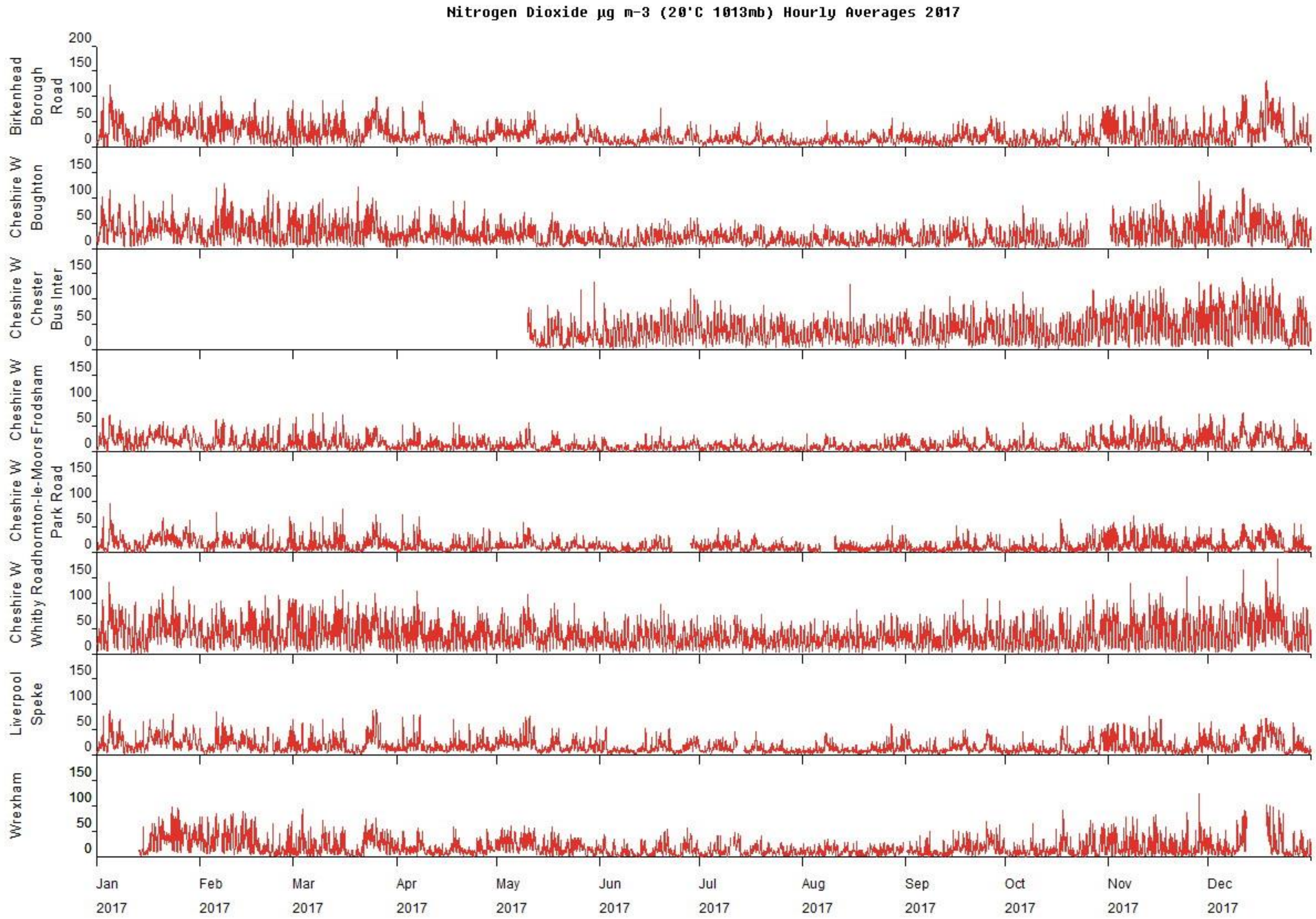


Figure 24 Inter-site daily PM_{10} comparisons 2017 (AQDM Ltd.)

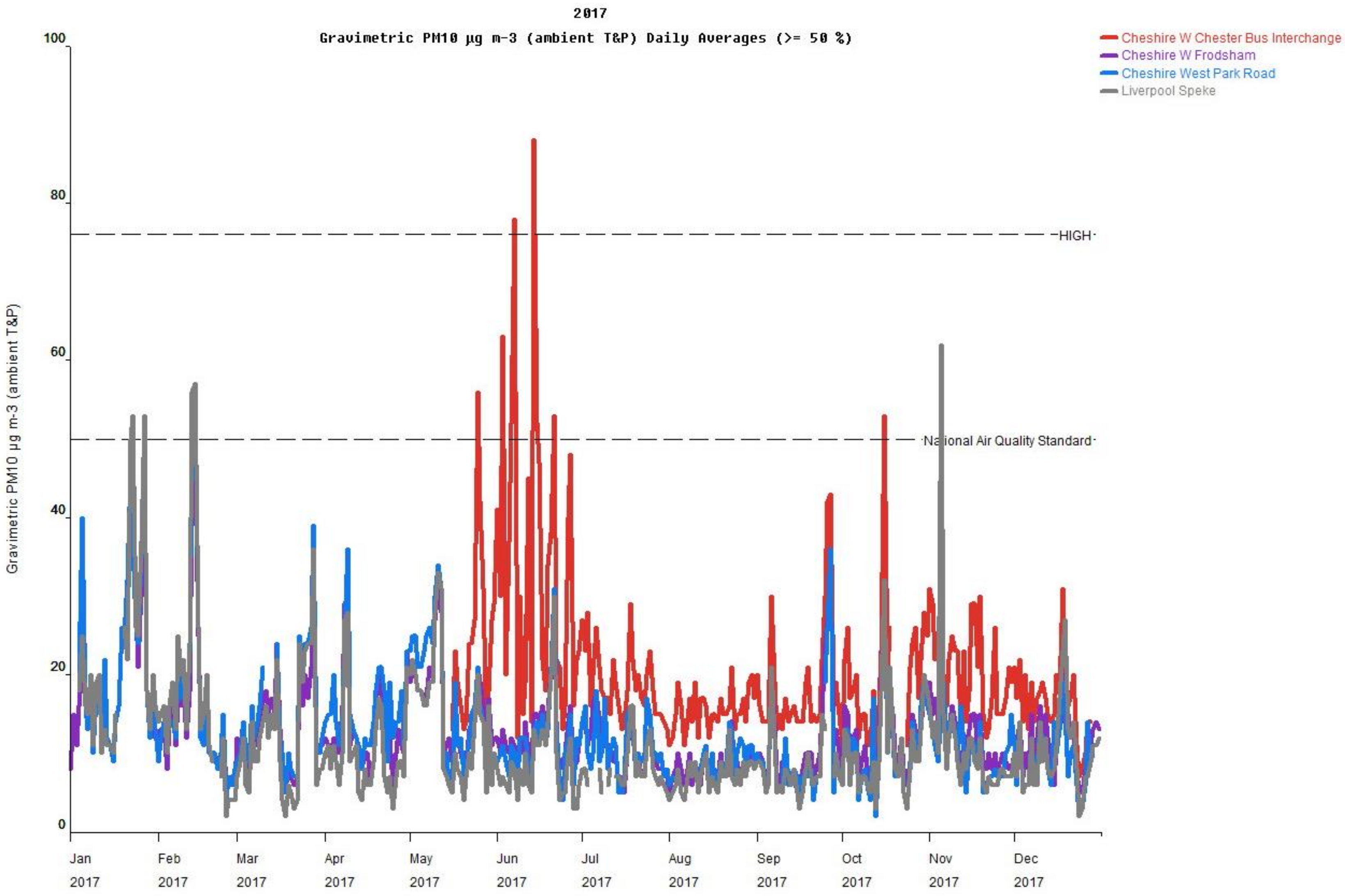
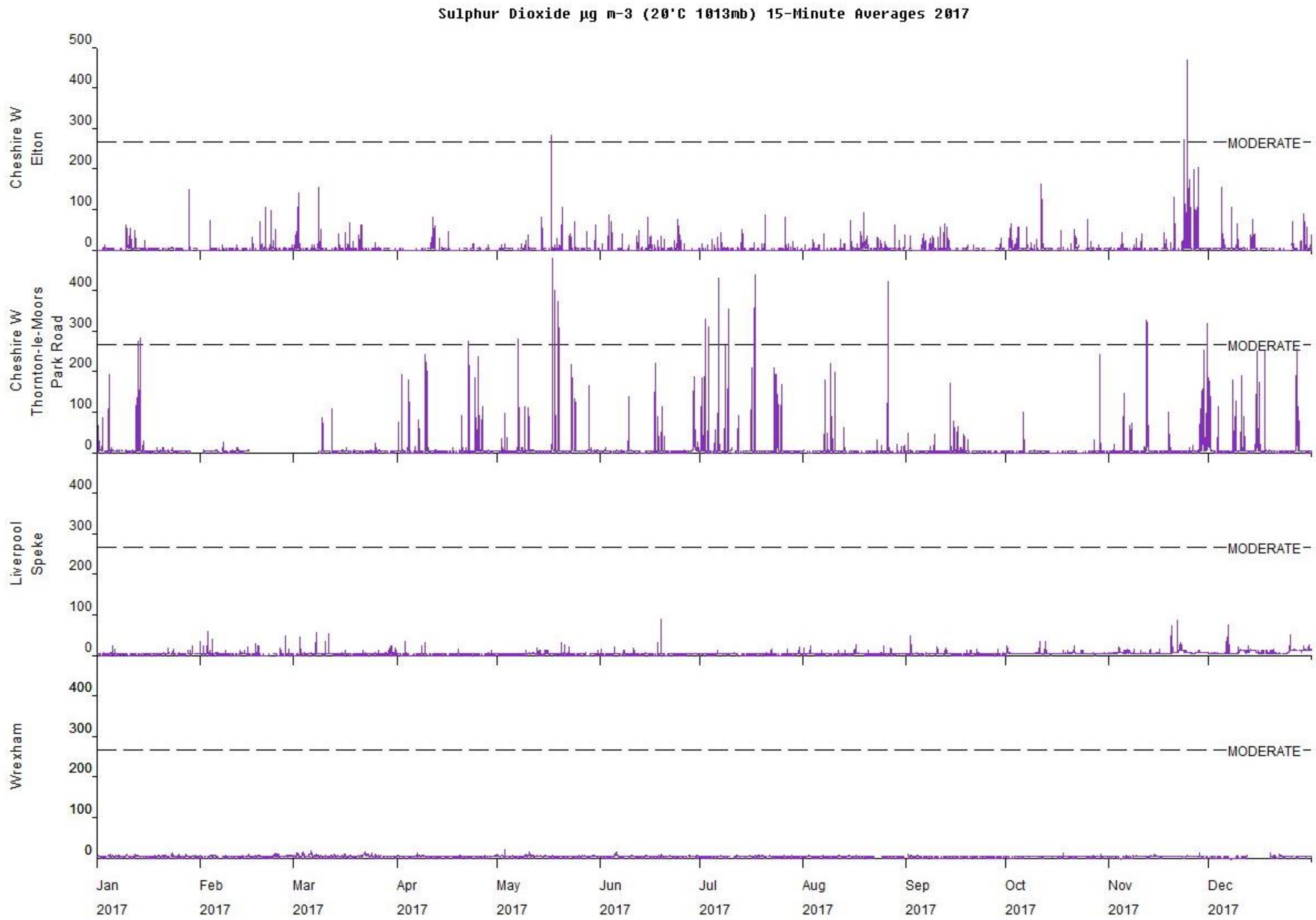


Figure 25 Inter-site 15-minute SO_2 comparisons 2017 (AQDM Ltd.)



Glossary of terms

Abbreviation	Description
AQAP	Air quality action plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the LA intends to achieve air quality limit values
AQMA	Air quality management area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
ASR	Annual status report for air quality
AURN	Automatic urban and rural network
Defra	Department for environment, food and rural affairs
CBTF / CVTF	Clean bus / vehicle technology fund
EU	European Union
EV	Electric vehicle
LAQM	Local air quality management
LES	Low emission strategy
NICE	National Institute for Health and Care Excellence
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
PM_{10}	Airborne particulate matter with a diameter of 10µm (micrometres/microns) or less
$PM_{2.5}$	Airborne particulate matter with a diameter of 2.5µm or less
QA/QC	Quality assurance and quality control
SO_2	Sulphur dioxide
TEA	Triethanolamine
$\mu g/m^3$	micrograms per cubic metre

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