Worcestershire
Regulatory Services
Supporting and protecting you

2017 Air Quality Annual Status Report (ASR)

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

March 2018

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Executive Summary: Air Quality in Our Area

Air Quality in Wychavon

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].

Worcestershire Regulatory Services (WRS) is a shared service formed from the Environmental Health and Licensing departments of the six Worcestershire District Councils. Responsibility for managing (monitoring and reporting of) local air quality transferred from the partnership councils to WRS in April 2011.

No discernible trend in NO_2 levels can be observed across the Wychavon District area as a whole over the five year period 2012 – 2016. A slight increase in NO_2 levels can be observed at many monitoring locations between 2015 and 2016 across the District as a whole. This slight increase can also generally been observed across Worcestershire. Some discernible trends can be observed where specific areas are reviewed in finer detail, e.g. the Port Street, Evesham AQMA, and these are discussed further throughout this ASR.

[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

A single Air Quality Management Area (AQMA) was declared by Wychavon District Council in 2007 for exceedences of the annual average mean objective for nitrogen dioxide (NO_2). The AQMA is known as the Port Street, Evesham AQMA.

Details of declaration and plans of the AQMA can be found on the following pages of WRS website: http://www.worcsregservices.gov.uk/pollution/air-quality/air-quality-management-areas.aspx

Port Street AQMA in 2016

In 2016 there have been no exceedences of the annual average mean objective for NO_2 in the Port Street AQMA. In addition, in 2016 no concentrations of NO_2 were within 5% of the annual average mean objective for NO_2 in the Port Street AQMA.

Following collection of 2016 monitoring data a detailed Revocation Screening Assessment of monitoring data gathered over the ten year period 2006 to 2016 has been carried out. This Revocation Screening Assessment is attached as Appendix C and is also available to view online at:

http://www.worcsregservices.gov.uk/media/3332956/Port-Street-Revocation-Screening-Assessment-FINAL.pdf

The Screening Assessment determined that over the ten year period assessed levels of NO_2 have generally followed a downward trend in the locality of Port Street. Over the same period there have been three marginal exceedances of the Objective at relevant exposure. These exceedances occurred in 2010 and 2013 when higher than usual levels of air pollution were observed across England due to prevailing meteorological conditions at the time. There has been no exceedance of the Objective at relevant exposure in the past three years.

Defra describe the circumstances under which an AQMA can be revoked. We are confident that these requirements are being met at the AQMA. Further details in relation to this can be found in the appended Revocation Screening Assessment report.

Based on the evidence provided by the assessment it is considered very unlikely that any consistent exceedance of the Objective will occur at relevant exposure in the future.

On 22nd November 2017 Wychavon District Council took the decision to revoke the Port Street AQMA. This decision was subject to consultation until 2nd March 2018. At the time of the writing of this report consultation responses are being reviewed, after which a formal revocation order will be drawn up.

Worcester Road, Wychbold in 2016

Three exceedences of the annual mean objective for NO_2 have been recorded at relevant exposure in the Worcester Road, Wychbold area in 2016.

Wychavon District Council has completed a Dispersion Modelling Assessment for the Wychbold area to confirm that an AQMA is required and to determine the necessary geographical extent of that AQMA. A copy of this Dispersion Modelling Assessment is attached in Appendix C and can also be viewed at http://www.worcsregservices.gov.uk/media/3332953/Worcester-Rd-Wychbold-Dispersion-Modelling-Assessment-October-2017-FINAL.pdf

On 22nd November 2017 Wychavon District Council took the decision to declare an AQMA at Worcester Road Wychbold. This decision was subject to consultation until 2nd March 2018. At the time of the writing of this report consultation responses are being reviewed.

Following completion of the consultation process Wychavon District Council will prepare an Action Plan within 12 months of the formal declaration of the AQMA. This Action Plan will be developed in close consultation with all relevant stakeholders.

Other areas across the District in 2016

No exceedences of the annual mean objective for NO_2, or any concentrations within 5% of that objective, have been recorded at any other location in the District in 2016.

Actions to Improve Air Quality

Following the conclusions of the Port Street, Evesham Revocation Screening Assessment and the decision by Wychavon District Council to revoke the AQMA the Air Quality Action Plan (AQAP) for this area has not been progressed. Going forward Wychavon District Council and WRS will continue to promote improvements to air quality in the area through various mechanisms including:

- Continued partnership working with Worcestershire County Council, including active participation in the upcoming Transport Strategy Steering Group for Evesham and development of the Evesham Town Transport Strategy.
- Facilitating adoption of draft Supplementary Planning Document by local planning authorities. The SPD is currently out to consultation with all six Worcestershire planning authorities, including Wychavon District Council.
- Continued detailed review of the area when new planning applications are received through continued use of WRS existing Air Quality Planning Consultation Zones. These are zones in which planning authorities are advised to consult more thoroughly with WRS due to presence of existing or former AQMAs and areas of emerging poor air quality.

Progress on more general County-wide actions, including progress with the development of a countywide SPD, is provided in Section 2 of this report.

Conclusions and Priorities

The main conclusions of the 2016 ASR are:

- The Port Street, Evesham AQMA can be revoked following a review of ten years of nitrogen dioxide monitoring data.
- A new AQMA is required at Worcester Road, Wychbold.
- In general there has been a slight upward trend in nitrogen dioxide levels between 2015 and 2016 across the district. There is no discernible upward or downward trend in levels over the five year period 2012-2016.

Priorities for addressing air quality in Wychavon across the coming year are:

- Completion of the consultation process and formal revocation of the Port Street, Evesham AQMA
- Completion of the consultation process and formal declaration of an AQMA at Worcester Road, Wychbold.
- Launch of Steering Group to work towards developing and delivering Action Plan for Worcester Road, Wychbold.
- Development of an Action Plan for the new Worcester Road, Wychbold AQMA within 12 months of the date of formal declaration. It is anticipated that the key challenge in developing the Action Plan will be in relation to securing engagement and involvement of key stakeholders.
- Formal adoption of the WRS Supplementary Planning Document by Wychavon District Council.

Local Engagement and How to get Involved

In general there has been an increase in interest with regard to local air quality from the public and some local decision makers. This is likely attributable to recent increases in exposure in both national and local media.

Local engagement can be summarised as follows:

Port Street AQMA

- A Steering Group was established. However interest and participation was limited to district councillors and Worcestershire County Council.

Worcester Road, Wychbold

Initial engagement has been through completion of a consultation on the decision to declare the AQMA. This has lead to the following:

- Continued engagement with Worcestershire County Council.
- Initial engagement with Highways England.
- Continued engagement with the local district councillor.
- Initial and continued engagement with Dodderhill Parish Council.

Going forward a large proportion of engagement is likely to be through a formal steering group. It is anticipated that key stakeholders, decision makers and members of the public will participate in the steering group and development of the Action Plan.

There are a number of ways members of the public can help to improve local air quality:

- Walk or cycle around the District instead of driving;
- Avoid travelling through AQMAs.

- Worcestershire County Council have launched a car sharing website, Lift Share, to help people find others journeying to the same destinations to

  share journeys and costs, and reduce traffic and emissions. Visit this link for more information: https://worcestershire.liftshare.com/

- General travel planning advice is available on Worcestershire County Council's website (including walking, cycling and bus maps and timetables).

- If you have to drive follow fuel efficient driving advice, often known as 'Smarter Driving Tips', to save on fuel and reduce your emissions. A number of websites promote such advice including:

  - http://www.energysavingtrust.org.uk/travel/driving-advice
  - http://www.theaa.com/driving-advice/fuels-environment/drive-smart
  - http://www.dft.gov.uk/vca/fcb/smarter-driving-tips.asp

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1 Local Air Quality Management

This report provides an overview of air quality in Wychavon 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 Wychavon District 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 E.3 in Appendix E.

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 number of changes in relation to declared AMQAs have occurred in the Wychavon District during 2017 and early 2018. Wychavon District Council has recently completed consultation on the revocation of the existing AQMA at Port Street, Evesham and the declaration of a new AQMA at Worcester Road, Wychbold. At the time of the writing of this report consultation responses are being reviewed.

A summary of AQMAs declared by Wychbold District Council as of 31st January 2018 can be found in Table 2.2. Further information related to currently declared or revoked AQMAs, including maps of AQMA boundaries are available online at http://www.worcsregservices.gov.uk/pollution/air-quality/air-quality-management-areas.aspx Alternatively, see Appendix D: Map(s) of Monitoring Locations and AQMAs, which provides maps of air quality monitoring locations in relation to the AQMA(s).

Revocation of Port Street, Evesham AQMA

Wychavon District Council has taken the decision to revoke the existing Port Street Evesham AQMA. This decision was subject to consultation until 2nd March 2018. At the time of the writing of this report consultation responses are being reviewed, after which a formal revocation order will be drawn up.

This decision has been taken following a detailed Screening Assessment of monitoring data for the period 2006 to 2016. This Screening Assessment is attached as Appendix C or available to view online at

http://www.worcsregservices.gov.uk/media/3332956/Port-Street-Revocation-Screening-Assessment-FINAL.pdf

Over the ten year period assessed levels of NO_2 have followed a downward trend. Over the same period there have been three marginal exceedances of the Objective at relevant exposure. These exceedances occurred in 2010 and 2013 when higher than usual levels of air pollution were observed across England due to prevailing meteorological conditions at the time. There has been no exceedance of the Objective at relevant exposure in the past three years. Defra describe the circumstances under which an AQMA can be revoked. We are confident that these requirements are being met at the AQMA. Based on the evidence provided by the assessment it is considered very unlikely that any consistent exceedance of the Objective will occur at relevant exposure in the future.

Declaration of new AQMA at Worcester Road, Wychbold

Wychavon District Council has taken the decision to declare a new AQMA for exceedances of the NO_2 annual mean objective at Worcester Road, Wychbold. This decision was subject to consultation until 2nd March 2018. At the time of the writing of this report consultation responses are being reviewed.

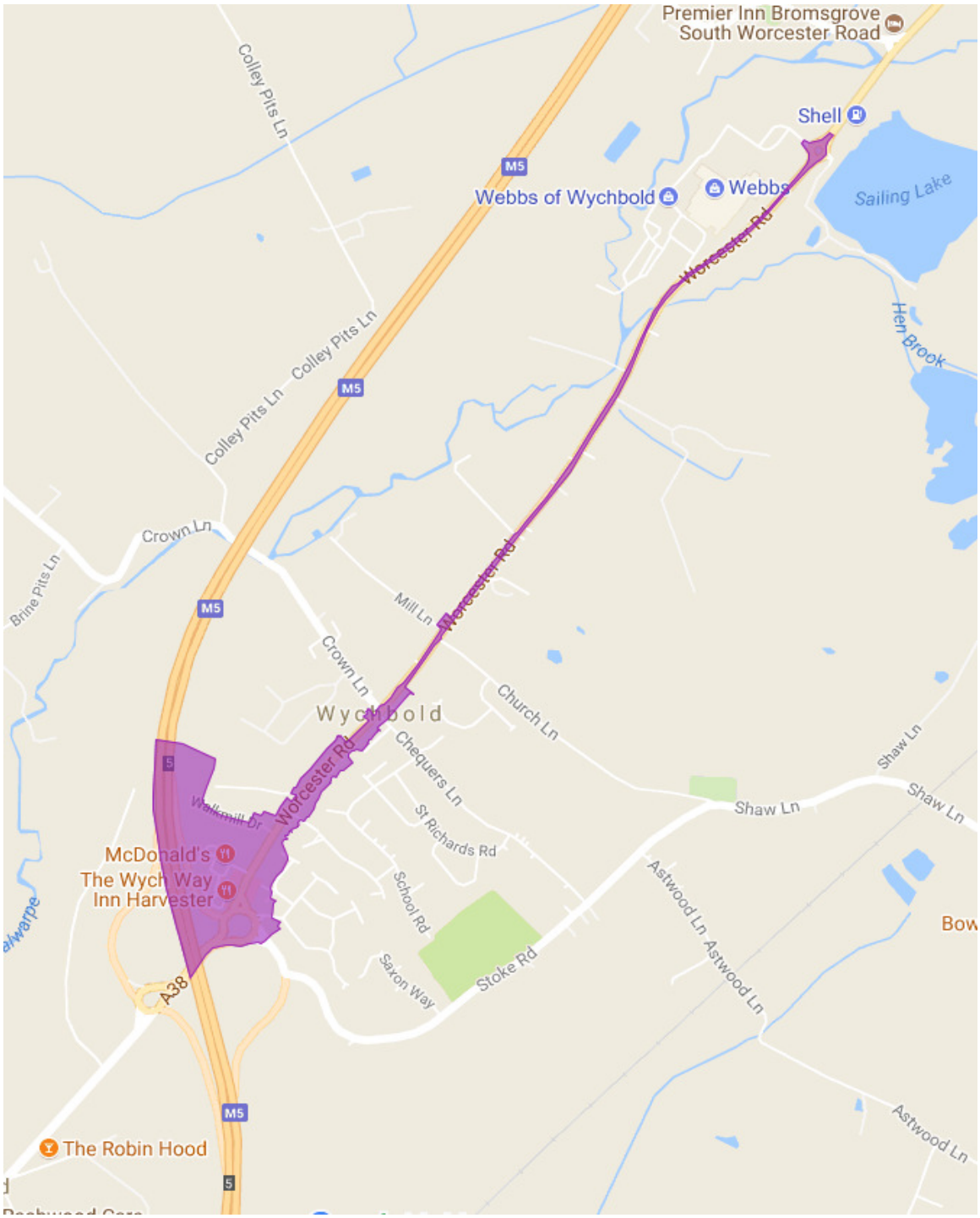
This decision has been taken following monitoring and modelling exercises. Monitoring data is available to view in the Monitoring Section of this report. In addition a Dispersion Modelling Assessment has been undertaken to determine the necessary geographical extent of the AQMA and is attached as Appendix C, or available online at http://www.worcsregservices.gov.uk/media/3332953/Worcester-Rd-Wychbold-Dispersion-Modelling-Assessment-October-2017-FINAL.pdf

A plan of the proposed geographical extent of the AQMA is provided as Figure 2.1. The proposed geographical area is based on measured and predicted exceedances

of the NO_2 annual mean objective and areas considered as being relevant in terms of the management of an AQMA, for example, the surrounding strategic road network.

It is noted that this geographical area may change as a result of consultation responses received and will be finalised as a formal order, which will be provided to DEFRA in due course.

Figure 2.1 – Proposed extent of Worcester Road, Wychbold AQMA



Map Data © 2018 Google

Table 2.2 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	City / Town	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance (maximum monitored/modelled concentration at a location of relevant exposure)		Action Plan (inc. date of publication)
						At Declaration	Now	
Port Street, Evesham AQMA	Declared 22nd August 2007	NO_2 Annual Mean	Evesham	Mixed residential and retail street canyon along main route into town centre from the east	NO	40.0 µg/m3 at declaration in 2007 Maximum monitored concentration was 42.4 µg/m3 in 2010	34.7 µg/m3	Air Quality Action Plan for Worcestershire (2013) and subsequent 2015 and 2016 AQAP Progress Reports. Available at http://www.worcsregservices.gov.uk/pollution/air-quality/air-quality-action-plan.aspx

☒ **Wychavon District Council confirm the information on UK-Air regarding their AQMA(s) is up to date** – *note, this will require updating following formal revocation of Port Street, Evesham and declaration of Worcester Road, Wychbold*

2.2 Progress and Impact of Measures to address Air Quality in Wychavon District

Appraisal of last year's ASR concluded the following:

Detailed Review of Monitoring Data for Port Street, Evesham AQMA

A detailed review of monitoring data for the Port Street, Evesham AQMA was required to determine whether the AQMA can be revoked. This detailed review has been undertaken and is attached as Appendix C and available to view online at http://www.worcsregservices.gov.uk/media/3332956/Port-Street-Revocation-Screening-Assessment-FINAL.pdf The detailed review concluded that the AQMA can be revoked and the decision to revoke was taken by Elected Members at Wychavon District Council on 22nd November 2017. The decision was subject to consultation until 2nd March 2018. At the time of the writing of this report consultation responses are being reviewed, after which a formal revocation order will be drawn up and a copy provided to DEFRA.

It is likely that compliance with the Objective at the Port Street, Evesham AQMA is attributable to the following:

- It is WRS view that the declaration was made based on limited data and marginal exceedances of the Objective. Further assessment at the time may not have resulted in declaration of an AQMA in the area.
- Improvements in emission of the UK vehicle fleet will have contributed to lowering nitrogen dioxide levels below the Objective.

In light of the above it is not considered necessary to progress the Air Quality Action Plan for Port Street, Evesham.

Wychavon District Council will continue to monitoring nitrogen dioxide levels in the Port Street, Evesham area. Wychavon District Council will continue to promote

improvements to air quality in the area through continued partnership working with Worcestershire County Council, including active participation in the upcoming Transport Strategy Steering Group for Evesham and development of the Evesham Town Transport Strategy.

Dispersion modelling assessment of Worcester Road, Wychbold

A dispersion modelling assessment of Worcester Road, Wychbold was required to confirm that an AQMA is required and to determine the necessary minimum geographical extent of the AQMA. This dispersion modelling exercise has been undertaken and is attached as Appendix C and available online at http://www.worcsregservices.gov.uk/media/3332953/Worcester-Rd-Wychbold-Dispersion-Modelling-Assessment-October-2017-FINAL.pdf A plan of the proposed geographical extent of the AQMA is attached as provided as Figure 2.1 above. The decision to declare an AQMA has been taken by Members at Wychavon District Council. The decision was subject to consultation until 2nd March 2018. At the time of the writing of this report consultation responses are being reviewed.

Following formal declaration of the AQMA Wychavon District Council will develop an Action Plan for the Worcester Road, Wychbold AQMA. Work on this has already begun and includes commencement of a source apportionment study for the area and initial liaison with key stakeholders. All relevant stakeholders have been consulted on the decision to declare the AQMA and the responses received are currently being reviewed. It is anticipated that a draft Action Plan will be completed within 12 months of the formal declaration of the AQMA. Progress on the implementation of the Action Plan will be reported to Defra via Annual Status Reports.

Wychavon District Council has taken forward a number of general measures during the reporting year of 2016 in pursuit of improving local air quality across its District. Details of all measures completed, in progress or planned are set out in Table 2.3.

More detail on these measures can be found in the Air Quality Action Plan for Worcestershire and its subsequent updates, available online at http://www.worcsregservices.gov.uk/pollution/air-quality/air-quality-action-plan.aspx

Wychavon District Council expects the following to be completed over the course of 2018:

- Formal declaration of an AQMA at Worcester Road, Wychbold
- Formal revocation of the existing AQMA at Port Street, Evesham
- Launch of Steering Group to work towards formulating and delivering Action Plan for Worcester Road, Wychbold.
- Formal adoption of the WRS Supplementary Planning Document by Wychavon District Council.

Wychavon District Council expects the following to be commenced over the course of 2018:

- Commencement of development a draft Action Plan for Worcester Road, Wychbold including a source apportionment exercise. To be completed within 12 months of the formal declaration of the AQMA.

Table 2.3 – Progress on Measures to Improve Air Quality

Measure No.	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
5.2.10	Installing electric vehicle charging points	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	Wychavon District Council, Worcestershire County Council	2013 - 2019	2014 onwards	Increase in availability of EV charging points and corresponding increase in use of electric vehicles	Reduced vehicle emissions	Recommendations for installation of EV Charging Points on relevant planning consents formalised in draft SPD currently with Wychavon District Council planning authority for consideration.	Estimate SPD adoption 2018. T	Lack of prioritisation for funding opportunities for EV charging infrastructure for authorities unnamed in Govt AQAP
5.2.2	Freight Quality Partnership – work with satellite navigation companies to route HGVs around AQMAs	Traffic Management	UTC, congestion management, traffic reduction	Worcestershire County Council	COMPLETED 2014 - 15	On-going.	Fewer HGVs travelling through AQMA	Reduced emissions	Ongoing	On-going duty under Traffic Management	Can take time for information to filter down to users
5.3.2	Car Sharing	Alternatives to private car use	Car and lift sharing schemes	Worcestershire County Council	2014 – 2015 COMPLETED	Liftshare Scheme launched Autumn 2015	Increase in number of people car sharing	<1%	Liftshare Scheme launched in Autumn 2015	Liftshare website scheme launched Autumn 2015. Currently operating	Following an initial surge in interest from public, use of service has slowed down

5.3.4	Promote flexible working arrangements	Promoting travel alternatives	Encourage/facilitate home-working	Worcestershire County Council, Superfast Worcestershire	N/A	On-going	Increase in number of people able to work from home	Reduce emissions	94% Superfast Broadband coverage across County. 69,212 properties able to access superfast broadband	96% coverage by Dec 2019	Potential reticence from companies to allow employees to WFH. Further actions on hold to prioritise emerging strategic plans and strategies. Need for improved rural soft infrastructure
5.3.6	Improve cycling and walking routes in local areas	Promoting Travel Alternatives	Promotion of cycling	Worcestershire County Council,	201 8 onwards	Currently unknown	Uptake in commuter journeys undertaken by cycle or walking	Reduce emissions	LTP4 (201-2030) outlines a number of planned active corridors in the Wyhavon District. These include active travel corridors between the new Worcester Parkway Rail Station and Pershore, Worcester and Droitwich Spa, Perhore to Evesham and Pershore to Pinvin	up to 2030	Effectiveness depends on individual motivation to modal shift
5.3.1	Travel Planning	Promoting Travel Alternatives	Personalised travel planning	Worcestershire County Council	2016	2017	Increased uptake of alternative modes of transport	Reduced emissions	Worcestershire County Council is delivering PTP services on behalf of developers. Building on best practice developed by the Council this proven tool encourages modal shift in new developments towards more sustainable and space efficient forms of transport.	On-going	
5.4.1	Smarter Driving Tips	Public Information	Via the Internet	WRS and Worcestershire County Council	2017	2017	Increase in website hits	Reduce emissions	New advice page created for all groups affected by and impacting air quality and shared with County Public Health. Activation on WRS webpages held up by website platform	2018-19	Effectiveness depends on behavioural change

									changes and security issues caused by outside links requiring signidficant additional work to web design.		
5.4.2	Provide link to real time air quality informatio n	Public Informatio n	Via the Internet	WRS and Worcestershire County Council	2017	2017	Increase in WRS Twitter subscribers	0	System put in place at WRS to tweet alerts when Air pollution > 3 (Low) in any given 5 day forecast on Defra Daily Air Quality Index and shared with County Public Health representative	On-going	Limited to Twitter users
5.4.4	Make air quality informatio n more available and accessible	Public Informatio n	Via the Internet	WRS	2012	2012-2016	Website hits and enquiries for information	0	All exisiting LAQM reports and details of AQMAs are available to public on WRS website.	On-going	
5.45	Raise the profile and increase awarenes s of air quality within the region	Other	Other	WRS, Midland Joint Advisory Council (MJAC), Central England Environmental Protection Group (CEEPG), DEFRA LAQM Team	2014	2014 onwards	Improved cross boundary knowledge sharing between local authorities in West Midlands	Reduce emissions	WRS hold position of Air Quality technical coordinator for MJAC, member of CEEPG and member of Defra LAQM Team Local Authority Advisory Group both formed in 2017.	WRS has been MJAC AQ Technical Coordinator since 2014. MJAC/CEEPG Knowledge Hub group set up in 2017 delivered by joint working between WRS and Cannock Chase DC. Member of LA advisory group to Defra LAQM team following invitation 2017.	Reduced AQ officers in regional authorities and resource
5.5.1	Produce Air Quality Supplemе ntary Planning Document	Policy Guidance and Developm ent	Air quality planning and policy guidance	WRS and Wychavon District Council	2016-2017	2017 2018	Formally adoption and utilised by Worcester City Council planning authority	Reduced emissions from new Develop-ments	SPD drafted by WRS and provided to City Council late 2017. Currently being considered by planning authority.	Amendments following consultation followed by formal adoption by City Council 2018	Varying views on SPD from 6 different local authorities could hamper adoption of single SPD

5.6.3	Air Quality Networks	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	Worcestershire Regulatory Services, Central England Environmental Protection Group (CEEPG), DEFRA LAQM Team	2017	2017 onwards	Improved cross boundary working between local authorities in West Midlands	Reduce emissions	WRS are member of regional environmental protection managers group (CEEPG) and member of Defra LAQM Team Local Authority Advisory Group both formed in 2017.	On-going.	Differing AQ issues, priorities and resources in regional authorities
5.6.8	Forge closer links with local health agencies	Other	Other	WRS and Worcestershire County Council	N/A	On-going	Increase participation of Public Health in Worcestershire Air Quality issues and action groups	0	WRS officers have met with the Director of Public Health at Worcestershire County Council to highlight the air quality agenda in relation to NO_2 and PM2.5.	On-going	Limited engagement in air quality matters from Worcestershire DoPH.

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.

There are currently no automatic $PM_{2.5}$ monitoring stations in Worcestershire. The nearest AURN $PM_{2.5}$ monitoring station is the Birmingham Acocks Green site approximately 32 miles to the north east of the Wychavon District.

WRS has reviewed the 2015 based DEFRA national background maps to determine projected $PM_{2.5}$ concentrations with the Wychavon District for the 2016 calendar year. The average total $PM_{2.5}$ at 656 locations (centre points of 1km x 1km grids) across the Wychavon District is 8.76ug/m3, with a minimum concentration of 7.69ug/m3 and a maximum concentration of 10.88ug/m3.

This indicates that $PM_{2.5}$ concentrations within the Wychavon District are well below the annual average EU limit value for $PM_{2.5}$ of 25ug/m3.

As outlined in Policy Guidance LAQM.PG16 WRS have discussed the role of the DoPH, and the details of $PM_{2.5}$ levels across the County, with the Director of Public Health at Worcestershire County Council. The DoPH has not confirmed to WRS that they are advocating or supporting any specific actions to reduce $PM_{2.5}$ concentrations across the County at this time.

In light of the above no additional actions are currently planned by Wychavon District Council in relation to the reduction of $PM_{2.5}$ levels. However it is anticipated that any

actions taken to improve NO_2 levels across the District will likely result in a linked improvement in $PM_{2.5}$ levels.

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

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

Wychavon District Council undertook automatic (continuous) monitoring at one site during 2016. Table A.1 in Appendix A shows the details of the site.

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

Wychavon District Council undertook non- automatic (passive) monitoring of NO_2 at twenty five sites during 2016. Table A.2 in Appendix A shows the details of the sites.

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

Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. “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” and distance correction. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO_2)

Table A.3 in Appendix A compares the ratified and adjusted monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

For diffusion tubes, the full 2016 dataset of monthly mean values is provided in Appendix B.

Table A.4 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m^3, not to be exceeded more than 18 times per year.

Figure 3.1 shows the five year trend for NO_2 concentrations at all diffusion tube locations across the Wychavon District.

Figure 3.1 – Long term Trends NO_2 Concentrations 2012 - 2016

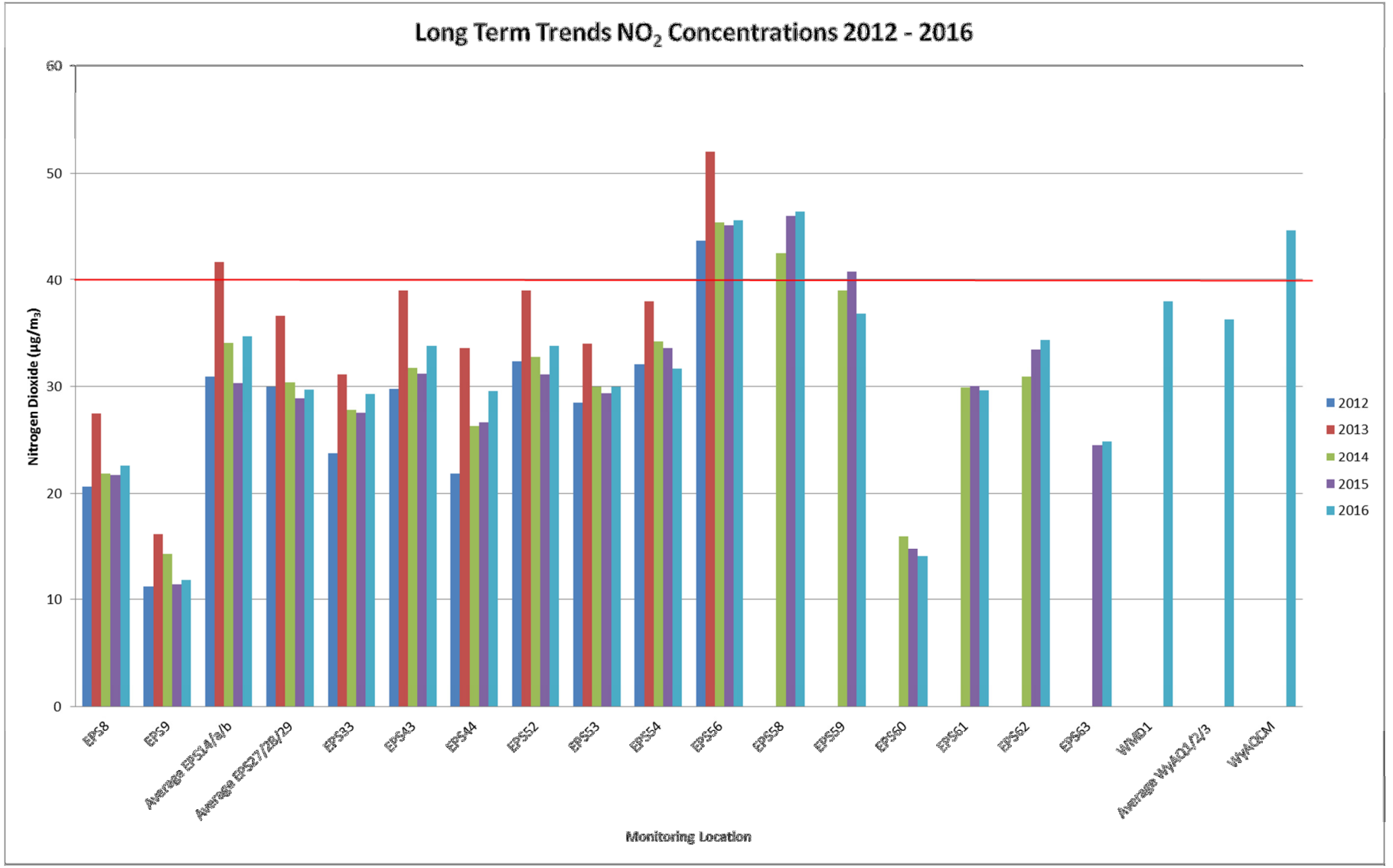


Figure 3.1 demonstrates that there has generally been a slight increase in NO_2 concentrations across the District between 2015 and 2016, this trend can also be observed across Worcestershire as a whole. Overall there is no descernible common trend in concentrations over the five year period across the District with concentrations fluctuating slightly on an annual basis.

Table 3.1 below provide a summary of all measured exceedances and concentrations within 5% of the annual mean objective in 2016 (bias-adjusted, annualised and calcualted back to relevant exposure where necessary).

Table 3.1 Summary of measured exceedances and concentrations withn 5% of the NO_2 dioxide annual mean objective in 2016

Site ID	Site Name	NO2 Annual Mean Objective (µg/m^3)	2016 NO2 (µg/m^3)	Level of exceedance (µg/m^3)
EPS56	Façade of Post Office, Worcester Road, Wychbold	40	45.57	5.57 (114%)
EPS58	Lampost outside 2 Rose Villas, Worcester Road, Wychbold	40	46.4	6.4 (116%)
WyAQCM	Continuous Monitor, Worcester Road, Wychbold	40	44.6	4.6 (112%)
WMD1	Walkmill Drive, Wychbold LP363	40	38.0	N/A

The three identified exceedances and single concentration within 5% of the annual mean objective are all located within the vicinity of Worcester Road, Wychbold and are dicussed further below.

No annual means greater than 60µg/m^3 have been recorded indicating that it is unlikley that there have been any exceedances of the 1-hour mean objective for NO_2 across the Wychavon District.

Port Street AQMA

No exccedances of the annual mean objective for NO_2 have been recorded in the Port Street AQMA in 2016. In addition no levels within 5% of the annual mean objective have been recorded in 2016.

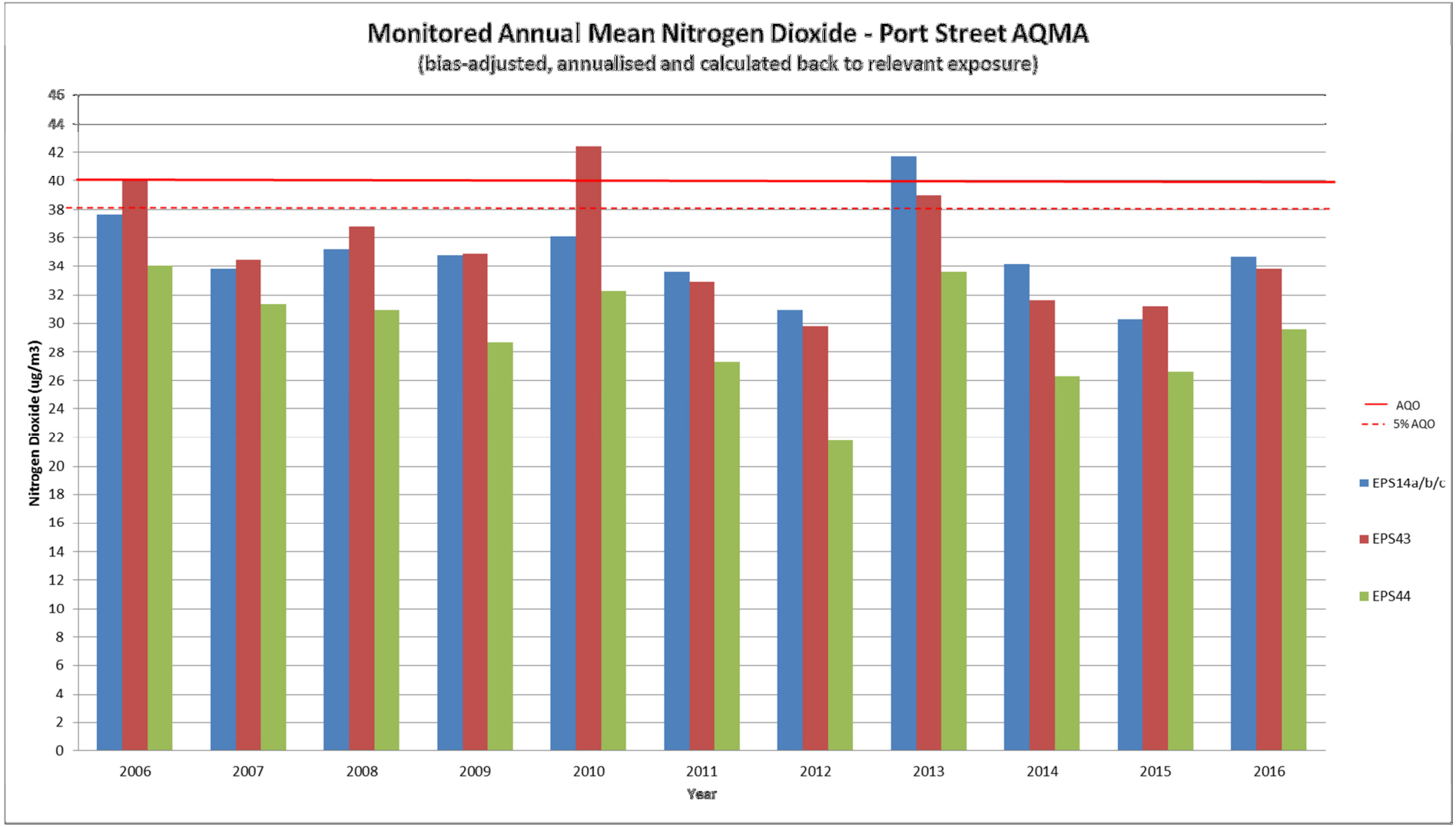
Figure 3.2. below shows the ten year trend for NO_2 concentrations in the Port Street AQMA. The data included in the figure has been adjusted for bias, annualised and calculated back to relevant exposure where necessary.

Wychavon District Council has undertake a detailed Screening Assessment of concentrations of NO_2 in the AQMA for the period 2006 – 2016. This detailed Screening Assessment is attached as Appendix C or available online at http://www.worcsregservices.gov.uk/media/3332956/Port-Street-Revocation-Screening-Assessment-FINAL.pdf

Over the ten year period assessed levels of nitrogen dioxide have generally followed a downward trend. Over the same period there have been three marginal exceedances of the Objective at relevant exposure. These exceedances occurred in 2010 and 2013 when higher than usual levels of air pollution were observed across England due to prevailing meteorological conditions at the time. There has been no exceedance of the Objective at relevant exposure in the past three years. Defra describe the circumstances under which an AQMA can be revoked. We are confident that these requirements are being met at the AQMA. Based on the evidence provided by the assessment it is considered very unlikely that any consistent exceedance of the Objective will occur at relevant exposure in the future.

Following the above Wychavon District Council has taken the decision to revoke the Port Street, Evesham AQMA. This decision was subject to consultation until 2nd March 2018. At the time of the writing of this report consultation responses are being reviewed, after which a formal declaration order will be drawn up and a copy provided to DEFRA.

Figure 3.2 – Port Street AQMA long term trends 2006 - 2016



Worcester Road, Wychbold

Three exceedances of the annual mean objective have been recorded in the Worcester Road, Wychbold area in 2016. One further concentration in the area has been recorded within 5% of the objective.

Figure 3.3 shows the long term trend for NO_2 concentrations over the period 2012 – 2016.

The diffusion tube network in the area was expanded in 2012 with the aim of gaining a better understanding of NO_2 levels in the area. Since this monitored levels of NO_2 have exceeded the annual mean objective at relevant exposure at three locations (EPS56, EPS58 and EPS59). In addition monitored levels of NO_2 have been within 5% of the objective at relvant exposure on two further occasions (at EPS59 in 2014 and WMD1 in 2016). As a result of this emerging exceedance of the NO_2 annual mean objective Wychavon District Council conducted a dispersion modelling assessment to determine the necessary geographical extent of the required AQMA. This Dispersion Modelling Assessment is attached as Appendix C and is also available online at http://www.worcsregservices.gov.uk/media/3332953/Worcester-Rd-Wychbold-Dispersion-Modelling-Assessment-October-2017-FINAL.pdf

Levels of NO_2 over the five year period have remained relatively consistent year on year with no discernible significant upward or downward trend.

Following the above Wychavon District Council has taken the decision to declare the Worcester Road, Wychbold area as an Air Quality Management Area. At the time of the writing of this report consultation responses are being reviewed.

It should be noted that during the period October 2015 to May 2017 major road network enhancement schemes have been undertaken in the immediate area, namely the upgrading of the M5 to a Smart Motorway and significant enhancement of

the Junction 5 slip-roads and roundabout. These schemes have necessarily involved periods of traffic rerouting and speed/flow management that will have had an impact on levels of NO2 monitored in the area during this time. However monitoring data demonstrates exceedances of the NO_2 annual mean objective in 2012, 2013 and 2014 prior to the start of these major works. In addition the levels of monitored NO2 remain relatively consistent over the period 2012 to 2016 suggesting that these works have not had a significant impact in relation to the annual mean objective. It is anticipated that the improvements to flow and traffic management delivered by these major enhancement schemes will have a positive impact on levels of NO_2 in the area; however it is not clear that any improvements will be such that compliance with the Objective will be achieved as a result. Monitoring data over the coming years will continue to be analysed to determine the extent of any impact of these major enhancement works on NO_2 levels.

3.2.2 Particulate Matter (PM_{10})

PM_{10} is not monitored within the Wychavon District.

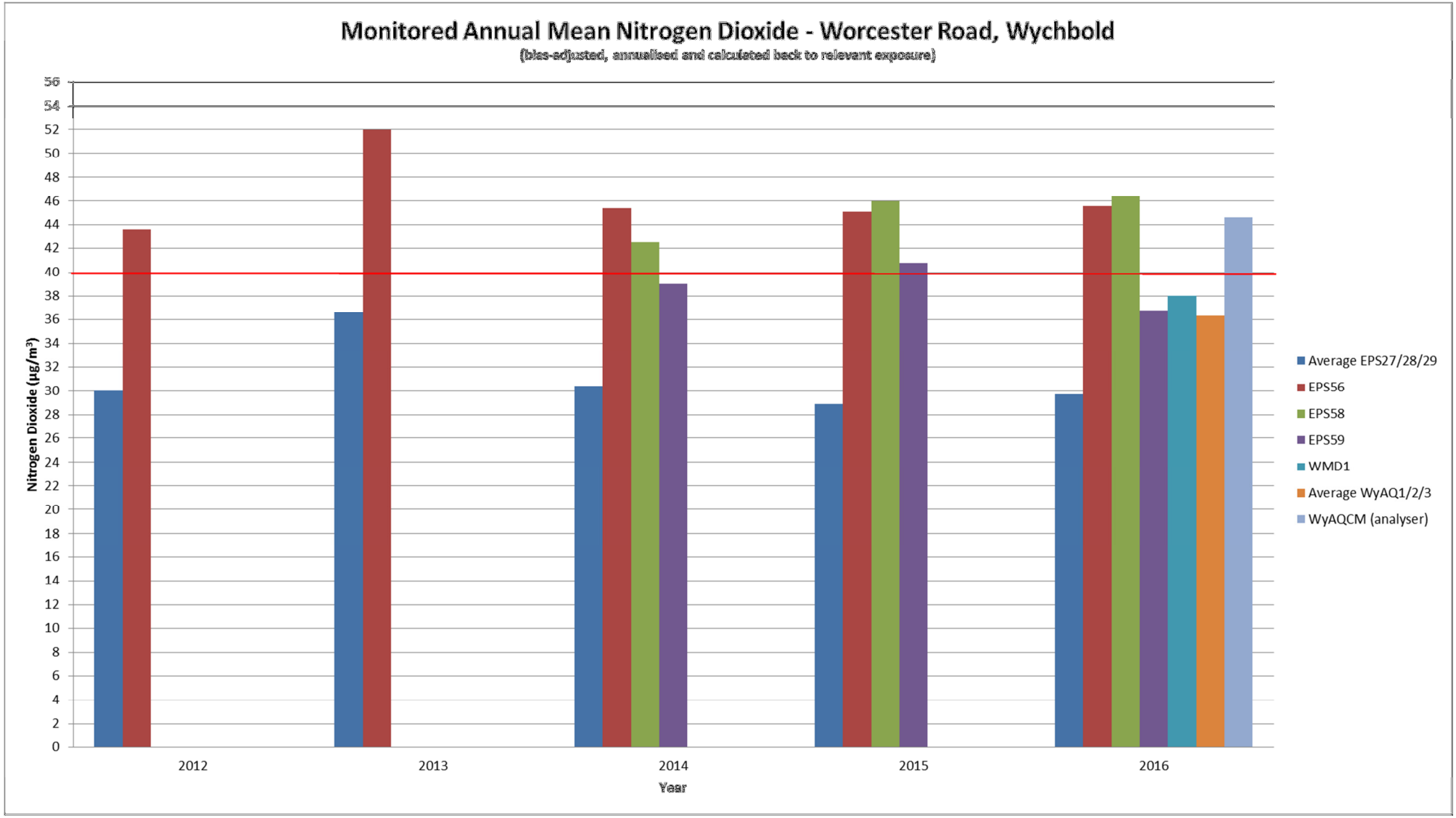
3.2.3 Particulate Matter ($PM_{2.5}$)

$PM_{2.5}$ is not monitored within the Wychavon District.

3.2.4 Sulphur Dioxide (SO_2)

Sulphur Dioxide is not monitored within the Wychavon District.

Figure 3.3 – Worcester Road, Wychbold long term trends 2012 - 2016



Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
WyAQCM	Worcester Road, Wychbold	Roadside	392019	265019	NO2	NO	Chemiluminescent	9.91	1.93	1.5

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable.

Table A.2 – Details of Non-Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	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)
EPS8	40 High Street Street Light 8, Pershore	Roadside	395048	245527	NO2	NO	2	0.5	NO	2.27
EPS9	St. Andrews Road Street light 139, Pershore	Suburban	394571	245377	NO2	NO	6	2.98	NO	2.26
EPS14	Port Street Road Sign, Evesham	Kerbside	404128	243630	NO2	YES	1.7	0.73	NO	2.35
EPS14a	Port Street Road Sign, Evesham	Kerbside	404128	243630	NO2	YES	1.7	0.73	NO	2.35
EPS14b	Port Street Road Sign, Evesham	Kerbside	404128	243630	NO2	YES	1.7	0.73	NO	2.35
EPS27	Worcester Rd, Wychbold	Roadside	392031	265624	NO2	NO	15.5	2.31	NO	2.13
EPS28	Worcester Rd, Wychbold	Roadside	392031	265624	NO2	NO	15.5	2.31	NO	2.13
EPS29	Worcester Rd,	Roadside	392031	265624	NO2	NO	15.5	2.31	NO	2.13

	Wychbold									
EPS33	High Street Street light LP 32, Evesham	Roadside	403753	244068	NO2	NO	2.5	3.5	NO	2.3
EPS43	Long Stay opp cinema, Port St, Evesham	Roadside	404222	243598	NO2	YES	0	1.85	NO	2.35
EPS44	Camera Post opp 33, Port St, Evesham	Roadside	404183	243611	NO2	YES	2.6	1.18	NO	2.45
EPS52	The Bungalow, Whittington	Roadside	387598	252511	NO2	NO	0	12	NO	1.99
EPS53	Hillview Cottage, Whittington	Suburban	387595	252533	NO2	NO	0	22	NO	1.68
EPS54	Green Rise, Whittington	Suburban	387591	252541	NO2	NO	0	24	NO	1.85
EPS56	Post Office, Worcester Rd, Wychbold	Roadside	391983	265688	NO2	NO	0	8.08	NO	2.13

EPS58	2 Rose Villas, Worcester Road, Wychbold S14	Roadside	392034	265762	NO2	NO	9	3	NO	2.27
EPS59	Weathervale, Worcester Rd, Wychbold (LP3(3373)	Roadside	392061	265807	NO2	NO	7.5	2.37	NO	2.12
EPS60	Corner of Rynal Street & De La Bere Close, Evesham SL2	Roadside	403914	244046	NO2	NO	5.5	1.1	NO	2.13
EPS61	1-6 The Old Dairy, Swan Lane, Evesham	Roadside	403796	244006	NO2	NO	0	1.9	NO	2
EPS62	Bengal Dreams No 53 Façade, Evesham	Roadside	403729	243971	NO2	NO	1.32	5.38	NO	2.18
EPS63	60 Mayflower Road, Droitwich	Roadside	390708	262863	NO2	NO	0	2.46	NO	1.93
WMD1	Walk Mill Drive, Wychbold LP363	Roadside	392050	265790	NO2	NO	4.94	2.3	NO	2.14

WyAQ1	Rose Dene, Worcester Road, Wychbold	Roadside	392019	265736	NO2	NO	9.91	1.93	YES	2.22
WyAQ2	Rose Dene, Worcester Road, Wychbold	Roadside	392019	265736	NO2	NO	9.91	1.93	YES	2.22
WyAQ3	Rose Dene, Worcester Road, Wychbold	Roadside	392019	265736	NO2	NO	9.91	1.93	YES	2.22

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on/adjacent to the façade of a residential property).

(2) N/A if not applicable.

Table A.3 – Annual Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2016 (%) [2]	NO_2 Annual Mean Concentration ($\mu g/m^3$) [3]				
					2012	2013	2014	2015	2016
EPS8	Roadside	Diffusion Tube	100	100	20.6	27.4	21.8	21.7	22.6
EPS9	Suburban	Diffusion Tube	100	100	11.3	16.2	14.3	11.5	11.9
EPS14	Kerbside	Diffusion Tube	92	92	-				34.3
EPS14a	Kerbside	Diffusion Tube	100	100					35.2
EPS14b	Kerbside	Diffusion Tube	100	100					35
Average EPS14/a/b	Kerbside	Diffusion Tube	97.3	97.3	30.9	**41.7**	34.1	30.3	34.7
EPS27	Roadside	Diffusion Tube	100	100					30.1
EPS28	Roadside	Diffusion Tube	100	100					29.4
EPS29	Roadside	Diffusion Tube	75	75					29.6
Average EPS27/28/29	Roadside	Diffusion Tube	91.6	91.6	30	36.6	30.4	28.9	29.7
EPS33	Roadside	Diffusion Tube	83	83	23.8	31.1	27.8	27.5	29.3
EPS43	Roadside	Diffusion Tube	75	75	29.8	39	31.7	31.2	33.78
EPS44	Roadside	Diffusion Tube	92	92	21.8	33.6	26.3	26.6	29.63
EPS52	Roadside	Diffusion Tube	100	100	32.4	39	32.81	31.1	33.78
EPS53	Suburban	Diffusion Tube	100	100	28.5	34	30	29.35	29.99

EPS54	Suburban	Diffusion Tube	92	92	32.1	38	34.22	33.63	31.66
EPS56	Roadside	Diffusion Tube	100	100	**43.6**	**52**	**45.38**	**45.12**	**45.56**
EPS58	Roadside	Diffusion Tube	92	92			**42.5**	**46**	**46.4**
EPS59	Roadside	Diffusion Tube	33	33			39	**40.8**	36.8
EPS60	Roadside	Diffusion Tube	58	58			16	14.8	14.1
EPS61	Roadside	Diffusion Tube	92	92			29.9	30.01	29.63
EPS62	Roadside	Diffusion Tube	100	100			30.89	33.47	34.37
EPS63	Roadside	Diffusion Tube	100	100				24.54	24.87
WMD1	Roadside	Diffusion Tube	58	58					38
WyAQ1	Roadside	Diffusion Tube	67	67					35.7
WyAQ2	Roadside	Diffusion Tube	67	67					37.1
WyAQ3	Roadside	Diffusion Tube	67	37					36.3
Average WyAQ1/2/3	Roadside	Diffusion Tube	67	67					36.3
WyAQCM	Roadside	Automatic	96.4	46.4					**44.6**

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

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

☒ **If applicable, all 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 1-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 (e.g. if monitoring was carried out for 6 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.

Figure A.1 – Trends in Annual Mean NO_2 Concentrations

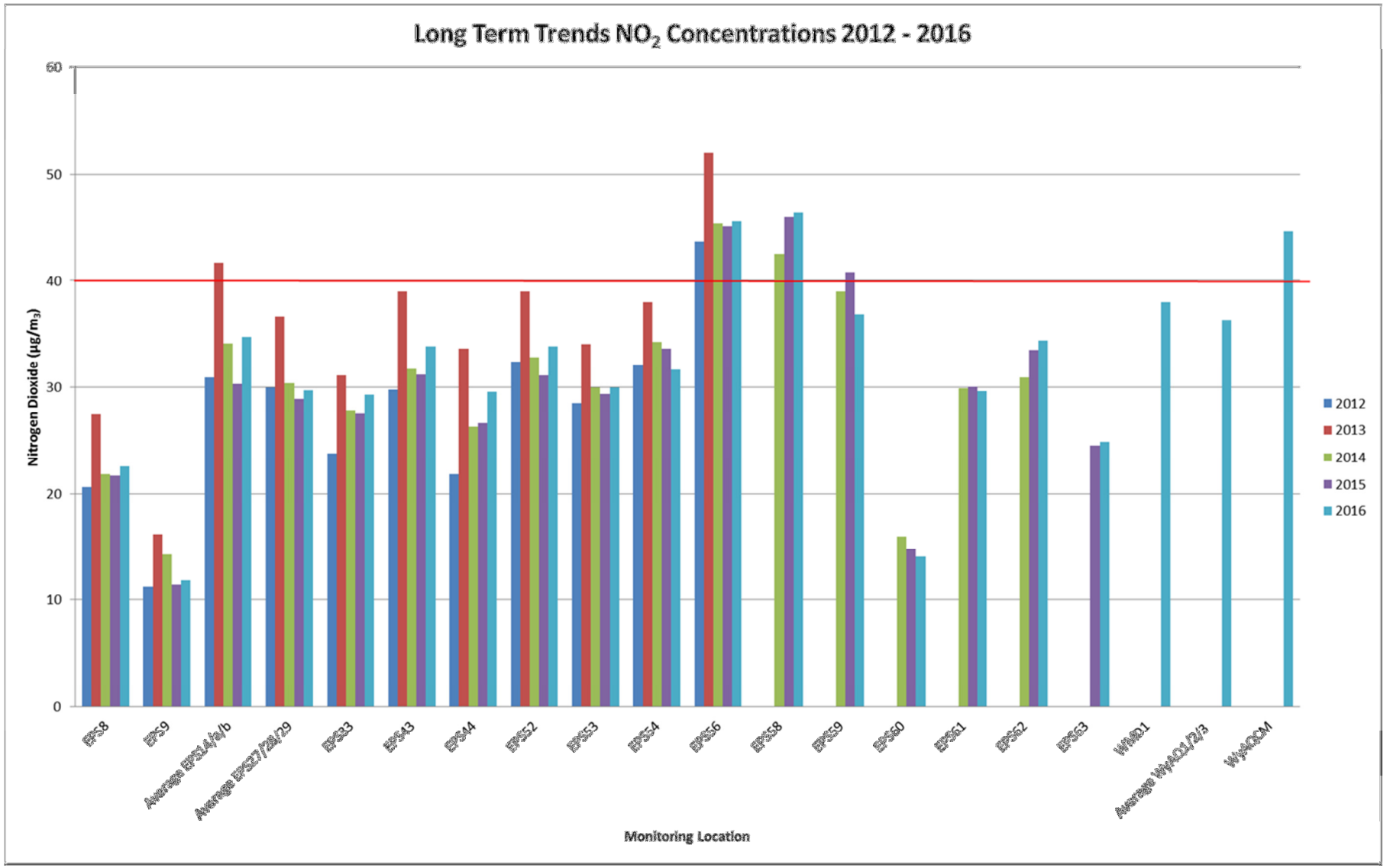


Table A.4 – 1-Hour Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
					2012	2013	2014	2015	2016
WyAQCM	Roadside	Automatic	96.4	50.28					2 (142)

Notes:

Exceedances of the NO_2 1-hour mean objective (200µg/m^3 not to be exceeded more than 18 times/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 (e.g. if monitoring was carried out for 6 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.

Appendix B: Full Monthly Diffusion Tube Results for 2016

Table B.1 – NO_2 Monthly Diffusion Tube Results - 2016

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) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
EPS8	34.02	41.85	40.13	31.22	27.78	28.78	21.46	24.53	28.45	28.39	40.15	39.19	32.16	28.62	22.6
EPS9	14.71	20.28	17.26	12.31	11.50	11.58	7.51	7.12	11.62	18.38	22.02	25.31	14.97	13.32	11.9
EPS14	47.48	45.77	47.32	47.15	44.97	43.64		41.37	42.54	43.12	51.86	49.61	45.89	**40.84**	34.3
EPS14a	52.47	49.90	49.50	48.29	44.74	45.53	46.37	38.72	42.87	42.11	51.99	53.48	47.16	**41.97**	35.2
EPS14b	51.44	51.83	49.31	49.43	45.60	42.59	47.09	41.37	41.57	38.75	51.99	52.22	46.93	**41.77**	35.0
Average EPS14/a/b													46.66	**41.53**	34.7
EPS27	60.33	53.13	55.80	49.11	48.83	41.50	54.54	46.38	47.29	41.76	56.60	54.73	50.83	**45.24**	30.1
EPS28	58.43	56.89	58.41	44.27	46.89	41.05	51.18	44.83	48.85	42.35	58.55	49.74	49.36	**43.93**	29.4
EPS29		55.16	55.56	48.31	47.65		48.84		50.41	36.10	59.37	46.12	49.73	**44.26**	29.6
Average EPS27/28/29													49.97	**44.47**	29.7
EPS33	32.59	33.08	41.40	37.04	34.94	35.79			30.26	35.27	39.65	46.10	36.61	32.58	29.3
EPS43	38.85		38.78	39.37	32.98	37.78		33.48	34.03	36.63	49.68		37.95	33.78	33.8
EPS44	39.86	40.12	38.54	40.89		37.43	38.00	33.31	37.41	35.98	45.91	48.44	39.63	35.27	29.6
EPS52	44.80	40.57	39.01	40.64	35.01	33.21	34.25	35.08	35.07	34.08	46.24	37.60	37.96	33.78	33.8
EPS53	38.88	37.02	35.11	36.10	30.27	28.78	29.16	28.85	32.54	29.41	42.50	35.80	33.70	29.99	30.0

EPS54	47.68	42.53	42.67	39.38	33.18	26.45	34.00	23.85	32.33	21.50	47.68		35.57	31.66	31.7
EPS56	50.36	49.73	55.44	59.99	51.12	51.15	47.51	50.37	47.99	45.06	53.43	52.19	51.20	**45.57**	**45.6**
EPS58	80.50	69.05	68.40		71.75	78.02	75.15	70.24	57.33	65.53	81.81	67.50	71.39	**63.54**	**46.4**
EPS59	66.26	62.32	63.68	55.57									61.96	**48.65**	36.8
EPS60	21.64					14.17		9.49	16.68	21.00	25.30	32.00	20.04	16.63	14.1
EPS61	39.75	32.95	38.61	29.07	28.79	28.68	32.10	28.37		28.85	37.47	41.57	33.29	29.63	29.6
EPS62	42.48	40.26	42.22	38.24	34.88	34.79	36.37	32.01	35.82	39.52	42.78	44.10	38.62	34.37	34.4
EPS63	29.71	33.31	29.26	27.65	28.56	27.54	14.31	19.05	24.28	31.16	34.02	36.43	27.94	24.87	24.9
WMD1	N/A	N/A	N/A	N/A	N/A	50.64	49.60	40.44	50.06	49.60	67.53	50.56	51.21	**46.28**	38.0
WyAQ1					59.35	60.41	49.96	47.93	56.06	52.38	58.73	52.64	54.68	**48.67**	35.7
WyAQ2					57.41	62.64	55.24	51.26	52.94	53.67	67.48	56.76	57.18	**50.89**	37.1
WyAQ3					55.47	61.60	58.60	50.91	54.36	56.33	53.93	54.41	55.70	**49.57**	36.3
Average WyAQ1/2/3													55.85	**52.00**	36.3

☒ **Local bias adjustment factor used**

☐ **National bias adjustment factor used**

☒ **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 1-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

Worcester Road, Wychbold Dispersion Modelling Report

A copy of the Worcester Road, Wychbold Dispersion Modelling Assessment (October 2017, ref: WDC/WORCSRD/DA/2017) can be viewed at http://www.worcsregservices.gov.uk/media/3332953/Worcester-Rd-Wychbold-Dispersion-Modelling-Assessment-October-2017-FINAL.pdf

A copy is also provided below.

Port Street, Evesham Detailed Screening Assessment Report

A copy of the Port Street, Evesham Revocation Screening Assessment (October 2017, ref: WDC/PORTST/REV/2017) can be viewed at

http://www.worcsregservices.gov.uk/media/3332956/Port-Street-Revocation-Screening-Assessment-FINAL.pdf

A copy is also provided below.

Worcestershire
Regulatory Services
Supporting and protecting you

Worcester Road, Wychbold
Dispersion Modelling Assessment 2016

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

October 2017

Local Authority Officer	Laura Carradine
Department	Land & Air Quality Team
Address	Wyre Forest House Finepoint Way Kidderminster Worcestershire DY11 7WF
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Report Reference number	WDC/WORCSRD/DA/2017
Date	October 2017

Executive Summary

Previous rounds of Local Authority Review and Assessment highlighted the need for a detailed review of Nitrogen Dioxide concentrations at Worcester Road, Wychbold. This detailed review was undertaken to confirm that declaration of an Air Quality Management Area (AQMA) is required and to determine the geographical extent of predicted exceedances at relevant receptors.

This detailed review was undertaken using both measured and modelled concentrations. Levels of nitrogen dioxide in the area are measured via a network of six diffusion tubes, supplemented by six months of automatic monitoring (between March 2016 and September 2016). Modelling was undertaken using ADMS-Roads dispersion model and verified against five diffusion tube locations and one automatic monitor location.

Monitored and modelled results indicate exceedances of the annual mean objective for nitrogen dioxide at relevant exposure in the south-west portion of the study area.

Monitoring and modelling nitrogen dioxide results at relevant exposure do not exceed 60µg/m^3 as an annual mean concentration. Therefore exceedances of the nitrogen dioxide 1-hour objective are unlikely.

It is recommended that Wychavon District Council move to declare an Air Quality Management Area in relation to likely exceedances of the nitrogen dioxide annual mean objective.

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4 Introduction

The policy framework for air quality management in the UK is set out in The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007). The Strategy provides air quality standards and objectives for key pollutants designed to protect human health and the environment. The Strategy also sets out how local government can contribute to achieving the air quality objectives. The Local Air Quality Management (LAQM) regime is set out in the Strategy and requires every local authority to carry out regular reviews and assessments of air quality in its area to identify whether the air quality objectives have been, or will be, achieved at relevant locations by the appropriate dates. Where air quality objectives are not being met the local authority must declare an Air Quality Management Area (AQMA) and produce an action plan to identify appropriate measures that can be taken in pursuit of the objectives.

The Air Quality Strategy (Defra, 2007) sets out air quality standards and objectives for key pollutants. The standards are set as concentrations below which health effects are unlikely, or below which risks to public health would be very small (even in sensitive population groups). The air quality objectives only apply where “relevant exposure” exists, i.e. where members of the public are likely to be regularly present for the duration of the averaging time of the objective. For annual mean objectives relevant exposure is limited to residential proprieties, school and hospitals. The 1-hour objective applies to residential properties, schools and hospitals as well as any outdoor location where members of the public might reasonably be expected to stay for 1 hour or more, such as outdoor seating areas at eating establishments, parks, busy shopping streets etc. The statutory air quality objectives applicable to LAQM in England can be found in Table A.1 in Appendix A.

Technical Guidance for LAQM (LAQM.TG.16) sets out the approach for LAQM. When an exceedance of an air quality objective has been identified the local authority can take one of two approaches to declaring an AQMA; the decision can follow the “fast track option” and an AQMA can be declared immediately or the local authority

can obtain further information and/or data before deciding on the declaration of an AQMA. In the case of Worcester Road, Wychbold further information has been gathered to inform the declaration of an AQMA, specifically detailed dispersion modelling has been undertaken to determine the likely geographical extent of the identified exceedance to inform the decision making process.

This report provides a detailed review, following the findings of Wychavon District Council's ASR in 2016, which concluded that there were measured exceedances of the annual mean nitrogen dioxide objective at locations of relevant exposure at Worcester Road, Wychbold (Worcestershire Regulatory Services, 2016).

Background

Non-automatic monitoring (passive) of nitrogen dioxide has been undertaken in the Worcester Road, Wychbold area since 2012. Exceedences of the nitrogen dioxide annual mean objective have been measured between 2012 and 2016. As a result the 2015 Annual Status Report produced for the Wychavon area concluded that a detailed review is required in the Worcester Road, Wychbold area. Passive monitoring results and long-term trend data are reproduced in Appendix B.

Section 1.25 of LAQM.TG(16) provides local authorities with the option of fast-tracking declaration of an AQMA where annual monitoring and local intelligence shows a persistent exceedance. In the case of Worcester Road, Wychbold it was decided that further assessment in the form of dispersion modelling was required in order to determine the necessary geographical extent of any AQMA.

This report provides a detailed review of nitrogen dioxide levels in the Worcester Road, Wychbold area. The review has been undertaken for the twelve month period January 2016 to December 2016.

The aim of this review is to confirm that the annual mean objective for nitrogen dioxide is being exceeded at locations with relevant exposure and determine the

geographical extent of any required Air Quality Management Area (AQMA). The study area is shown in Figure 1. The study area extends along Worcester Road from the roundabout at junction 5 of the M5 to the Mill Lane junction. The study area has been defined in this way because it both encompasses the areas where passive monitor indicates exceedences of the annual mean objective for nitrogen dioxide exist, and because the area represents relevant exposure, i.e. residential properties adjacent to the A38.

Figure 1: Indicative Study Area Location Plan

5 Assessment Methodology

The detailed review has been undertaken using a combination of passive and automatic monitoring and detailed dispersion modelling for the 12 month period January 2016 – December 2016.

5.1 Monitoring

5.1.1 Automatic Monitoring Sites

A chemiluminescent automatic analyser was installed at Worcester Road, Wychbold and operated between 23rd March 2016 and 29th September 2016. The monitor was used to continuously monitor levels of nitrogen dioxide (NO_2) and is based on the chemiluminescent reaction between nitrogen oxide (NO) and ozone (O_3). Calibration was undertaken by officers from Worcestershire Regulatory Services and data management was undertaken by Air Quality Data Management (AQDM) Ltd.

A co-location study using triplicate nitrogen dioxide diffusion tubes location was undertaken at the automatic monitor site between May 2016 and December 2016. A local bias-adjustment factor for 2016 has been calculated using data from this co-location study. The local bias-adjustment factor (0.89) is slightly higher than the national published factor for 2016 (0.88) and therefore provides a worst-case assessment. Full details of the co-location study and bias-adjustment factor calculation can be found in Appendix B, Figure B5.1.

Results, supporting technical information and QA/QC data can be found in Appendix C.

The location of the automatic monitor is shown in Figure 2.

Figure 2: Automatic Monitor Location Plan

5.1.2 Non-Automatic Monitoring Sites

Wychavon District Council undertook non- automatic (passive) monitoring of NO_2 using diffusion tubes at six locations within the study area in 2016. The location of these monitoring sites is shown in Figure 3.

Diffusion tubes are prepared and analysed by Somerset Scientific Services using the 20% triethanolamine (TEA)/ deionised water preparation method. It is necessary to adjust diffusion tube data to account for laboratory bias, the local bias-adjustment factor as discussed above, has been used for this purpose.

Results, supporting technical information and QA/QC details relating to non-automatic monitoring sites and results can be found in Appendix B.

Figure 3: Diffusion Tube Location Plan

5.2 Modelling

Annual nitrogen dioxide (NO_2) concentrations in 2016 have been predicted within the study area using ADMS-Roads v4.0.1.0. Nitrogen dioxide concentrations have been predicted for a selection of receptors where relevant exposure exists. The location of the modelled receptor points is shown in Figure 4

Figure 4: Modelled Receptor Locations

Full details of model input parameters, model verification, model outputs and modelled receptor points can be found in Appendix D.

5.3 Uncertainty

There is an element of uncertainty in all measured and modelled data. All values presented in this report are the best possible estimates implementing approved methods of investigation, however uncertainties in the results may cause over-predictions or under-predictions. Full details of monitoring and model uncertainty and error can be found in Appendix D.

6 Results

3.1 Monitoring

Diffusion tube monitoring of nitrogen dioxide was carried out at six locations within the study area in 2016. Automatic monitoring was carried out at one location between 23rd March 2016 and 29th September 2016.

The results of diffusion tube monitoring are presented in Table 1 and results of automatic monitoring are presented in Table 2.

Results confirm that measured annual mean nitrogen dioxide concentrations are exceeding the objective at all six diffusion tube monitoring locations. When measured levels are calculated back to relevant exposure (facades of nearest residential properties) exceedences of the objective are seen at two of the six monitoring locations.

Long-term trend data for diffusion tube monitoring in the area between 2012 and 2016 is presented in Appendix B.

Table 1 – Annual mean nitrogen dioxide concentrations measured at diffusion tube locations along Worcester Road, Wychbold (µg/m^3)

Site	Description	2016[ab]	2016[abc]
EPS27/28/29	Lamppost on roundabout, Worcester Road	45.21	30.1
EPS56	Façade of post office, Worcester Road	45.57	**45.57** (**42.7**[d])
EPS58	Road sign outside 2 Rose Villas, Worcester Road	58.21	**42.9**
EPS59	Lamppost outside Weathervale, Worcester Road, Wychbold	48.99	37.1
WMD1	Lamppost at Walkmill Drive/Worcester Road junction	46.28	38.00

WyAQ1/2/3	Triplicate with automatic monitor lamppost outside Rose Dene, Worcester Road	52.00	36.3
Objective		**40**	

[a] bias-adjusted using 2016 local factor 0.89
[b] annualised in accordance with DEFRA TG16
[c] calculated back to relevant exposure in accordance with DEFRA TG16
[d] calculated up to relevant exposure at first floor using DEFRA fall off with distance tool

Results also confirm that measured annual mean nitrogen dioxide concentrations are exceeding the objective at the site of the automatic monitor. Results show that the 1-hour mean objective for nitrogen dioxide is not being exceeded and is not close to being exceeded, as such further assessment of exceedances of the 1-hour mean objective has not been undertaken.

Full details of bias-adjustment, annualisation of both passive and automatic results and calculations back to relevant exposure can be found in Appendix B.

Table 2 – Annual mean nitrogen dioxide concentrations measured at the Worcester Road automatic monitor site at Worcester Road, Wychbold (µg/m^3)

Site Name	Data Capture[a] (%)	Estimated Annual Mean Concentration[b] (µg/m^3)	Number of exceedences of Hourly Mean (200µg/m^3
Worcester Road, Wychbold	96.4	66.3 **(44.6[c])**	2
Objective		40	18

[a] for operational period of monitor 23rd March 2016 to 29th September 2016
[b] annualised based on operational period of monitor 23rd March 2016 to 29th September 2016
[c] calculated back to relevant exposure in accordance with DEFRA TG16

3.2 Modelling

Annual mean nitrogen dioxide concentrations in 2016 have been calculated at relevant exposure level (1.5m or 4.5m) at each of the receptors shown in Figure 4. The results are set out in Table 3.

Table 3 – Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors

Receptor	Location	Height (m)	Predicted NO_2 (µg/m3)
R1	Facade Post Office, Worcester Road	4.5	**42.39**
R2	Facade Rosedene, Worcester Road	1.5	**47.78**
R3	Facade 1 Rose Villas, Worcester Road	1.5	**48.72**
R4	Facade Weathervale, Worcester Road	1.5	**47.72**
R5	Façade The Cloverleaf, Worcester Road	1.5	**47.00**
R6	Facade Sandalwood, Worcester Road	1.5	39.77
R7	Facade 1 Council House, Worcester Road	1.5	38.81
R8	Facade 5 Council House, Worcester Road	1.5	35.97
R9	Facade Fernleigh, Worcester Road	1.5	35.26
R10	Facade Oakley, 18 Worcester Road	1.5	27.29
R11	Facade Ploda Cottage, Crown Lane	1.5	38.36
R12	Facade The Crown Public House, Worcester Road	4.5	23.71
R14	Facade Avondale, Worcester Road	1.5	34.40
R15	Facade 2 Pentre Villas, Worcester Road	1.5	21.80
R16	Facade Daisy Cottage, Worcester Road	1.5	24.02
R17	Facade Clive Cottage, Worcester Road	1.5	28.09
R18	Facade Norvena, Worcester Road	1.5	30.50
R19	Facade Montifoire, Worcester Road	1.5	25.42
R20	Northern facade The Poplars, Worcester Road	1.5	33.69
R21	Central facade The Poplars, Worcester Road	1.5	39.50
R22	Facade 2 Prospect Villas, Worcester Road	1.5	38.33

R23	Facade 6 Prospect Villas, Worcester Road	1.5	38.47
R24	Facade Briarleigh, Worcester Road	1.5	32.99
R25	Facade The Orchard, Worcester Road	1.5	32.44
R26	Facade The White House, Worcester Road	1.5	33.93
R27	Facade 1 Post Office Row, Worcester Road	1.5	**42.30**
R28	Facade White Cottage, Worcester Road	1.5	**42.64**
R29	Facade 21 Sheldon Close	1.5	**44.29**
R30	Facade 9 Sheldon Close	1.5	**50.35**
R31	Facade 5 Sheldon Close	1.5	**47.67**

* Note R13 omitted as not representative of relevant exposure (BP Garage Forecourt, no residential exposure)

Concentrations of nitrogen dioxide have been calculated for a grid of receptors across the study area to allow concentration contours (isopleths) to be plotted on OS base mapping. These isopleths are shown as Figure 5.

Modelling results calculate exceedances of the annual mean objective at receptors R1, R2, R3, R4, R5, R27, R28, R29, R30 and R31 all located in the south-western portion of the study area. No exceedances of 60µg/m^3 have been calculated at any locations with relevant exposure, therefore exceedances of the 1-hour objective are unlikely.

Figure 5 – Isopleth Contours at 1.5m (whole model area)

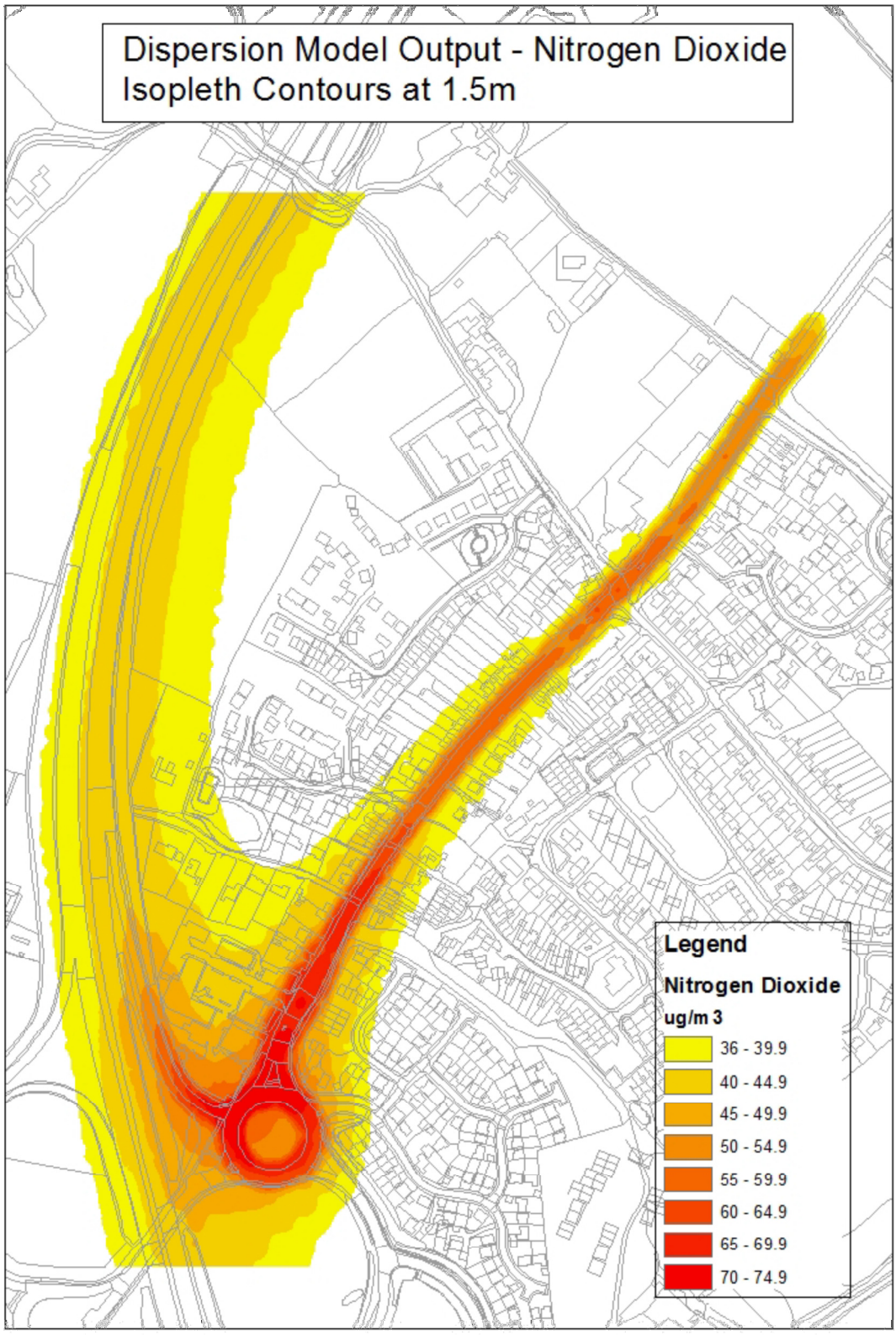


Figure 6 – Isopleth Contours at 1.5m (southern section of model area)

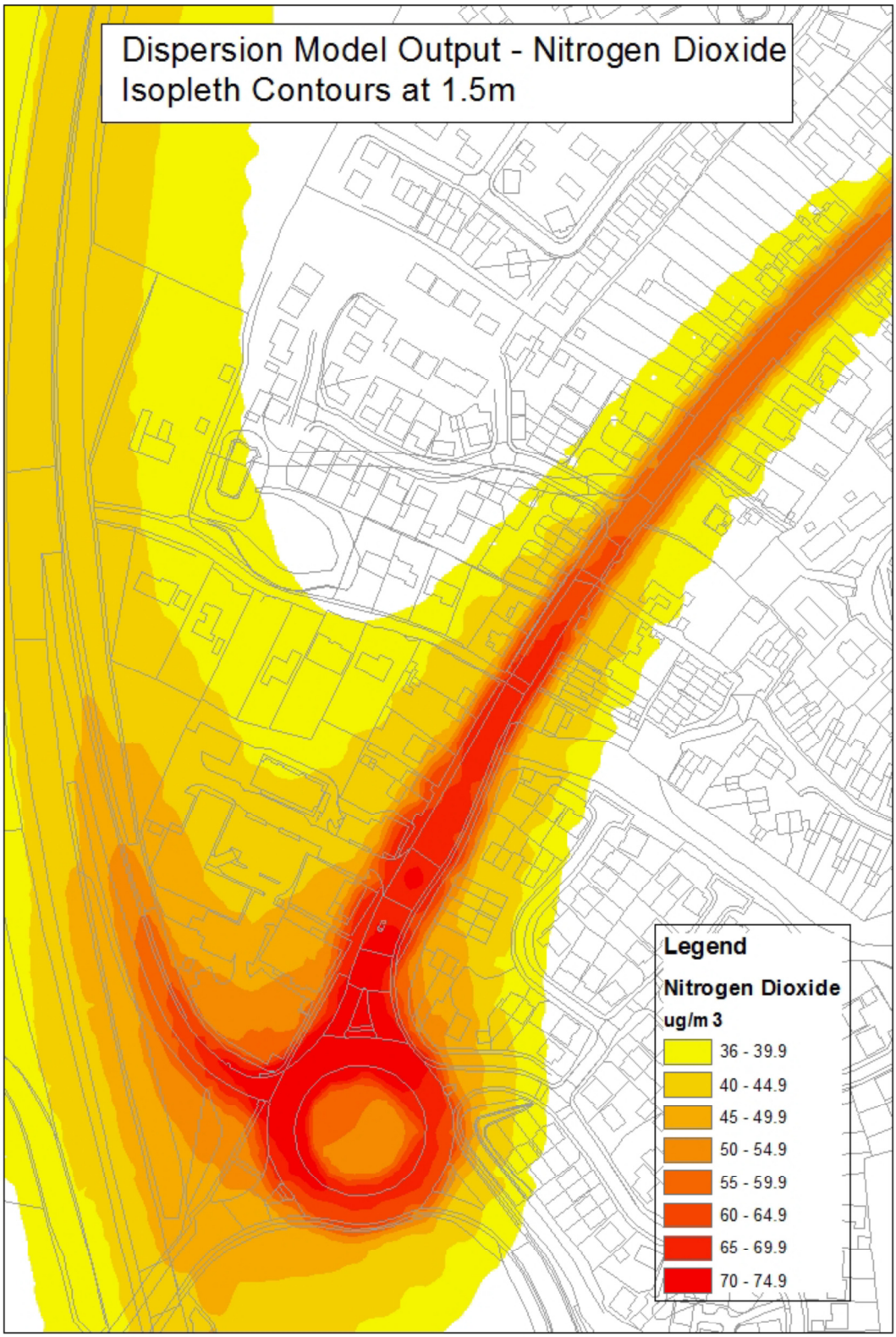
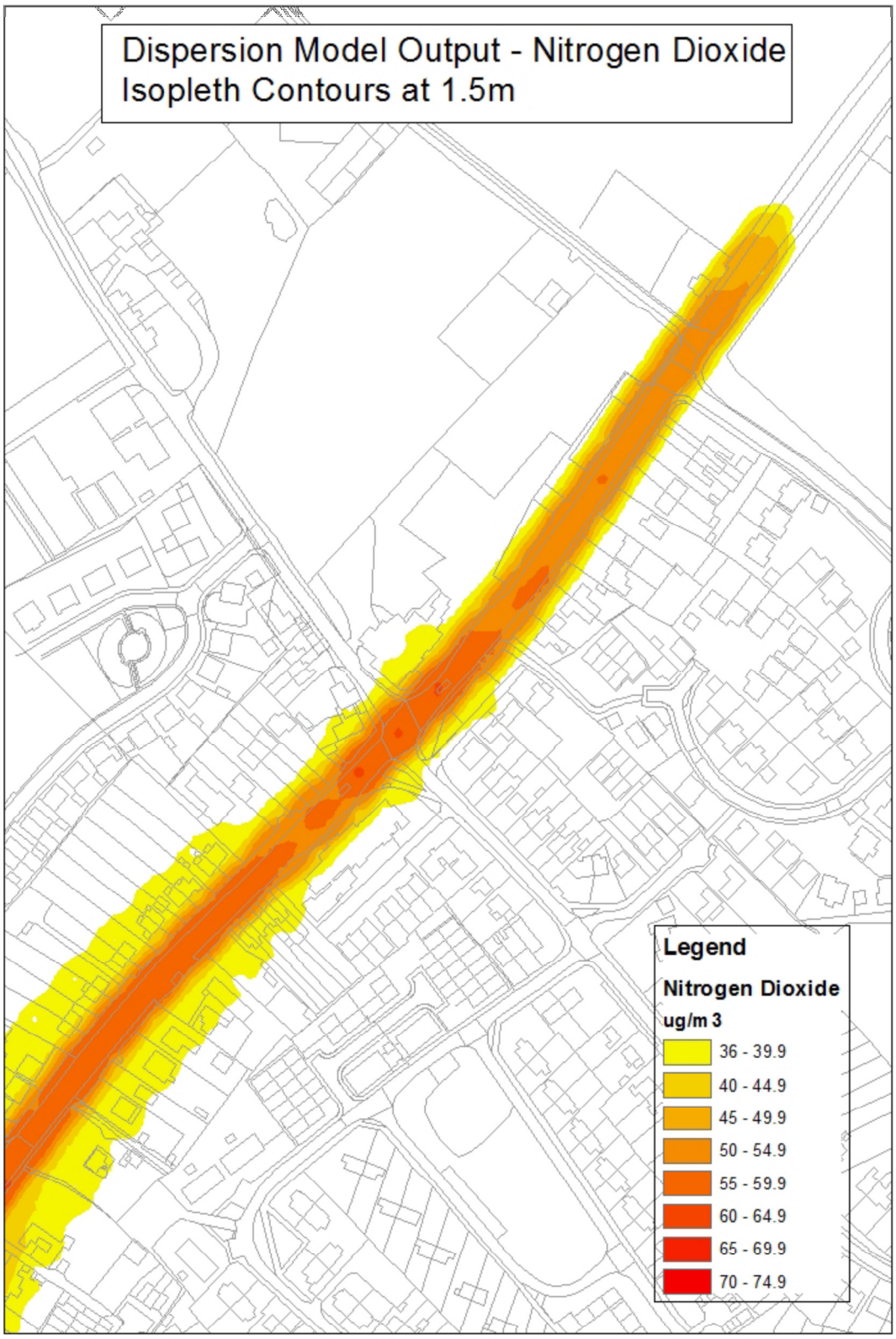


Figure 7 – Isopleth Contours at 1.5m (northern section of model area)



7 Conclusions and Recommendations

A detailed review has been carried out for Worcester Road, Wychbold. The area was identified as exceeding the annual mean objective in Wychavon District Council's Progress Reports and 2015 ASR. A detailed review was carried out to confirm that an AQMA declaration is required and to inform the decision making process in regard to the necessary geographical extent of any AQMA.

Monitoring and modelling results indicate exceedances of the annual mean objective for nitrogen dioxide at relevant exposure in the south-west portion of the study area.

Monitoring and modelling nitrogen dioxide results at relevant exposure do not exceed 60µg/m^3 as an annual mean concentration. Therefore exceedances of the nitrogen dioxide 1-hour objective are unlikely.

It is recommended that Wychavon District Council declare an Air Quality Management Area in relation to likely exceedances of the nitrogen dioxide annual mean objective. A number of options as to the possible geographical extent of this AQMA will be presented to decision makers during the AQMA declaration process. Consultation on AQMA declaration will be carried out in accordance with LAQM(TG)16 and LAQM(PG)16.

8 References

1. DEFRA (2011) Local Bias-Adjustment Factor Calculator v04

2. DEFRA (2016) NO_2 Fall-Off with Distance Calculator v4.1

3. DEFRA (2016) Emissions Factor Toolkit v7.0

4. DEFRA (2016) 'Local Air Quality Management Policy Guidance LAQM PG.(16)'

5. DEFRA (2016) 'Local Air Quality Management Technical Guidance LAQM TG.(16)'

6. DEFRA (2016) 'National Diffusion Tube Bias Adjustment Factor Spreadsheet v.03/17 v2'

7. DEFRA (2016) NOx to NO2 Conversion Spreadsheet v5.1

8. Worcestershire Regulatory Services (2013) 'Air Quality Action Plan for Worcestershire'

9. Worcestershire Regulatory Services (2015) 'Air Quality Action Plan Progress Report for Worcestershire April 2013-April 2015'

10. Worcestershire Regulatory Services (2016) 'Air Quality Action Plan Progress Report for Worcestershire April 2015 – March 2016'

11. Worcestershire Regulatory Services (2016) 'Air Quality Annual Status Report (ASR)'

Technical Appendices

Appendix A: Summary of Statutory Air Quality Objectives in England

A.1 – 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 microgrammes of pollutant per cubic metre of air (µg/m^3).

Appendix B: Diffusion Tube Monitoring

B.1 – Details of Non-Automatic Monitoring Sites

Site ID	Site Description	Site Type	X OS Grid Ref	Y OS Grid Ref	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)
EPS27/28/29	Worcester Rd, Wychbold	Roadside	392031	265624	NO_2	N	15.5	2.29	N	2.16
EPS56	Post Office, Worcester Rd, Wychbold	Roadside (façade)	391983	265688	NO_2	N	0	8.05	N	2.06
EPS58	2 Rose Villas, Worcester Road, Wychbold	Roadside	392034	265762	NO_2	N	6.42	1.73	N	2.11
EPS59	Weathervale, Worcester Rd, Wychbold	Roadside	392061	265807	NO_2	N	7.5	2.37	N	2.12
WMD1	Lamppost at Walkmill Drive/Worcester Road junction	Roadside			NO_2	N	4.94	2.66	N	2.23
WyAQ1/2/3	Lamppost outside Rose Dene, Worcester Road	Roadside	392019	265736	NO_2	N	9.91	1.93	Y	2.22

B.2 – Annual Mean NO_2 Non-Automatic Monitoring Results 2012 - 2016

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3)				
					2012	2013	2014	2015	2016
EPS27/28/29	Roadside	Diffusion Tube	92	92	**42.6**	**55**	**44.4**	39	**44.7**
EPS56	Roadside (façade)	Diffusion Tube	100	100	**43.6**	**52**	**45.4**	**45.1**	**45.56**
EPS58	Roadside	Diffusion Tube	92	92	-	-	**57.2**	**60.9**	**63.54**
EPS59	Roadside	Diffusion Tube	100	33	-	-	**51.2**	**52.67**	**48.65**
WMD1	Roadside	Diffusion Tube	100	58	-	-	-	**-**	**46.28**
WyAQ1/2/3	Roadside	Diffusion Tube	100	67	-	-	-	**-**	**52.3**

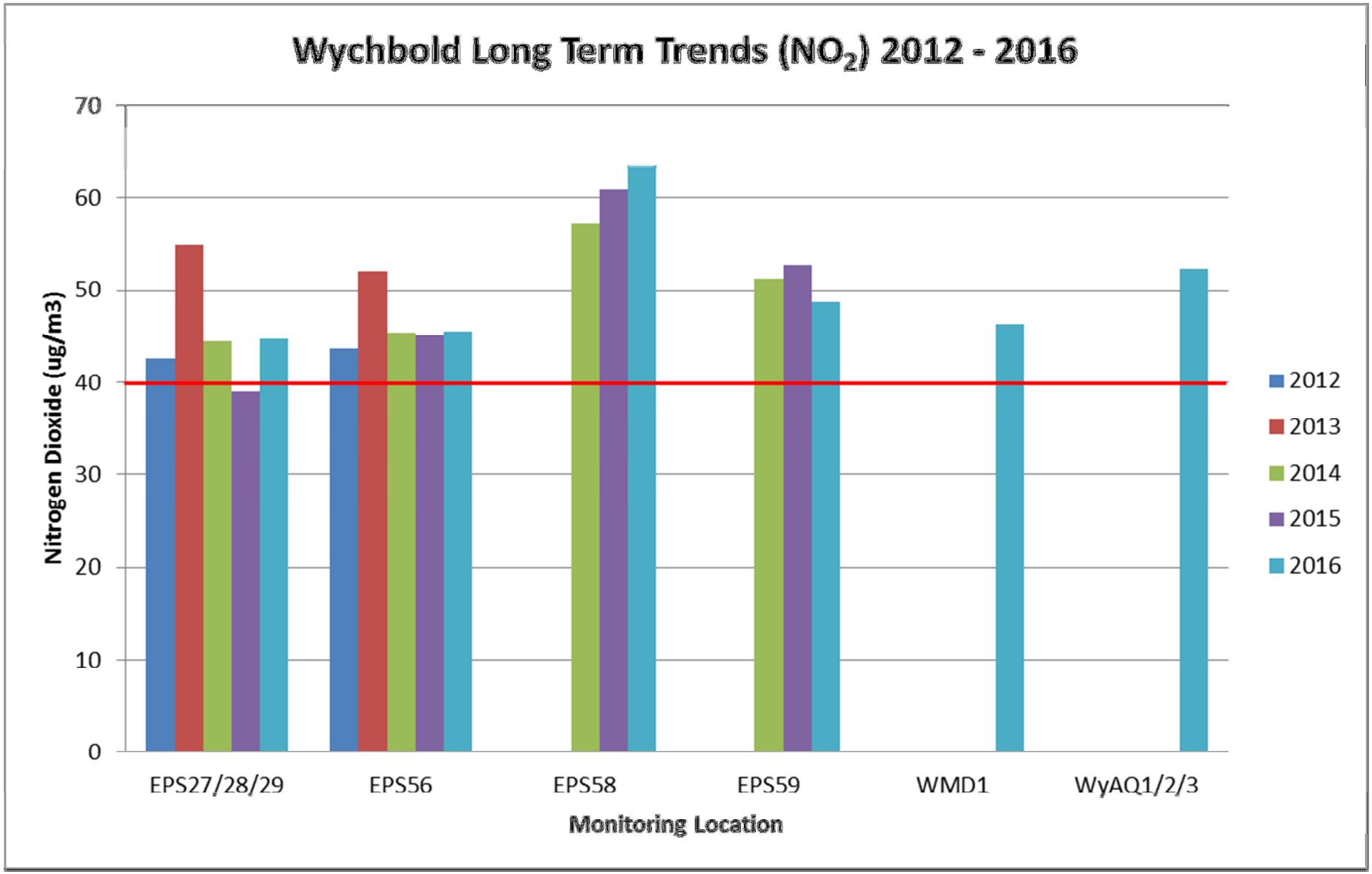
Notes: Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-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 (e.g. if monitoring was carried out for 6 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 Technical Guidance LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.


Wychbold Long Term Trends (NO_2) 2012 - 2016
Nitrogen Dioxide (ug/m3)
70
60
50
40
30
20
10
0
EPS27/28/29
EPS56
EPS58
EPS59
WMD1
WyAQ1/2/3
Monitoring Location
2012
2013
2014
2015
2016

B.3 – Annual Mean NO_2 Monitoring Results 2012 - 2016 – calculated back to relevant exposure

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3)(4)				
					2012	2013	2014	2015	2016
EPS27/28/29	Roadside	Diffusion Tube	92	92	30	36.6	30.4	28.9	29.8
EPS56	Roadside (façade)	Diffusion Tube	100	100	**43.6**	**52**	**45.4**	**45.1**	**45.56**
EPS58	Roadside	Diffusion Tube	92	92	-	-	**42.5**	**46**	**46.4**
EPS59	Roadside	Diffusion Tube	100	33	-	-	39.0	**40.8**	36.8
WMD1	Roadside	Diffusion Tube	100	58	-	-	-	-	38.00
WyAQ1/2/3	Roadside	Diffusion Tube	100	67	-	-	-	-	36.5

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

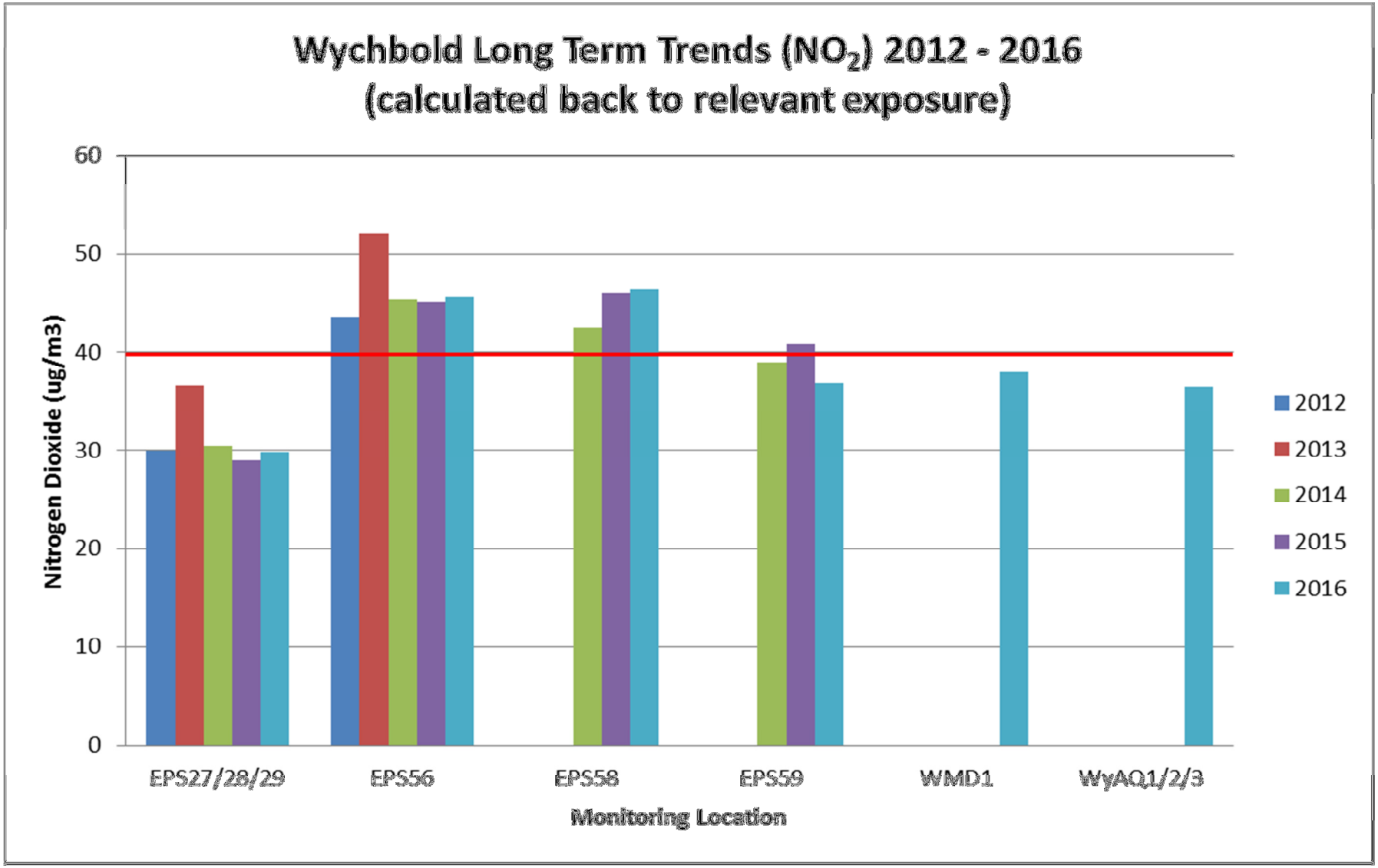
NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**

(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 (e.g. if monitoring was carried out for 6 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 Technical Guidance LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix B Section B.5 for details.

(4) Concentrations have been calculated back to relevant exposure as per Technical Guidance LAQM.TG16. Copies of calculations follow in Appendix B, Section B.5.


Wychbold Long Term Trends (NO_2) 2012 - 2016
(calculated back to relevant exposure)
Nitrogen Dioxide (ug/m3)
60
50
40
30
20
10
0
EPS27/28/29
EPS56
EPS58
EPS59
WMD1
WyAQ1/2/3
Monitoring Location
2012
2013
2014
2015
2016

B.4 – Full NO_2 Monthly Diffusion Tube Results for 2016

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 (1)(2)
EPS27/28/29	59.38	55.06	56.59	47.23	47.79	41.28	51.52	45.60	48.85	40.07	58.17	50.20	50.15	44.7
EPS56	50.36	49.73	55.44	59.99	51.12	51.15	47.51	50.37	47.99	45.06	53.43	52.19	51.20	45.56
EPS58	80.5	69.05	68.4	-	71.75	78.02	75.15	70.24	57.33	65.53	81.81	67.5	71.39	63.54
EPS59	66.26	62.32	63.98	55.57	-	-	-	-	-	-	-	-	62.03	48.65
WMD1	-	-	-	-	-	50.64	49.6	40.44	50.06	49.6	67.53	50.56	51.20	46.28
WyAQ1/2/3	-	-	-	-	57.41	61.55	54.60	50.03	54.45	54.13	60.05	54.60	55.85	52.3

(1) Means for diffusion tubes have been corrected for bias.

(2) All means have been "annualised" as per Technical Guidance LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix B Section B.5 for details.

B.5 – Passive Air Quality Monitoring Data QA/QC

Diffusion Tube Bias Adjustment Factors

The following UKAS accredited company provides Wychavon District Council with nitrogen dioxide diffusion tubes and analysis:

Somerset Scientific Services

The Crescent

County Hall

Taunton

TA1 4DY

Tel: 0300 123 2224

Email: somersetscientific@somerset.gov.uk

The 20% Triethanolamine (TEA) / Deionised Water preparation method is used.

The bias adjustment factor applied to the results in 2016 is 0.89 which has been derived from local co-location study at Worcester Road, Wychbold. The co-location study was undertaken in accordance with LAQM.TG16 and the local bias-adjustment factor calculated using the AEA Environment & Technology spreadsheet tool provided by DEFRA, see figure B5.1 below. The national bias-adjustment factor published by DEFRA in April 2017 (spreadsheet version number 03/17 V2) is 0.88 indicating good agreement between the national bias-adjustment figure and that calculated following the local co-location study at Worcester Road, Wychbold. The local bias-adjustment factor of 0.89 is considered to be more conservative than the national figure and has therefore been adopted for use across Worcestershire for bias-adjustment of 2016 diffusion tube data.

Figure B5.1 – Local Bias-adjustment factor calculation

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation	95% CI of mean
1	26/04/2016	25/05/2016	59.4	57.4	55.5	57	1.9	3	4.8
2	25/05/2016	28/06/2016	60.4	62.6	61.6	62	1.1	2	2.8
3	28/06/2016	26/07/2016	50.0	55.2	58.6	55	4.4	8	10.8
4	26/07/2016	23/08/2016	47.9	51.3	50.9	50	1.8	4	4.5
5	23/08/2016	27/09/2016	56.1	52.9	54.4	54	1.6	3	3.9
6									
7									
8									
9									
10									
11									
12									
13									

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Automatic Method		Data Quality Check	
Period	Data Capture	Tubes Precision	Automatic Monitor
Mean	(% DC)	Check	Data
53	96.4	Good	Good
57	96.4	Good	Good
53	96.4	Good	Good
41	96.4	Good	Good
44	96.4	Good	Good
Overall survey -->		Good precision	Good Overall

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Wychbold

Precision 5 out of 5 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%

Bias calculated using 5 periods of data

Bias factor A 0.89 (0.81 - 0.99)

Bias B 12% (1% - 23%)

Diffusion Tubes Mean: 56 µgm^{-3}

Mean CV (Precision): 4

Automatic Mean: 50 µgm^{-3}

Data Capture for periods used: 96%

Adjusted Tubes Mean: 49 (45 - 55) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA

Bias calculated using 5 periods of data

Bias factor A 0.89 (0.81 - 0.99)

Bias B 12% (1% - 23%)

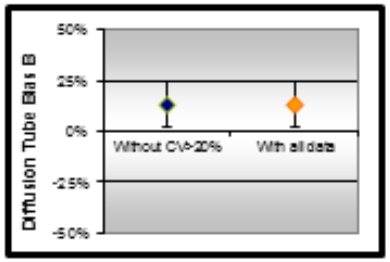
Diffusion Tubes Mean: 56 µgm^{-3}

Mean CV (Precision): 4

Automatic Mean: 50 µgm^{-3}

Data Capture for periods used: 96%

Adjusted Tubes Mean: 49 (45 - 55) µgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

QA/QC of Diffusion Tube Monitoring

Under the WASP scheme Somerset Scientific Services performed 100% satisfactory for all periods between January 2016 and February 2017. Tube precision was "Good" throughout 2016.

Short-term to Long-term Data Adjustment - Annualisation

Annualisation calculation for tube locations WMD1, ESP59 and WyAQ1/2/3 are shown below in Tables B.1, B.2 and B.3

Table B.1 Annualisation calculation WMD1 – Walkmill Drive

Site	Site Type	2016 Annual Mean	Period Mean	Ratio
Birmingham Acocks Green	Urban Background	21	20.7	1
Birmingham Tyburn	Urban Background	29	28.6	1
Coventry Allesley	Urban Background	22	21.4	1
Leamington Spa	Urban Background	21	20.9	1
			Adjsutment factor	1
			WMD1 result	45.75
			WMD1 result annualised	46.28

Table B.2 Annualisation calculation ESP59 – Nr. Walkmill Drive

Site	Site Type	2016 Annual Mean	Period Mean	Ratio
Birmingham Acocks Green	Urban Background	21	23.5	0.9
Birmingham Tyburn	Urban Background	29	32.3	0.9
Coventry Allesley	Urban Background	22	25.5	0.9
Leamington Spa	Urban Background	21	23.5	0.9
			Adjsutment factor	0.9
			EPS59 result	55.21
			EPS59 result annualised	48.99

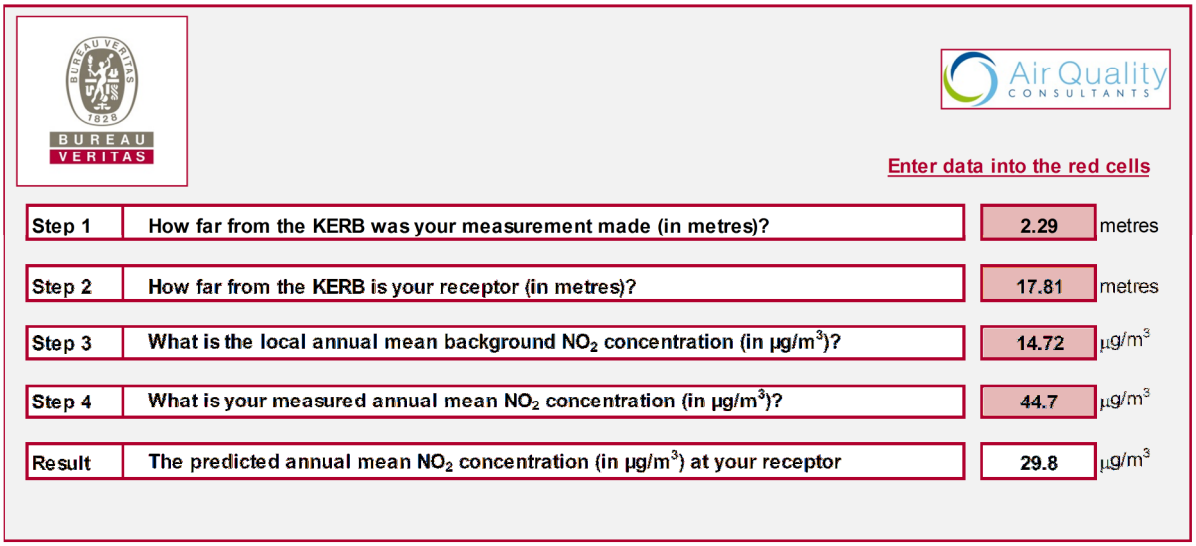
Table B.3 Annualisation calculation WyAQ1/2/3 – Automatic monitor triplicate

Site	Site Type	2016 Annual Mean	Period Mean	Ratio
Birmingham Acocks Green	Urban Background	21	20.4	1
Birmingham Tyburn	Urban Background	29	27.6	1
Coventry Allesley	Urban Background	22	20.9	1.1
Leamington Spa	Urban Background	21	20	1.1
			Adjsutment factor	1
			WyAQ1/2/3 result	49.71
			WyAQ1/2/3 result annualised	52

Estimates of concentrations at nearest receptor

If an exceedence (or result close to an exceedence) is measured at a monitoring site which is not representative of public exposure, the procedure specified in Technical Guidance LAQM.TG(16) has been used to estimate the concentration at the nearest receptor where applicable. The results are presented in Figures B.1 – B.4 below:

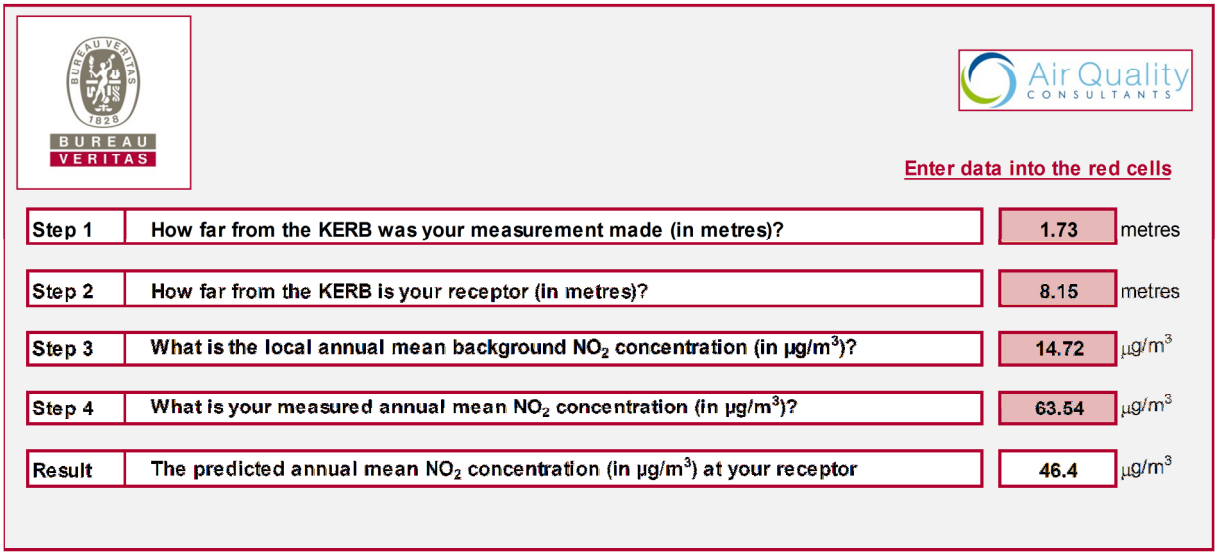
Figure B.1 – EPS27/28/29 Roundabout, Worcester Road



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	2.29	metres
Step 2	How far from the KERB is your receptor (in metres)?	17.81	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	14.72	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	44.7	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	29.8	$\mu g/m^3$

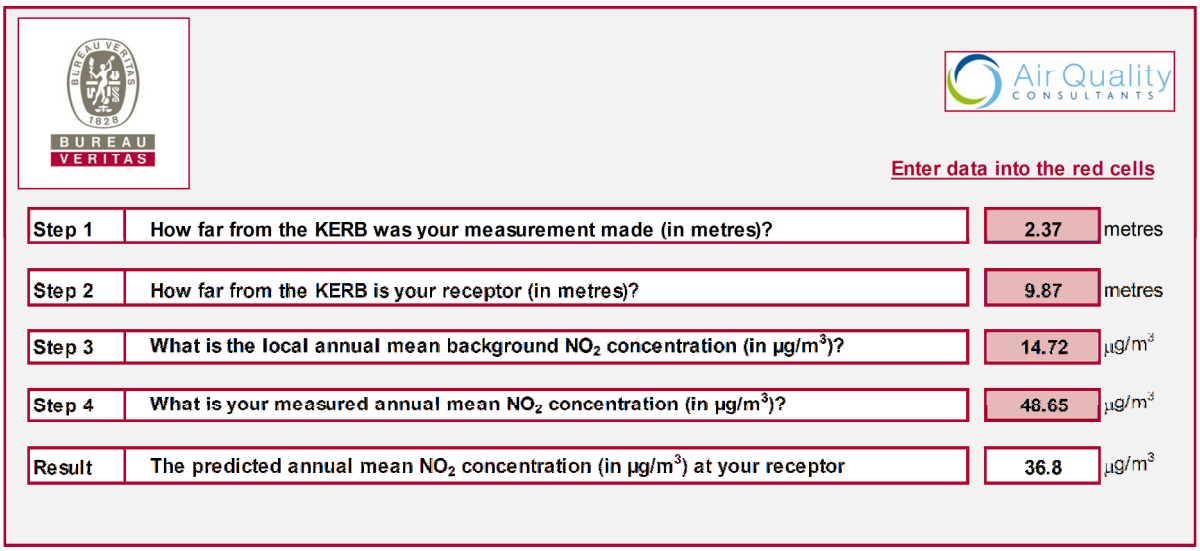
Figure B.2 – EPS58 2 Rose Villas, Worcester Road



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	1.73	metres
Step 2	How far from the KERB is your receptor (in metres)?	8.15	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	14.72	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	63.54	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	46.4	$\mu g/m^3$

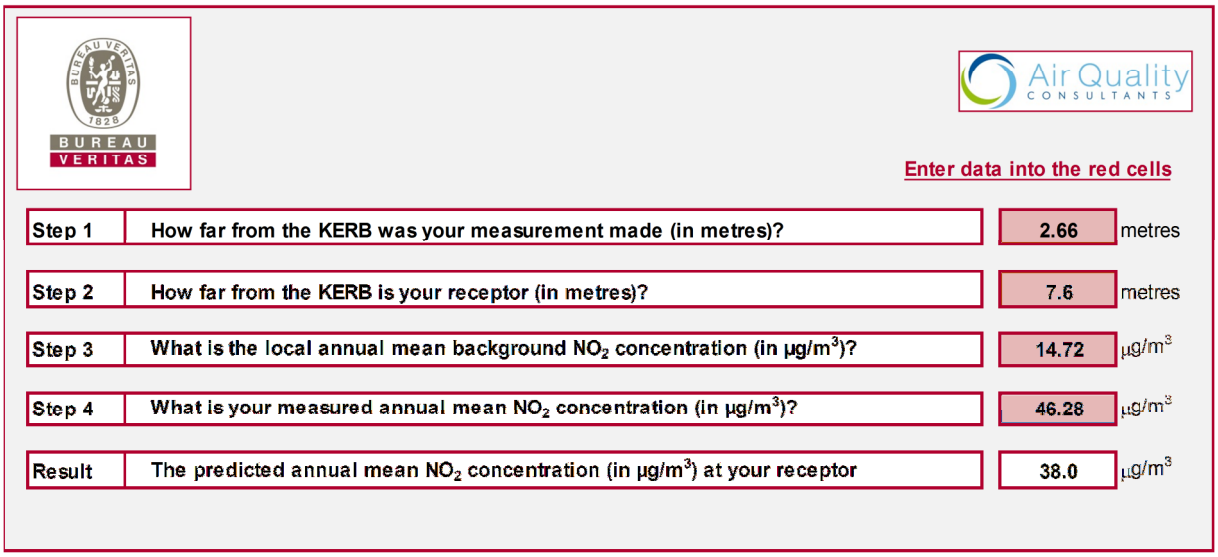
Figure B.3 – EPS59 Weathervale, Worcester Road



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	2.37	metres
Step 2	How far from the KERB is your receptor (in metres)?	9.87	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	14.72	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	48.65	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	36.8	$\mu g/m^3$

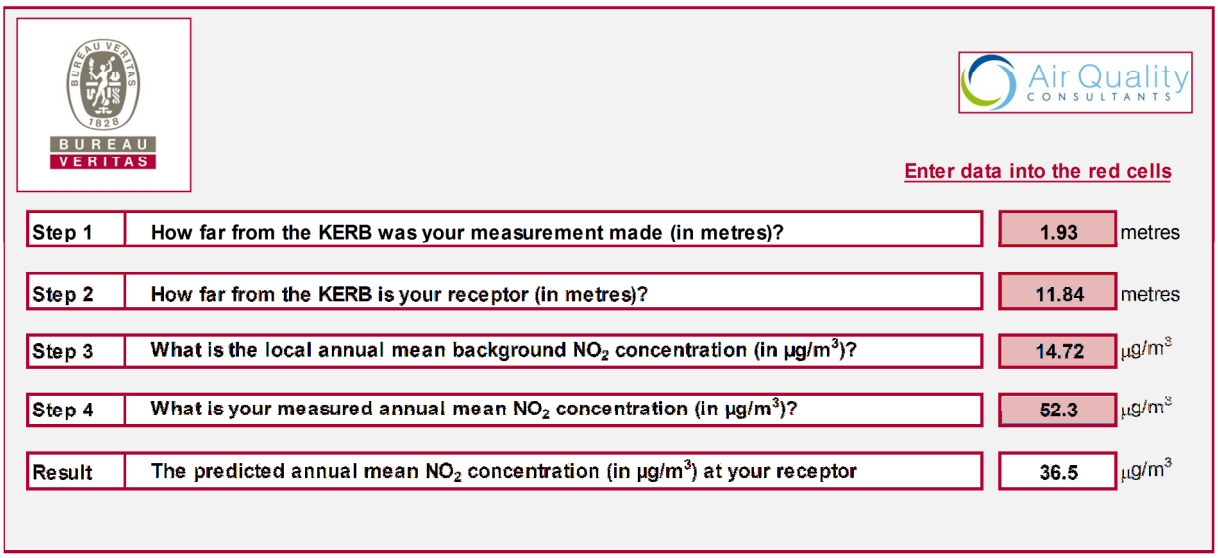
Figure B.4 – WMD1 Walkmill Drive junction



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	2.66	metres
Step 2	How far from the KERB is your receptor (in metres)?	7.6	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	14.72	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	46.28	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	38.0	$\mu g/m^3$

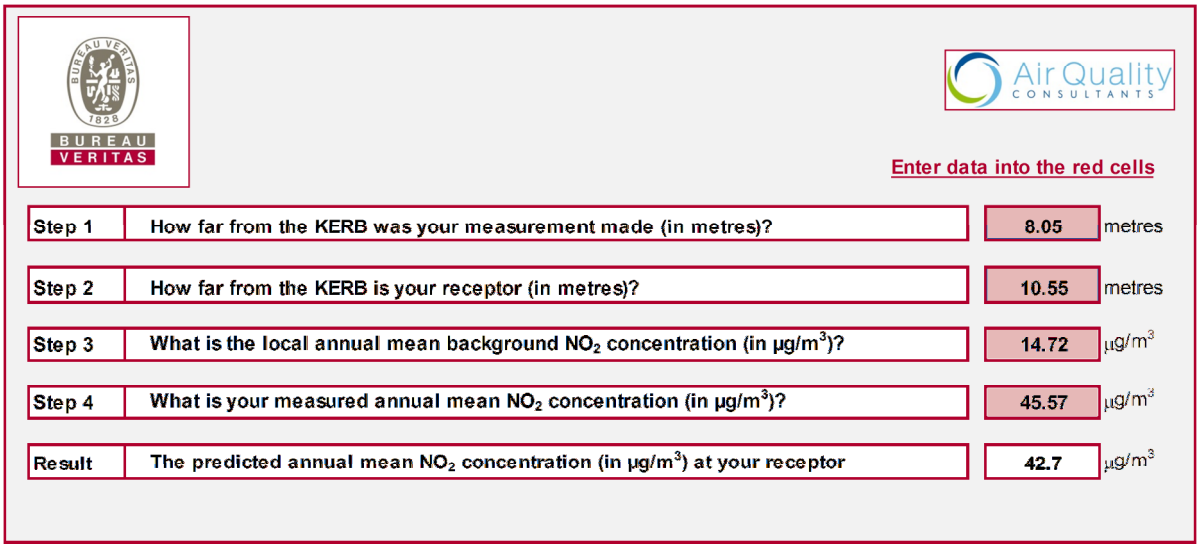
Figure B.5 – WyAQ1/2/3 Automatic Monitor Triplicate



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	1.93	metres
Step 2	How far from the KERB is your receptor (in metres)?	11.84	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	14.72	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	52.3	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	36.5	µg/m^3

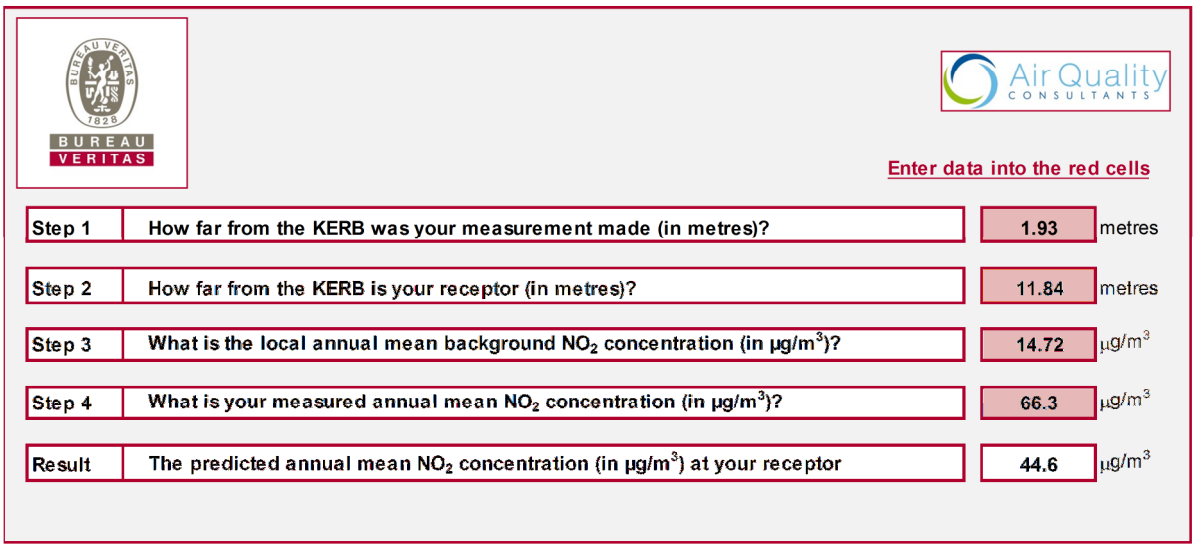
Figure B.6 – Façade Post Office calculated up to relevant exposure at first floor (addition of 2.5m to distance from kerb to receptor to account for difference between ground floor level at 1.5m and first floor level at 4m



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	8.05	metres
Step 2	How far from the KERB is your receptor (in metres)?	10.55	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	14.72	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	45.57	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	42.7	µg/m^3

Figure B.7 Continuous Monitor



BUREAU VERITAS

Air Quality CONSULTANTS

Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	1.93	metres
Step 2	How far from the KERB is your receptor (in metres)?	11.84	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	14.72	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	66.3	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	44.6	$\mu g/m^3$

Appendix C: Automatic Monitoring

C.1 – Details of Automatic Monitoring Site

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m)	Distance to kerb of nearest road (m)	Inlet Height (m)
WyAQCM	Worcester Road, Wychbold	Roadside	392019	265019	NO_2	No	Chemiluminescent	9.91	1.93	1.5

C.2 – Period and Annual Mean NO_2 Automatic Monitoring Results 2016

Site ID	Monitoring Type	Valid Data Capture for Monitoring Period (%)[1]	Valid Data Capture 2015 (%)[2]	NO_2 Period Mean Concentration 2016 (µg/m^3)	NO_2 Annual Mean Concentration 2016 (µg/m^3)[3]
WyAQCM	Chemiluminescent analyser	96.4	50.28	**51.0**	**<u>66.3</u>**

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 1-hour mean objective are shown in **<u>bold and underlined.</u>**

(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 (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) Annual mean has been "annualised" as per Technical Guidance LAQM.TG16 because valid data capture for the full calendar year is less than 75%. See Appendix C for details.

C.3 – 1-Hour Mean NO_2 Automatic Monitoring Results 2016

Site ID	Monitoring Type	Valid Data Capture for Monitoring Period (%)(1)	Valid Data Capture 2015 (%)(2)	NO_2 1-Hour Means >200µg/m^3(3)
WyAQCM	Chemiluminescent analyser	96.4	50.28	2 (142)

Notes:

Exceedances of the NO_2 1-hour mean objective (200µg/m^3 not to be exceeded more than 18 times/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 (e.g. if monitoring was carried out for 6 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.

C.4 – Automatic Air Quality Monitoring Data QA/QC

A chemiluminescent automatic analyser was installed at Worcester Road, Wychbold and operated between 23rd March 2016 and 29th September 2016. The monitor was used to continuous monitor levels of nitrogen dioxide (NO_2) and is based on the chemiluminescent reaction between nitrogen oxide (NO) and ozone (O_3). Calibration was undertaken by officers at Worcestershire Regulatory Services and data management by Air Quality Data Management (AQDM) Ltd.

Short-term to Long-term Data Adjustment - Annualisation

Annualisation calculation for tube locations WMD1, ESP59 and WyAQ1/2/3 are shown below in Tables B.1, B.2 and B.3

WyAQCM					
Site	**Site Type**		**2016 Annual Mean**	**Period Mean**	**Ratio**
Birmingham Acocks Green	Urban Background		21	15.7	1.3
Birmingham Tyburn	Urban Background		29	22.3	1.3
Coventry Allesley	Urban Background		22	16.7	1.3
Leamington Spa	Urban Background		21	15	1.4
				Adjsutment factor	1.3
				WyAQCM result	51
				WyAQCM result annualised	66.3

Appendix D: Dispersion Modelling

D.1 Model Input Parameters

The modelling exercise has been undertaken using ADMS-Roads v4.0.1.0. The model requires the user to provide various input data, including emissions from each section of road, and road characteristics. Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 7.0) published by Defra (2017).

Road Traffic

AADT flows, diurnal flow profiles and vehicle fleet composition for the A38 Worcester Road have been derived from a 12 hour traffic count undertaken by Worcestershire County Council on behalf of Worcestershire Regulatory Services on 30th June 2016. The 12 hour traffic count data have been scaled to 24 hour using DfT Table TRA0307 (DfT, 2016)

Table D.1 below details 12 hour and 24 hour scaled data

AADT flows, diurnal flows and vehicle composition for the M5 were obtained from the Department for Transport national transport datasets available at https://www.dft.gov.uk/traffic-counts/

Speed data for the A38 Worcester Road were derived from a basic speed survey carried out by Worcestershire Regulatory Services on Wednesday 25th January 2017. The survey was carried out using Android App “Speedometer GPS” which uses the inbuilt GPS of the smart phone to monitor and record journey statistics, including speed. These data are then displayed on a Google basemap. The data are stored and can be reviewed at t later date. There is no function to export the data from the app and as such it is not possible to reproduce it in full as part of this report. However a summary of the information gathered is provided in Table D.2 below.

The surveys were undertaken during peak times between 0730 and 0930 and then again between 1630 and 1800.

North bound and south bound speeds for specific points were extracted from the dataset. These were then averaged across the morning and evening peak time runs to give a single averaged speed at specific points along the model area. These data were then input into the model against the relevant road links.

Speed data for the M5 main carriage way were obtained from the Department for Transport national transport datasets available at https://www.dft.gov.uk/traffic-counts/

Speed data for the south-bound slip road was estimated based on reducing speeds exiting the main carriageway and approaching the traffic light junction with the A38.

Table D.1 A38 Traffic Count Data – 12 hour and scaled 24 hour

Hour Commencing		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Vehicles	Scaling factor	Scaled to 24hr
Pedal	NB	0	1	1	4	1	2	0	2	0	0	0	0	3	0	0	0	**14**	**1.28**	**18**
Cycles	SB	0	0	1	2	1	1	1	1	0	0	1	2	1	0	0	0	**11**	**1.28**	**14**
	Both	0	1	2	6	2	3	1	3	0	0	1	2	4	0	0	0	**25**	**1.28**	**32**
Motor	To	0	6	5	2	4	3	2	5	1	2	3	3	2	0	0	0	**38**	**1.28**	**49**
Cycles	From	0	5	6	1	4	1	2	4	2	2	2	2	1	0	0	0	**32**	**1.28**	**41**
	Both	0	11	11	3	8	4	4	9	3	4	5	5	3	0	0	0	**70**	**1.28**	**90**
	To	0	540	558	437	411	422	454	431	456	425	452	612	413	0	0	0	**5611**	**1.28**	**7182**
Cars	From	0	658	572	368	393	421	436	440	442	514	757	667	563	0	0	0	**6231**	**1.28**	**7976**
	Both	0	1198	1130	805	804	843	890	871	898	939	1209	1279	976	0	0	0	**11842**	**1.28**	**15158**
	To	0	7	7	9	8	5	4	9	8	8	8	6	5	0	0	0	**84**	**1.28**	**108**
Buses	From	0	6	8	6	7	10	6	6	9	6	5	10	10	0	0	0	**89**	**1.28**	**114**
	Both	0	13	15	15	15	15	10	15	17	14	13	16	15	0	0	0	**173**	**1.28**	**221**
Light	To	0	118	92	138	105	97	101	95	86	109	88	75	63	0	0	0	**1167**	**1.28**	**1494**
Goods	From	0	128	97	73	81	76	75	84	104	81	74	55	41	0	0	0	**969**	**1.28**	**1240**
Vehicles	Both	0	246	189	211	186	173	176	179	190	190	162	130	104	0	0	0	**2136**	**1.28**	**2734**
Smaller	To	0	7	10	5	18	12	11	5	6	6	1	4	3	0	0	0	**88**	**1.28**	**113**
2-Axle	From	0	13	13	9	7	4	13	16	16	12	8	6	4	0	0	0	**121**	**1.28**	**155**
Lorries	Both	0	20	23	14	25	16	24	21	22	18	9	10	7	0	0	0	**209**	**1.28**	**268**
Bigger	To	0	6	11	13	11	18	16	10	7	13	5	4	3	0	0	0	**117**	**1.28**	**150**
2-Axle	From	0	13	21	17	10	17	12	12	11	11	8	6	2	0	0	0	**140**	**1.28**	**179**
Lorries	Both	0	19	32	30	21	35	28	22	18	24	13	10	5	0	0	0	**257**	**1.28**	**329**
3-Axle	To	0	7	5	4	2	1	3	2	2	2	2	1	2	0	0	0	**33**	**1.28**	**42**
Rigid/Artic	From	0	7	10	3	4	8	7	3	4	3	2	2	1	0	0	0	**54**	**1.28**	**69**
	Both	0	14	15	7	6	9	10	5	6	5	4	3	3	0	0	0	**87**	**1.28**	**111**
4 Axles or	To	0	14	18	15	16	19	18	16	12	16	18	14	17	0	0	0	**193**	**1.28**	**247**
more	From	0	15	14	17	20	22	17	22	22	14	14	17	11	0	0	0	**205**	**1.28**	**262**
Rigid/Artic	Both	0	29	32	32	36	41	35	38	34	30	32	31	28	0	0	0	**398**	**1.28**	**509**
	NB	**0**	**706**	**707**	**627**	**576**	**579**	**609**	**575**	**578**	**581**	**577**	**719**	**511**	**0**	**0**	**0**	**7345**	**1.28**	**9402**
Totals	**SB**	**0**	**845**	**742**	**496**	**527**	**560**	**569**	**588**	**610**	**643**	**871**	**767**	**634**	**0**	**0**	**0**	**7852**	**1.28**	**10051**
	Both	**0**	**1551**	**1449**	**1123**	**1103**	**1139**	**1178**	**1163**	**1188**	**1224**	**1448**	**1486**	**1145**	**0**	**0**	**0**	**15197**	**1.28**	**19452**

Table D.2 A38 Speed Survey Data

NORTHBOUND - Morning				
	Speed (km/h)			
Location	**0730**	**0800**	**0927**	**Av**
Exiting M5 roundabout	28	30	33	**30**
McDonalds junction	32	37	38	**36**
Walkmill Drive turn	39	49	50	**46**
New Dev turn	47	53	57	**52**
Opp Wychbold garage	45	46	59	**50**
Crown Lane turn	47	45	58	**50**
Crown PH bus stop	41	47	60	**49**
BP Garage	57	49	64	**57**
Mill Lane turn	60	56	67	**61**
Paper Mill Lane turn	62	63	78	**68**

NORTHBOUND - Afternoon					
	Speed (km/h)				
Location	**1618**	**1644**	**1713**	**1743**	**Av**
Exiting M5 roundabout	33	36	38	43	**38**
McDonalds junction	33	40	29	47	**37**
Walkmill Drive turn	38	43	31	47	**40**
New Dev turn	43	49	42	50	**46**
Opp Wychbold garage	45	47	45	52	**47**
Crown Lane turn	40	40	44	54	**45**
Crown PH bus stop	43	50	47	55	**49**
BP Garage	57	54	50	55	**54**
Mill Lane turn	64	58	52	59	**58**
Paper Mill Lane turn	72	65	61	59	**64**

NORTHBOUND AV	Av across day
Exiting M5 roundabout	33.91666667
McDonalds junction	36.45833333
Walkmill Drive turn	42.875
New Dev turn	49.16666667
Opp Wychbold garage	48.625
Crown Lane turn	47.25
Crown PH bus stop	49.04166667
BP Garage	55.33333333
Mill Lane turn	59.625
Paper Mill Lane turn	65.95833333

SOUTHBOUND - Morning				
	Speed (km/h)			
Location	**0740**	**0810**	**0931**	**Av**
Entering M5 roundabout	11	24	15	**17**
Opp McDonalds junction	30	17	43	**30**
Opp Walkmill Drive turn	48	39	53	**47**
Opp New Dev turn	51	47	55	**51**
Wychbold Garage	46	46	60	**51**
Opp Crown Lane turn	24	44	60	**43**
OPP Crown PH bus stop	56	45	60	**54**
Opp BP Garage	55	48	60	**54**
Opp Mill Lane turn	59	49	57	**55**
Opp Paper Mill Lane turn	61	60	58	**60**

SOUTHBOUND - Afternoon					
	Speed (km/h)				
Location	**1634**	**1652**	**1720**	**1751**	**Av**
Entering M5 roundabout	37	31	31	31	**33**
Opp McDonalds junction	40	20	34	40	**34**
Opp Walkmill Drive turn	50	53	45	53	**50**
Opp New Dev turn	50	52	49	56	**52**
Wychbold Garage	51	54	43	57	**51**
Opp Crown Lane turn	17	30	16	55	**30**
OPP Crown PH bus stop	50	47	48	60	**51**
Opp BP Garage	53	57	55	61	**57**
Opp Mill Lane turn	53	58	52	59	**56**
Opp Paper Mill Lane turn	78	70	61	69	**70**

SOUTHBOUND AV	Av across day
Entering M5 roundabout	24.58333333
Opp McDonalds junction	31.75
Opp Walkmill Drive turn	48.45833333
Opp New Dev turn	51.375
Wychbold Garage	50.95833333
Opp Crown Lane turn	36.08333333
OPP Crown PH bus stop	52.45833333
Opp BP Garage	55.41666667
Opp Mill Lane turn	55.25
Opp Paper Mill Lane turn	64.58333333

BOTH DIRECTIONS	Av across day
Exiting M5 roundabout	29
McDonalds junction	34
Walkmill Drive turn	46
New Dev turn	50
Opp Wychbold garage	50
Crown Lane turn	42
Crown PH bus stop	51
BP Garage	55
Mill Lane turn	57
Paper Mill Lane turn	65

Figure D.1 below shows the road network included within the model and defines the study area. The M5 has been included to ensure that any local background contribution from the motorway is represented in the model

Road width were estimated using the measuring tool in ArcGIS v10.2

Figure D.1 Modelled Road Links

Background Concentrations

The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2017). These cover the whole country on a 1x1 km grid and are published for each year from 2013 until 2030.

Modelled Receptors

A total of 37 receptor points have been plotted, including the location of the five diffusion tubes and the location of the automatic monitor. Receptor locations were chosen to represent relevant exposure and to give even coverage across the model domain.

Receptor heights have generally entered at 1.5m (to represent ground floor level) with the exception of the monitoring points where measured tube heights were used. In addition heights for receptor points R1 and R12 have been entered at 4.5m to represent relevant exposure at first floor level where ground floor level is commercial (post office and public house).

The GIS files may be made available on request.

A plan of plotted receptor locations and table of location details can be found below

Figure D.2 Modelled Receptor Locations

Figure D.3 Receptor Locations

Receptor Reference Number	Receptor Location
R1	Facade Post Office, Worcester Road
R2	Facade Rosedene, Worcester Road
R3	Facade 1 Rose Villas, Worcester Road
R4	Facade Weathervale, Worcester Road
R5	Facade Sandalwood, Worcester Road
R6	Façade The Cloverleaf, Worcester Road
R7	Facade 1 Council House, Worcester Road
R8	Facade 5 Council House, Worcester Road
R9	Facade Fernleigh, Worcester Road
R10	Facade Oakley, 18 Worcester Road
R11	Facade Ploda Cottage, Crown Lane
R12	Facade The Crown Public House, Worcester Road
R13	BP Petrol Station Forecourt, Worcester Road
R14	Facade Avondale, Worcester Road
R15	Facade 2 Pentre Villas, Worcester Road
R16	Facade Daisy Cottage, Worcester Road
R17	Facade Clive Cottage, Worcester Road

R18	Facade Norvena, Worcester Road
R19	Facade Montifoire, Worcester Road
R20	Northern facade The Poplars, Worcester Road
R21	Central facade The Poplars, Worcester Road
R22	Facade 2 Prospect Villas, Worcester Road
R23	Facade 6 Prospect Villas, Worcester Road
R24	Facade Briarleigh, Worcester Road
R25	Facade The Orchard, Worcester Road
R26	Facade The White House, Worcester Road
R27	Facade 1 Post Office Row, Worcester Road
R28	Facade White Cottage, Worcester Road
R29	Facade 21 Sheldon Close
R30	Facade 9 Sheldon Close
R31	Facade 5 Sheldon Close
R32	Continuous Analyser Site
EPS56	Diffusion tube, facade post office, Worcester Road
EPS58	Diffusion tube, lamppost outside 2 Rose Villa, Worcester Road
WMD1	Diffusion tube, lamppost outside The Nest, Worcester Road
EPS27	Diffusion tube, lamppost adj roundabout junction
WyAQ1/2/3	Diffusion tube triplicate location with continuous analyser

Meteorological Inputs

Hourly sequential meteorological data from Pershore for 2016 have been used in the model. The data was supplied in an ADMS ready format. The Pershore data was missing 12% cloud cover, this gap was made up using data from Birmingham.

The Pershore met station is located at SO972500 (easting 397278, northing 250018). The site sits at the end of a small runway at Throckmorton airfield. To the north-east and north-west are agricultural fields, to the south-east the airfield and the south-west airfield buildings and a number of industrial units. The Pershore station is deemed to be the nearest monitoring stations representative of meteorological conditions in the area.

The surface roughness for the model area is set at 1.0m which best describes the situation at Worcester Road, Wychbold. The surface roughness for the meteorological station sties is set at 0.1m which best describes the mix of airfield and runway with adjacent agricultural fields.

The Monin-Obukhov Length is set at 10m (small towns <50,000) as this best describes the model area.

D.2 Model Verification

In order to ensure that ADMS-Roads predicts local concentrations as accurately as possible it is necessary to verify the model against local monitoring data.

Most nitrogen dioxide is produced in the atmosphere by a reaction between nitric oxide and ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOX) The model has been run to predict the annual mean NOX concentrations during 2016 at the EPS56, EPS58, WMD1, EPS27 and WyAQ diffusion tube locations and at the site of the Wychbold automatic monitor. Concentrations were modelled at heights of the respective monitoring location.

The model output of road-NOX is has been compared with measured road-NOX. Measured road-NOX has been calculated from measured concentrations of NO_2 and predicted NO_2 background concentrations using the NOx to NO_2 calculator (version 5.1) available via the Defra LAQM Support Website (Defra, 2017).

An adjustment factor has been determined as the line of best-fit between the 'measured' road contribution and the modelled road contribution, forced through zero (Figure D.3) The calculated adjustment factor of 1.49 has been applied to the modelled road-NOx contribution for each receptor to provide adjusted modelled road-NOx concentrations.

The total NO_2 concentrations have been calculated by combining the adjusted modelled road-NOx concentrations with the predicted NO_2 background concentrations within the NOx to NO_2 calculator (version 5.1) (Defra, 2017). Figure D.3 compares the final adjusted modelled total NO_2 concentration at each of the monitoring sites used in the verification process to measured total NO_2.

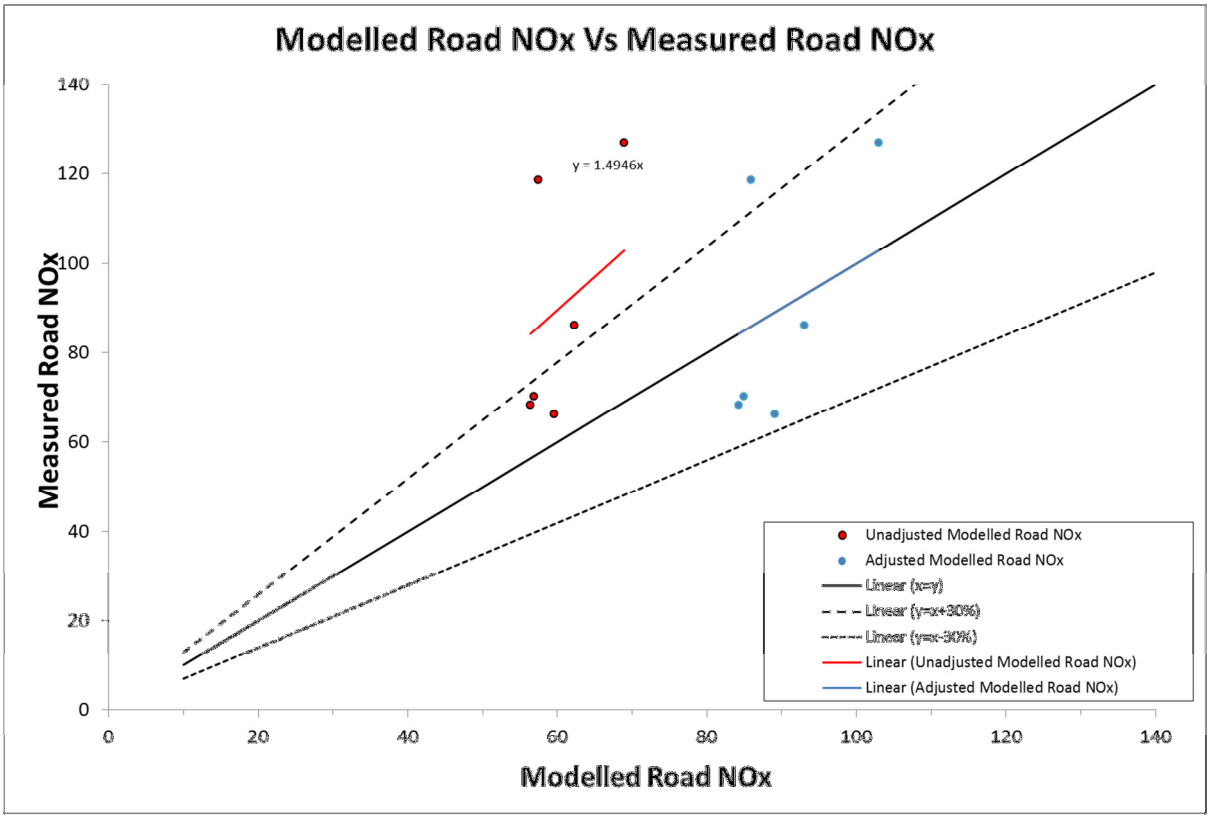
In order to ensure that the model is fit for purpose Worcestershire Regulatory Services commissioned a peer review of the model by Ricardo PLC. Ricardo

provided advice in relation to the general performance of the model and improving model accuracy.

All reasonable steps were taken to minimise model uncertainty however an average error of approximately 6µg/m^3 persists in the results. Advice in relation to this error was sought from Ricardo who advised that, given the magnitude of the concentrations modelled at receptors this error is not sufficient to materially change the conclusions of the work; that is that an AQMA is warranted and should be declared based on this modelling.

Ricardo advised it would be useful for the model to be revisited during any action planning process in order to narrow down the compliance gap as much as possible.

Figure D.3 Comparison of measured road-NOX to unadjusted modelled road-NOX concentrations and adjusted modelled road-NOX concentrations



Glossary of Terms

Abbreviation	Description
AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority 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	Air quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
EFT	Emission Factor Toolkit
EU	European Union
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
TEA	Triethanolamine – absorption of nitrogen dioxide in diffusion tubes

Worcestershire
Regulatory Services
Supporting and protecting you

Port Street, Evesham AQMA Revocation Screening Assessment

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

October 2017

Local Authority Officer	Laura Carradine
Department	Land & Air Quality Team
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Report Reference number	WDC/PORTST/REV/2017
Date	October 2017

Executive Summary

This report has been produced on behalf of Wychavon District Council (WDC) and represents a screening assessment of air quality at the Port Street, Evesham AQMA between 2006 and 2016. The assessment has been carried out to determine whether the Port Street, Evesham AQMA can be revoked. The assessment has not included a detailed dispersion model as available monitoring data is sufficient to provide a robust review of nitrogen dioxide levels at the Port Street AQMA over the past decade.

Levels of measured nitrogen dioxide between 2006 and 2016 have followed a downward trend over the period with only three measured exceedances of the NO_2 annual mean objective at relevant exposure observed in the past ten years (in 2010 and 2013).

It is considered to be very unlikely that a consistent exceedance of the nitrogen dioxide annual mean objective over future years will occur, as demonstrated by the lack of consistent exceedances between 2006 and 2016 and a consistent downward trend in NO_2 concentrations across that same ten year period. It is therefore recommended that the Port Street, Evesham AQMA is revoked following the necessary statutory consultation.

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9 Introduction

This report has been produced on behalf of Wychavon District Council (WDC) and represents a screening assessment of air quality at the Port Street, Evesham AQMA between 2006 and 2016. The assessment has been carried out to determine whether the Port Street, Evesham AQMA can be revoked. The assessment has not included a detailed dispersion model as available monitoring data is sufficient to provide a robust review of nitrogen dioxide levels at the Port Street AQMA over the past decade.

The policy framework for air quality management in the UK is set out in The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007). The Strategy provides air quality standards and objectives for key pollutants designed to protect human health and the environment. The Strategy also sets out how local government can contribute to achieving the air quality objectives. The Local Air Quality Management (LAQM) regime is set out in the Strategy and requires every local authority to carry out regular reviews and assessments of air quality in its area to identify whether the air quality objectives have been, or will be, achieved at relevant locations by the appropriate dates. Where air quality objectives are not being met the local authority must declare an Air Quality Management Area (AQMA) and produce an action plan to identify appropriate measures that can be taken in pursuit of the objectives.

The Air Quality Strategy (Defra, 2007) sets out air quality standards and objectives for key pollutants. The standards are set as concentrations below which health effects are unlikely, or below which risks to public health would be very small (even in sensitive population groups). The air quality objectives only apply where “relevant exposure” exists, i.e. where members of the public are likely to be regularly present for the duration of the averaging time of the objective. For annual mean objectives relevant exposure is limited to residential proprieties, school and hospitals. The 1-hour objective applies to residential properties, schools and hospitals as well as any outdoor location where members of the public might reasonably be expected to stay

for 1 hour or more, such as outdoor seating areas at eating establishments, parks, busy shopping streets etc. The statutory air quality objectives applicable to LAQM in England can be found in Table A.1 in Appendix A.

Technical Guidance for LAQM (LAQM.TG.16) sets out the approach for LAQM. When an exceedance of an air quality objective has been identified the local authority is required to declare an Air Quality Management Area (AQMA). LAQM.TG.16 and LAQM.PG.16 also sets out the requirements for when an AQMA may be revoked.

10 Background to the Port Street, Evesham AQMA

The Port Street, Evesham AQMA was declared by Wychavon District Council on 22nd August 2007 due to measured exceedances of the nitrogen dioxide (NO_2) annual mean objective. A copy of the sealed order, including a location plan, can be found in Appendix B.

It is understood that the AQMA was declared based solely on measured NO_2 concentrations from a network of diffusion tubes, and that no automatic monitoring or Detailed Assessment was undertaken to support the decision to declare an AQMA.

Since declaration of the AQMA in August 2007 monitoring of NO_2 levels has continued using a network of diffusion tubes.

An Action Plan for the AQMA was developed, the current iteration of which can be viewed at http://www.worcsregservices.gov.uk/pollution/air-quality/air-quality-action-plan.aspx This report also contains progress reporting in relation to the implementation of the Action Plan.

Levels of measured NO_2 between 2003 and 2016 have followed a downward trend with only three measured exceedances of the NO_2 annual mean objective at relevant exposure observed in the past ten years (in 2010 and 2013). Measured NO_2 concentrations between 2006 and 2016 are reproduced in Appendix C.

11 Detailed Review of Data

11.1 Monitoring Data and Long-term Trends

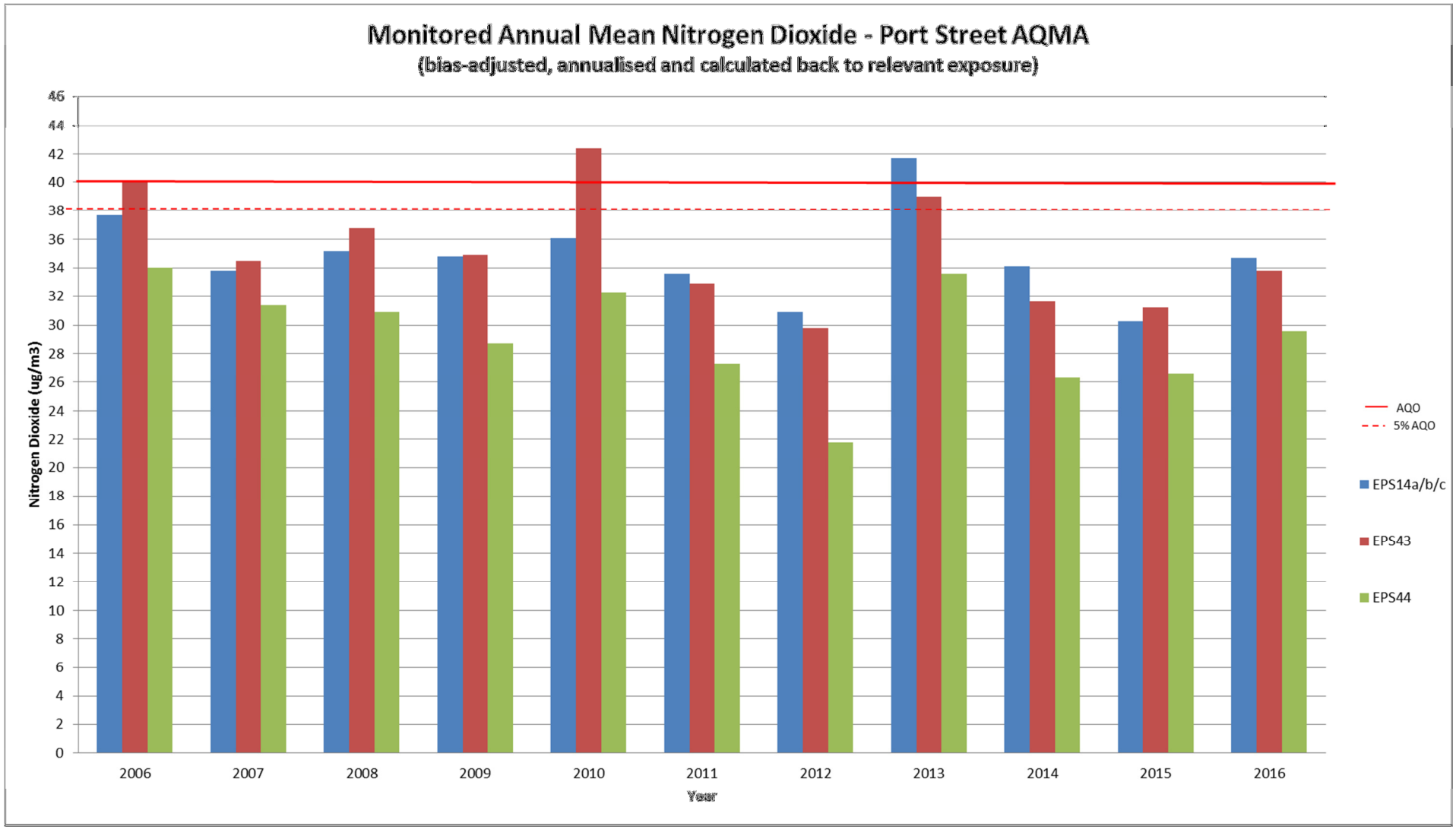
All available monitoring data for the period 2006 to 2016 for diffusion tubes located in the AQMA has been subject to review.

Details of the diffusion tubes subject to this review are provided in Appendix C.

Measured levels have been calculated back to relevant exposure where necessary in accordance with LAQM.TG.16 using the DEFRA NO_2 Fall-Off with Distance Calculator. The detailed workings for these calculations have not been reproduced in this report but can be found in each relevant years reporting to DEFRA. Years 2010 to 2016 are available via http://www.worcsregservices.gov.uk/pollution/air-quality/local-air-quality-progress-reports.aspx, years 2006 to 2009 can be made available on request.

A series of graphs has been produced to illustrate long-term trends in measured NO_2 concentrations at relevant exposure between 2006 and 2016. These are reproduced and discussed below.

Figure 1.0 Monitored Annual Mean NO_2 at relevant exposure



The available monitoring data has been assessed in relation to the number of exceedances of the annual mean objective for NO_2 (40µg/m^3) and observed levels within 5% of the annual mean objective (5% AQO) for NO_2 (38µg/m^3).

Table 1.0 provides details of the number of exceedances of the NO_2 annual mean air quality objective between 2006 and 2016 at relevant exposure.

Table 2.0 provides details of the number of concentrations observed within 5% of the NO_2 annual mean air quality objective between 2006 and 2016 at relevant exposure.

Table 1.0 – Number of exceedances of NO_2 annual mean AQO 2006 - 2016

Site ID	Site Description	No. exceedances of NO_2 Annual Mean Objective (40µg/m^3) at relevant exposure
EPS14a/b/c	Road sign, Port Street	1 (2013)
EPS43	Camera Post opposite 33 Port Street	2 (2006, 2010)
EPS44	Long stay car park sign, opposite Regal Cinema, Port Street	0

Table 2.0 – Number NO_2 concentrations observed within 5% AQO 2006 - 2016

Site ID	Site Description	No. exceedances within 5% of NO2 Annual Mean Objective (38µg/m^3) at relevant exposure
EPS14a/b/c	Road sign, Port Street	0
EPS43	Camera Post opposite 33 Port Street	1 (2013)
EPS44	Long stay car park sign, opposite Regal Cinema, Port Street	0

It can be seen that over the past decade there have only been three isolated monitored exceedances of the NO_2 annual mean objective at EPS 43 in 2006 and 2010 and at EPS14a/b/c in 2013, when calculated back to relevant exposure. A review of the monitoring data reproduced in Appendix C shows that these

exceedances were only slightly elevated in nature at 40.0µg/m^3, 41.7µg/m^3 and 42.4µg/m^3 respectively.

In addition there has been one occasion over the past decade where monitored NO_2 concentrations have been within 5% of the NO_2 annual mean objective i.e. above 38µg/m^3. These occurred at tube EPS43 in 2013, where a concentration of 39.0µg/m^3 was measured (see Appendix C for detailed monitoring data). It is useful to consider concentrations within 5% of the objective as an indication of how likely it is that the objective might be exceeded in future years. For example, an area with consistent NO_2 levels within 5% of the objective is more likely to see exceedances of the objective associated with meteorological fluctuations than an area where levels are consistently below 5% of the objective.

In addition trendlines for the individual tubes have been produced in order to provide a graphical representation of trends in NO_2 concentrations at each monitoring location between 2006 and 2016. These are reproduced below. It can be seen that a consistent downward trend in NO_2 concentrations has been observed at each monitoring location over the period 2006 to 2016.

Figure 2.0 EPS14a/b/c Monitored Annual Mean NO_2 at relevant exposure

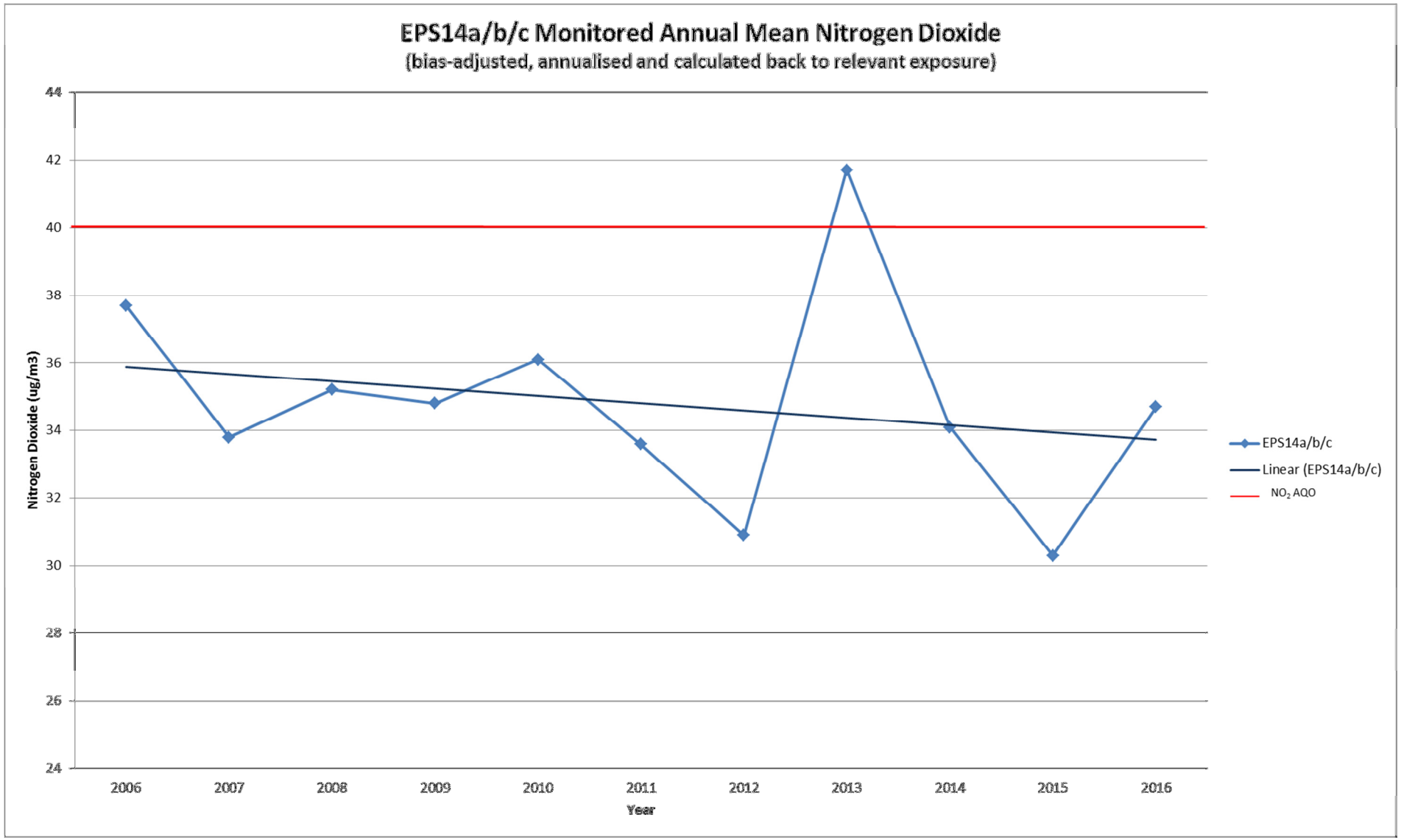


Figure 3.0 EPS43 Monitored Annual Mean NO_2 at relevant exposure

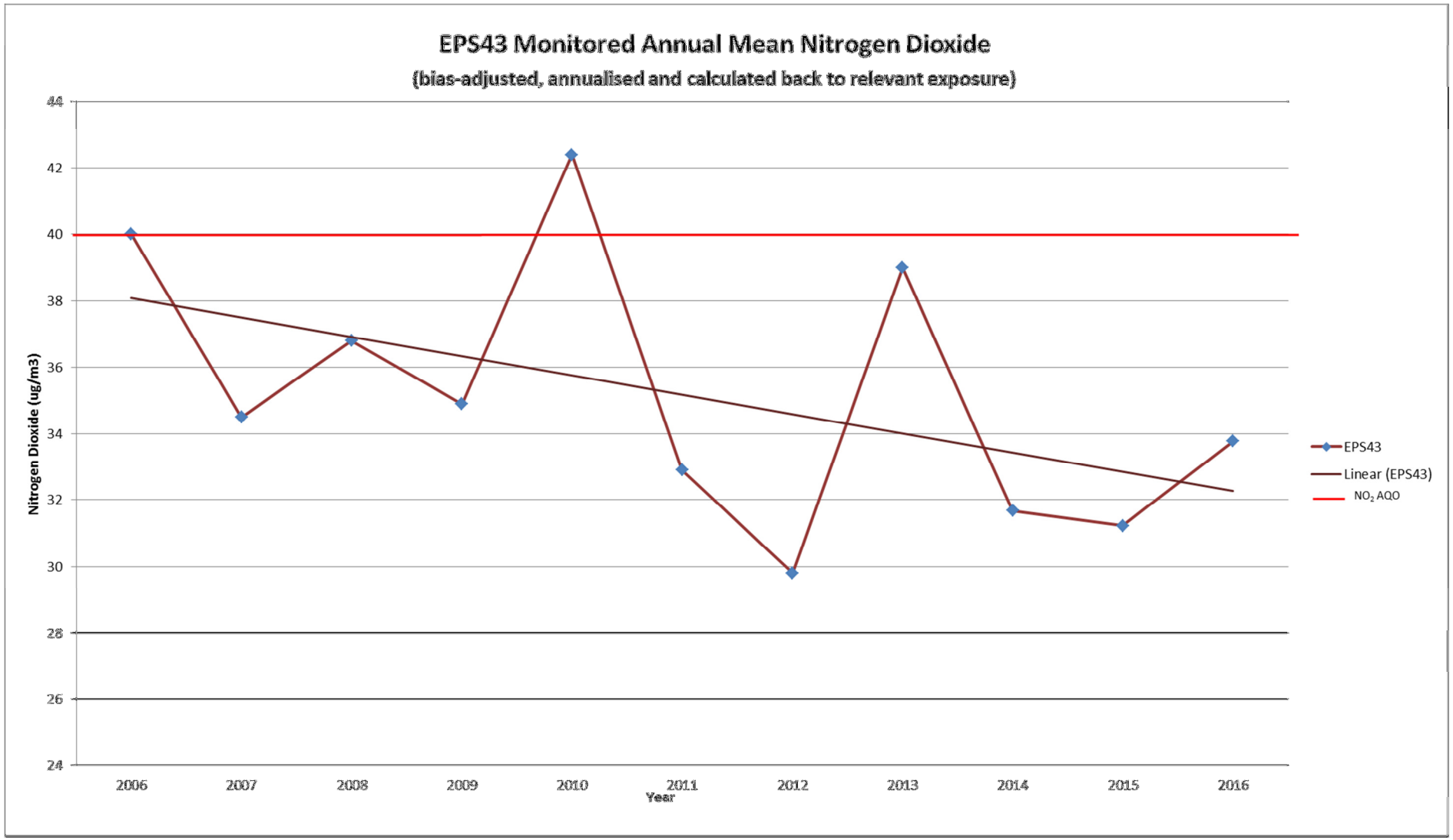
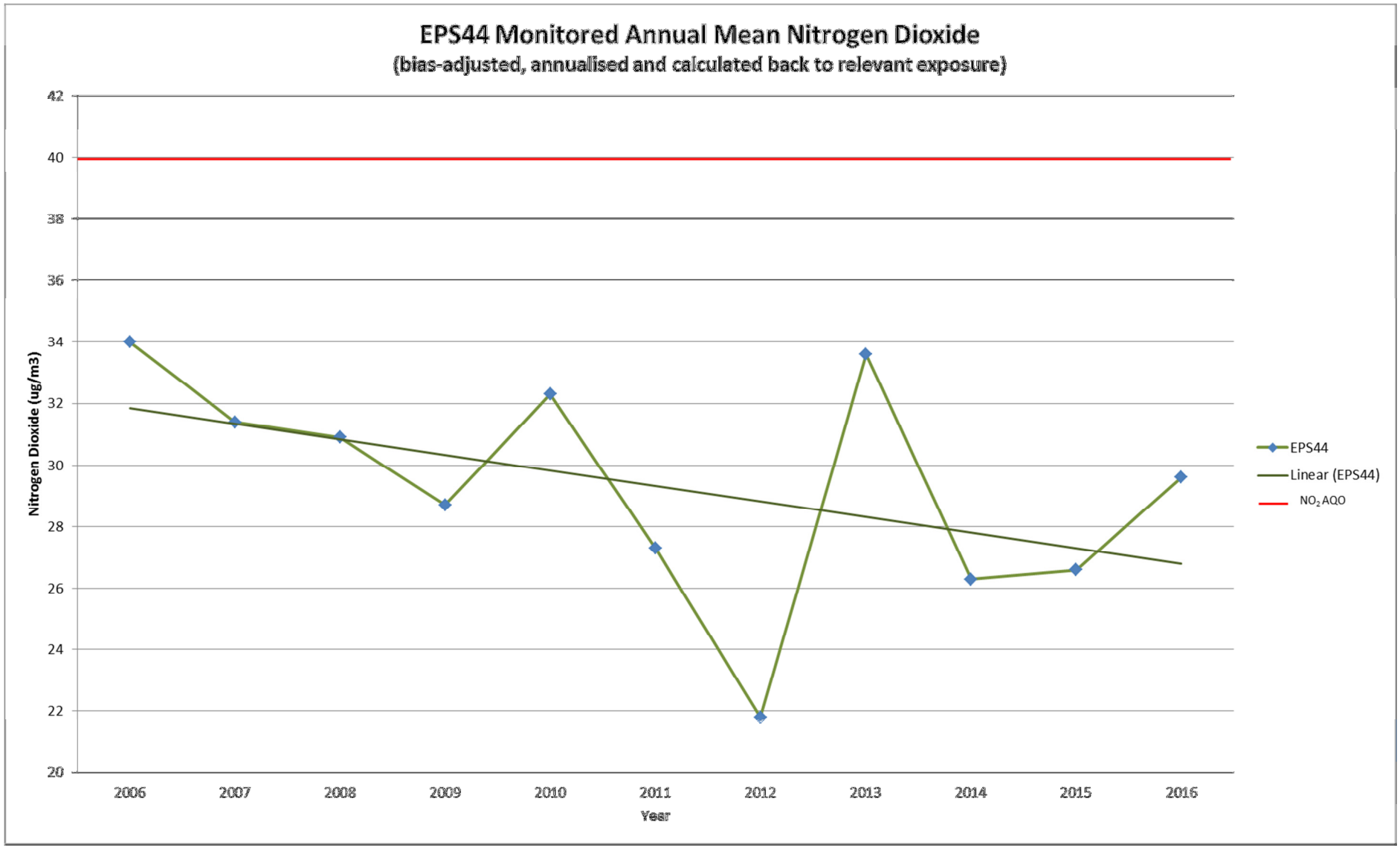


Figure 4.0 EPS44 Monitored Annual Mean NO_2 at relevant exposure



11.2 Results Discussion

Monitoring results have been assessed for the ten year period 2006 to 2016. As discussed above only three minor exceedances of the NO_2 annual mean objective have been measured during that time. In addition there has been once occasion on which measured levels of NO_2 fell within 5% of the NO_2 annual mean objective.

Three of the above instances occurred in 2010 and two in 2013. It is noted that both 2010 and 2013 saw higher than usual concentrations of NO_2 both across Worcestershire and nationally. NO_2 concentrations are extremely susceptible to meteorological conditions. Generally we see higher concentrations on cooler still days were NO_2 takes longer to volatise and disperse and lower concentrations on warmer windier days where volatilisation and dispersion occur much more rapidly. In 2010 and 2013 the UK experienced cooler winters than in previous and subsequent years and as such it is very likely that the higher concentrations of NO_2 observed during these years can be attributed to meteorological conditions. It is likely that this was also the case in 2006 however given the time elapsed since then it is difficult to provide additional comment.

With the exception of the instances outlined above in general monitored concentrations of NO_2 within the Port Street AQMA have been well below the NO_2 annual mean objective of 40µg/m^3 and have also not fallen within 5% of the NO_2 annual mean objective over the past decade.

A consistent downward trend in monitored NO_2 levels within the AQMA can be observed over the past decade. This downward trend may be attributed to any number of factors however the most significant is likely to be the general trend of increasingly mild winters combined with minor improvements in emissions associated with the general vehicle fleet. In addition factors such as anecdotal evidence for local changes in travel behaviours, such as small increases in uptake of cycling and walking, will contribute to any improvement in NO_2 concentrations..

12 Conclusions and Recommendations

The Port Street AQMA declaration was made based on marginal exceedances of the NO_2 annual mean objective in 2007. It is likely that the advent of increasingly mild winters over the past decade combined with small improvements to emissions of the general vehicle fleet have resulted in concentrations of NO_2 that consistently fall well below the NO_2 annual mean objective. It is acknowledged that it is possible that particularly cold winters may result in occasional marginal exceedances of the NO_2 annual mean objective however current understanding of the UK climate suggests that milder winters are likely to continue. Therefore any marginal exceedance of the NO_2 annual mean objective associated with possible occasional colder winters will be isolated and that there is very unlikely to be an consistent exceedance of the NO_2 annual mean objective over future years, as demonstrated by the lack of consistent exceedances between 2006 and 2016 and a consistent downward trend in NO_2 concentrations across that same ten year period.

It is also anticipated that the development of the Evesham Transport Strategy, a major component of which includes the Port Street corridor as the principle route into the town centre from the east, will provide improvements to congestion and traffic flow. This will have a positive impact on air quality in the area and will further support continuing downward trends in NO2 concentrations. Plans being developed for the Port Street area as part of the wider Evesham Transport Strategy include enhancement to the public realm, upgrading of signalling infrastructure and better managed parking, loading and access along the route, thus delivering a more effective corridor and further supporting the permanent revocation of the AQMA.

These planned improvement works have formed the cornerstone of the Action Plan for the Port Street AQMA and WRS will continue to be heavily involved in it's development to ensure that any improvements to air quality are realised, in accordance with PG(16) para. 4.11 *"Following a revocation, ideally the local authority should put in place a local air quality strategy (para 2.12) to ensure air quality remains a high profile issue…"*

It is therefore recommended that Wychavon District Council consider revocation of the Port Street AQMA.

LAQM Technical and Policy Guidance sets out some requirements in relation to revocation of AQMAs. These are summarised in the table below and evidence for each point provided.

Table 3.0 – Revocation Requirements LAQM.PG(16) and LAQM.TG(16)

LAQM revocation requirement laid out in PG(16) and TG(16)	Evidence in relation to Port Street AQMA
PG(16) 4.9 "Demonstrate that air quality objectives are being met and will continue to do so… Confidence that the improvements will be sustained…Typically this is after three years or more of compliance.	There has been no measured exceedance of the NO_2 annual mean objective at relevant exposure in the last three years. There has been no measured concentration of NO_2 within 5% of the NO_2 annual mean objective at relevant exposure in the last three years. Generally concentrations of NO_2 have consistently been below the NO_2 annual mean objective at relevant exposure over the past ten years, with three exceptions. Marginal exceedances of 40.0µg/m^3 42.4µg/m^3 and 41.7µg/m^3 in 2006, 2010 and 2013 respectively. These concentrations are likely associated with cooler winters and are consistent with observed higher concentrations across the County and nationally in those years. Generally concentrations of NO_2 have consistently been below 95% of the NO_2 annual mean objective at relevant exposure over the past ten years, with one exception. A concentration of 39.0µg/m^3 was observed in 2013. This concentration is likely to be associated with cooler winters and is consistent with observed higher concentrations across the County and nationally in that year. There has been a consistent downward trend in NO_2 concentrations at all

	monitoring locations within the AQMA over the past ten years.
TG(16) 3.46 & 3.47 "In most cases the decision to revoke an AQMA should only be taken following a detailed study….however, in some instances if compelling evidence exists, detailed modelling to support the decision to ..revoke an AQMA may not be necessary and an AQMA may be amended or revoked following a screening assessment on the basis of robust monitoring evidence.	Detailed dispersion modelling has not been undertaken in this case. It is considered that the ten years of monitoring data available provides sufficiently robust evidence on which to carry out a screening assessment, particularly considering the very small number of measured exceedances of the NO_2 annual mean objective. The Port Street AQMA has only seen three exceedances of the NO_2 annual mean objective at relevant exposure in the past decade, and none since 2013. And only one instance of concentrations within 5% of the NO_2 annual mean objective. It is considered to be disproportionate to carry out full detailed dispersion modelling in relation to any decision regarding revocation. As a result a detailed screening assessment has been undertaken and is presented in this report.
TG(16) 3.48 "… pollutant concentrations may vary significantly from one year to the next, due to the influence of meteorological conditions, and it is important that authorities avoid cycling between declaring, revoking and declaring again, due simply to these variations. Therefore, before revoking an AQMA on the basis of measured pollutant concentrations, the authority therefore needs to be reasonably certain that any future exceedances (that might occur in more adverse meteorological conditions) are unlikely. For this reason, it is expected that authorities will need to consider measurements carried out over several years or more, national trends in emissions, as well as local factors that may affect the AQMA, including measures introduced as part of the Air Quality Action Plan, together with information from national monitoring on high and low pollution years"	It is acknowledged that the influence of meteorological conditions is a significant factor when considering revocation of an AQMA. As discussed above it is considered likely that the two exceedances of the NO_2 annual mean objective observed at the Port Street AQMA over the past decade are likely to be attributable to cooler winters in 2010 and 2013. The trend for higher concentrations in these years can been seen both locally and nationally. However, in considering that NO_2 concentrations in the AQMA are generally measured to be well below the NO_2 annual mean objective and well below 95% of the NO_2 annual mean objective, it is considered to be very unlikely that changing meteorological conditions would produce any consistent exceedance of the NO_2 annual mean objective that would require re-

	declaration of an AQMA in the future. Particularly considering the current understanding of climate and the predicted increase in warmer winters across the UK going forward. In addition planned improvements to the Port Street corridor as part of the wider Evesham Transport Strategy will result in improved traffic flow and reduced congestion through the existing AQMA area having a positive impact on air quality. This planned improvement work formed the cornerstone of the Action Plan for the Port Street AQMA and WRS will continue to be involved in it's development to ensure that air quality remains a high profile issue and ensure that improvements to air quality as a result of junction improvements are realised.

In conclusion it is recommended that Wychavon District Council consider revocation of the Port Street, Evesham AQMA. There has been no consistent exceedance of the NO_2 annual mean objective between 2006 and 2016 and it is considered to be very unlikely that any consistent exceedance of the NO_2 annual mean objective will occur in the future.

Air Quality will remain an important high profile issue in the area in order to ensure that concentrations of NO_2 remain below the objective. The area will continue to be an "air quality consultation zone" within the WRS Planning Checklist ensuring that air quality is given due consideration through the planning process. In addition WRS will continue to be involved in the development of the Evesham Transport Strategy and the design and implementation of improvements to the Port Street/Bridge Street and Waterside junction.

Appendices

Appendix A: Summary of Statutory Air Quality Objectives in England

A.2 – Air Quality Objectives in England

Pollutant	Air Quality Objective[5]	
	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

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

Appendix B: Port Street AQMA Sealed Order

WYCHAVON DISTRICT COUNCIL

ENVIRONMENT ACT 1995, PART IV, SECTION 83

THE PORT STREET (EVESHAM) AIR QUALITY MANAGEMENT AREA (NITROGEN DIOXIDE) ORDER 2007

ORDER DESIGNATING AN AIR QUALITY MANAGEMENT AREA

Whereas the Wychavon District Council ("the Council"), having caused to be conducted a review and assessment of air quality in Wychavon, is satisfied that the air quality objective in respect of the nitrogen dioxide annual mean specified in the Air Quality (England) Regulations 2000 is unlikely to be achieved in the area described in the schedule below by reason of projected exceedance of the objective.

The Council in exercise of the powers conferred on it by section 83(1) of the Environment Act 1995 hereby makes the following order:

1. The area edged blue on the attached map which forms part of this Order and described in the schedule below is designated an Air Quality Management Area and shall be known as "The Port Street (Evesham) Air Quality Management Area (Nitrogen Dioxide)".

2. The Port Street (Evesham) Air Quality Management Area (Nitrogen Dioxide) is an air quality management area in relation to nitrogen dioxide only.

3. This Order may be cited as "The Port Street (Evesham) Air Quality Management (Nitrogen Dioxide) Order 2007".

4. This Order shall come into force on 1st September 2007 and shall remain in force until varied or revoked by subsequent order.

Schedule

The Port Street (Evesham) Air Quality Management Area (Nitrogen Dioxide) incorporates the section of Port Street Evesham between the Waterside/Port Street Traffic lights and the Shor Street Junction, as delineated in blue on the map attached to this order.

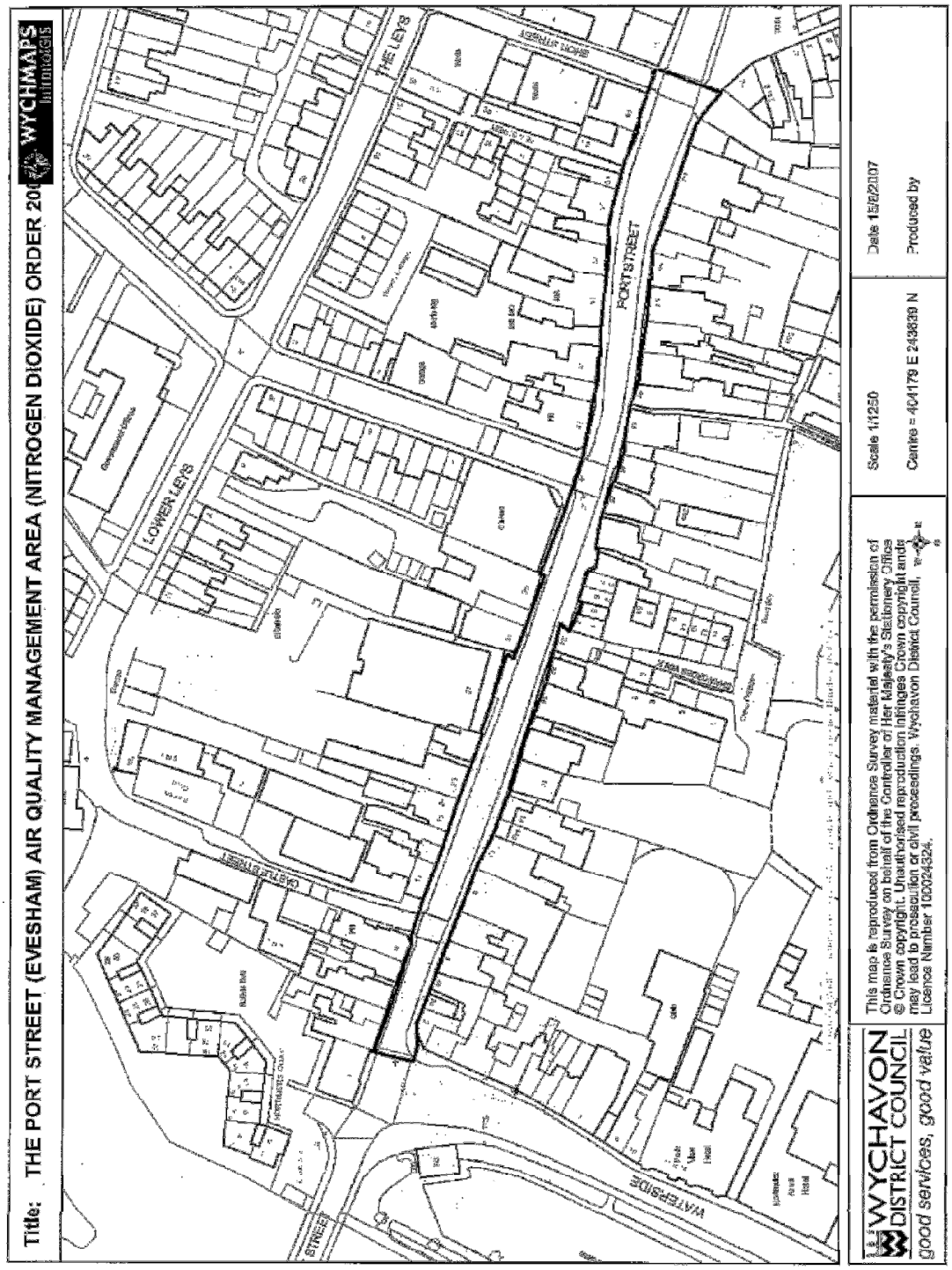
Dated this 12th day of September 2007

THE COMMON SEAL OF
WYCHAVON DISTRICT COUNCIL was hereunto
Affixed in the presence of:

11062

Managing Director

Head of Legal and Support Services


Title: THE PORT STREET (EVESHAM) AIR QUALITY MANAGEMENT AREA (NITROGEN DIOXIDE) ORDER 20
WYCHMAPS
THE LEYS
LOWER LEYS
PORT STREET
CHURCH STREET
WATERSIDE
STREET
WYCHAVON DISTRICT COUNCIL
good services, good value
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Wychavon District Council, License Number 100024324.
Scale 1:1250
Centre = 404179 E 243639 N
Date 15/6/2007
Produced by

Appendix C: Diffusion Tube Monitoring

C.1 Details of Non-Automatic Monitoring Sites

Site ID	Site Description	Site Type	X OS Grid Ref	Y OS Grid Ref	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)
EPS14a/b/c	Road sign, Port Street	Kerbside	404128	243630	NO_2	Y	1.7	0.73	N	2.35
EPS43	Camera Post opposite 33 Port Street	Roadside	404222	243598	NO_2	Y	0	1.85	N	2.35
EPS44	Long stay car park sign, opposite Regal Cinema, Port Street	Roadside	404183	243611	NO_2	Y	2.6	1.18	N	2.45

C.2 Monitoring Data 2006 – 2016

Site ID	NO_2 Annual Mean Concentration (µg/m^3) [1,2]										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EPS14a/b/c	37.7	33.8	35.2	34.8	36.1	33.6	30.9	**41.7**	34.1	30.3	34.7
EPS43	**40**	34.5	36.8	34.9	**42.4**	32.9	29.8	39	31.67	31.22	33.78
EPS44	34	31.4	30.9	28.7	32.3	27.3	21.8	**33.6**	26.3	26.6	29.6

(1) Means for diffusion tubes have been corrected for bias. All means have been "annualised" as per Technical Guidance LAQM.TG16 if valid data capture for the full calendar year is less than 75%.

(2) Concentrations have been calculated back to relevant exposure as per Technical Guidance LAQM.TG16 or relevant guidance at time.

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority 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
AQO	Air Quality Objective
Defra	Department for Environment, Food and Rural Affairs
EU	European Union
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
QA/QC	Quality Assurance and Quality Control

References

12. DEFRA (2016) 'Local Air Quality Management Policy Guidance LAQM PG.(16)'

13. DEFRA (2016) 'Local Air Quality Management Technical Guidance LAQM TG.(16)'

14. Worcestershire Regulatory Services (2013) 'Air Quality Action Plan for Worcestershire'

15. Worcestershire Regulatory Services (2015) 'Air Quality Action Plan Progress Report for Worcestershire April 2013-April 2015'

16. Worcestershire Regulatory Services (2016) 'Air Quality Action Plan Progress Report for Worcestershire April 2015 – March 2016'

17. Worcestershire Regulatory Services Website http://www.worcsregservices.gov.uk/pollution/air-quality/

Passive Air Quality Monitoring Data QA/QC

Diffusion Tube Bias Adjustment Factors

The following UKAS accredited company provides Wychavon District Council with nitrogen dioxide diffusion tubes and analysis:

Somerset Scientific Services

The Crescent

County Hall

Taunton

TA1 4DY

Tel: 0300 123 2224

Email: somersetscientific@somerset.gov.uk

The 20% Triethanolamine (TEA) / Deionised Water preparation method is used.

The bias adjustment factor applied to the results in 2016 is 0.89 which has been derived from local co-location study at Worcester Road, Wychbold. The co-location study was undertaken in accordance with LAQM.TG16 and the local bias-adjustment factor calculated using the AEA Environment & Technology spreadsheet tool provided by DEFRA, see figure B5.1 below. The national bias-adjustment factor published by DEFRA in April 2017 (spreadsheet version number 03/17 V2) is 0.88 indicating good agreement between the national bias-adjustment figure and that calculated following the local co-location study at Worcester Road, Wychbold. The local bias-adjustment factor of 0.89 is considered to be more conservative than the national figure and has therefore been adopted for use across Worcestershire for bias-adjustment of 2016 diffusion tube data.

Figure B5.1 – Local Bias-adjustment factor calculation

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation	95% CI of mean
1	26/04/2016	25/05/2016	59.4	57.4	55.5	57	1.9	3	4.8
2	25/05/2016	28/06/2016	60.4	62.6	61.6	62	1.1	2	2.8
3	28/06/2016	26/07/2016	50.0	55.2	58.6	55	4.4	8	10.8
4	26/07/2016	23/08/2016	47.9	51.3	50.9	50	1.8	4	4.5
5	23/08/2016	27/09/2016	56.1	52.9	54.4	54	1.6	3	3.9
6									
7									
8									
9									
10									
11									
12									
13									

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Automatic Method		Data Quality Check	
Period	Data Capture	Tubes Precision Check	Automatic Monitor Data
Mean	(% DC)		
53	96.4	Good	Good
57	96.4	Good	Good
53	96.4	Good	Good
41	96.4	Good	Good
44	96.4	Good	Good
Overall survey -->		Good precision	Good Overall

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Wychbold

Precision 5 out of 5 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%

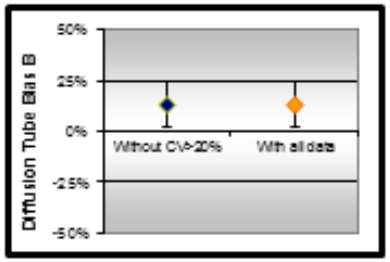
Bias calculated using 5 periods of data

Bias factor A	0.89 (0.81 - 0.99)
Bias B	12% (1% - 23%)
Diffusion Tubes Mean:	56 µgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	50 µgm^{-3}
Data Capture for periods used:	96%
Adjusted Tubes Mean:	49 (45 - 55) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA

Bias calculated using 5 periods of data

Bias factor A	0.89 (0.81 - 0.99)
Bias B	12% (1% - 23%)
Diffusion Tubes Mean:	56 µgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	50 µgm^{-3}
Data Capture for periods used:	96%
Adjusted Tubes Mean:	49 (45 - 55) µgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Under the WASP scheme Somerset Scientific Services performed 100% satisfactory for all periods between January 2016 and February 2017. Tube precision was "Good" throughout 2016.

Short-term to Long-term Data Adjustment - Annualisation

Annualisation calculations for monitoring locations not representative of relevant exposure are detailed below.

Annualisation calculation ESP59 – Nr. Walkmill Drive, Wychbold

Site	Site Type	2016 Annual Mean	Period Mean	Ratio
Birmingham Acocks Green	Urban Background	21	23.5	0.9
Birmingham Tyburn	Urban Background	29	32.3	0.9
Coventry Allesley	Urban Background	22	25.5	0.9
Leamington Spa	Urban Background	21	23.5	0.9
			Adjsutment factor	0.9
			EPS59 result	55.21
			EPS59 result annualised	48.99

Annualisation calculation EPS60 – Corner of Rynal Street, Evesham

EPS60				
Site	**Site Type**	**2016 Annual Mean**	**Period Mean**	**Ratio**
Birmingham Acocks Green	Urban Background	21	22.6	0.9
Birmingham Tyburn	Urban Background	29	31.0	0.9
Coventry Allesley	Urban Background	22	23.6	0.9
Leamington Spa	Urban Background	21	22.6	0.9
			Adjsutment factor	0.9
			EPS60 result	17.8
			EPS60 result annualised	16.6

Annualisation calculation WMD1 – Walkmill Drive, Wychbold

Site	Site Type	2016 Annual Mean	Period Mean	Ratio
Birmingham Acocks Green	Urban Background	21	20.7	1
Birmingham Tyburn	Urban Background	29	28.6	1
Coventry Allesley	Urban Background	22	21.4	1
Leamington Spa	Urban Background	21	20.9	1
			Adjsutment factor	1
			WMD1 result	45.75
			WMD1 result annualised	46.28

Annualisation calculation WyAQ1/2/3 – Automatic monitor triplicate, Wychbold

Site	Site Type	2016 Annual Mean	Period Mean	Ratio
Birmingham Acocks Green	Urban Background	21	20.4	1
Birmingham Tyburn	Urban Background	29	27.6	1
Coventry Allesley	Urban Background	22	20.9	1.1
Leamington Spa	Urban Background	21	20	1.1
			Adjsutment factor	1
			WyAQ1/2/3 result	49.71
			WyAQ1/2/3 result annualised	52

Estimates of concentrations at nearest receptor

If an exceedence (or result close to an exceedence) is measured at a monitoring site which is not representative of public exposure, the procedure specified in Technical Guidance LAQM.TG(16) has been used to estimate the concentration at the nearest receptor where applicable. The results are presented below:

EPS8 – 40 High Street, Pershore

BUREAU VERITAS

Air Quality CONSULTANTS

Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	0.5	metres
Step 2	How far from the KERB is your receptor (in metres)?	2.5	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	7.51	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	28.62	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	22.6	µg/m^3

EPS9 – St. Andrews Road, Pershore

Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	2.98	metres
Step 2	How far from the KERB is your receptor (in metres)?	8.98	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	8.18	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	13.32	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	11.9	$\mu g/m^3$

EPS33 – Hill View Cottage, Whittington

Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	3.5	metres
Step 2	How far from the KERB is your receptor (in metres)?	6	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	9.76	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	32.58	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	29.3	$\mu g/m^3$

EPS27/28/29 Roundabout, Worcester Road, Wychbold

Enter data into the red cells

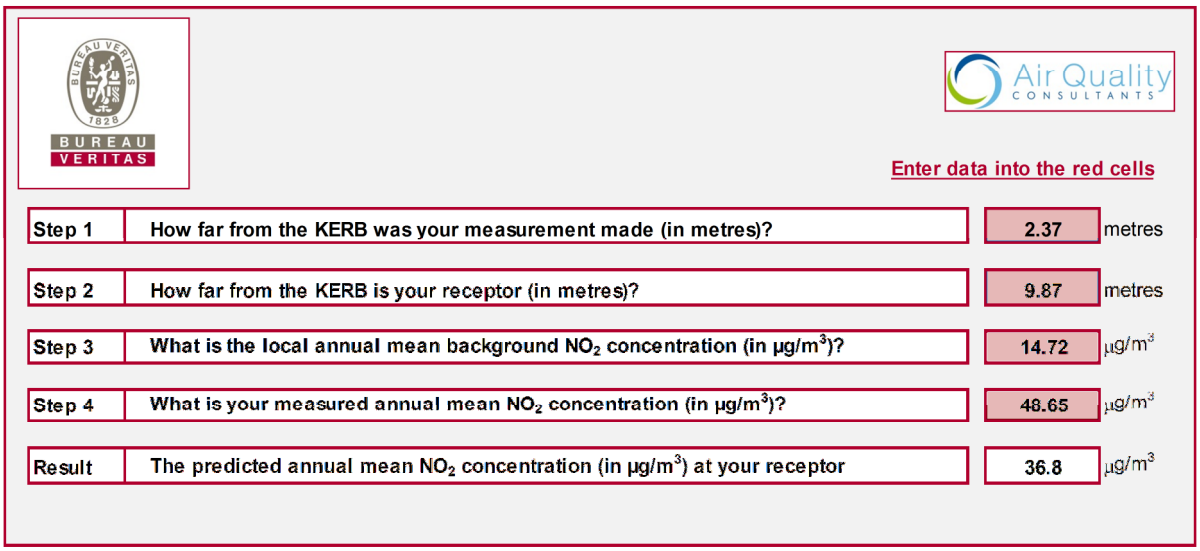
Step 1	How far from the KERB was your measurement made (in metres)?	2.29	metres
Step 2	How far from the KERB is your receptor (in metres)?	17.81	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	14.72	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	44.7	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	29.8	µg/m^3

EPS58 2 Rose Villas, Worcester Road, Wychbold

Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	1.73	metres
Step 2	How far from the KERB is your receptor (in metres)?	8.15	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	14.72	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	63.54	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	46.4	µg/m^3

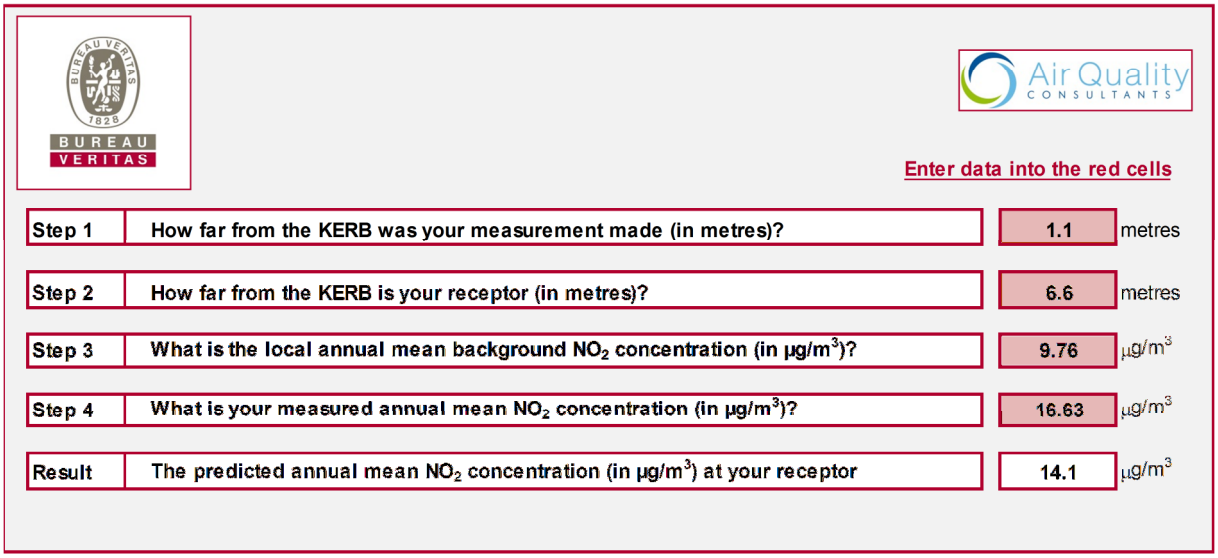
EPS59 Weathervale, Worcester Road, Wychbold



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	2.37	metres
Step 2	How far from the KERB is your receptor (in metres)?	9.87	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	14.72	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	48.65	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	36.8	$\mu g/m^3$

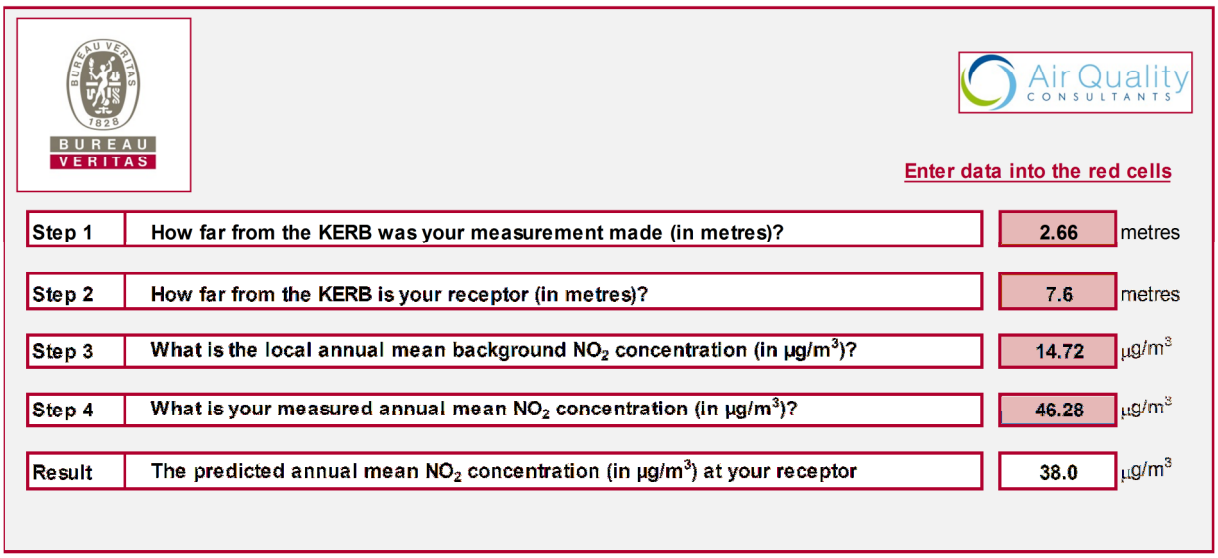
EPS60 – Corner of Rynal Street, Evesham



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	1.1	metres
Step 2	How far from the KERB is your receptor (in metres)?	6.6	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	9.76	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	16.63	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	14.1	$\mu g/m^3$

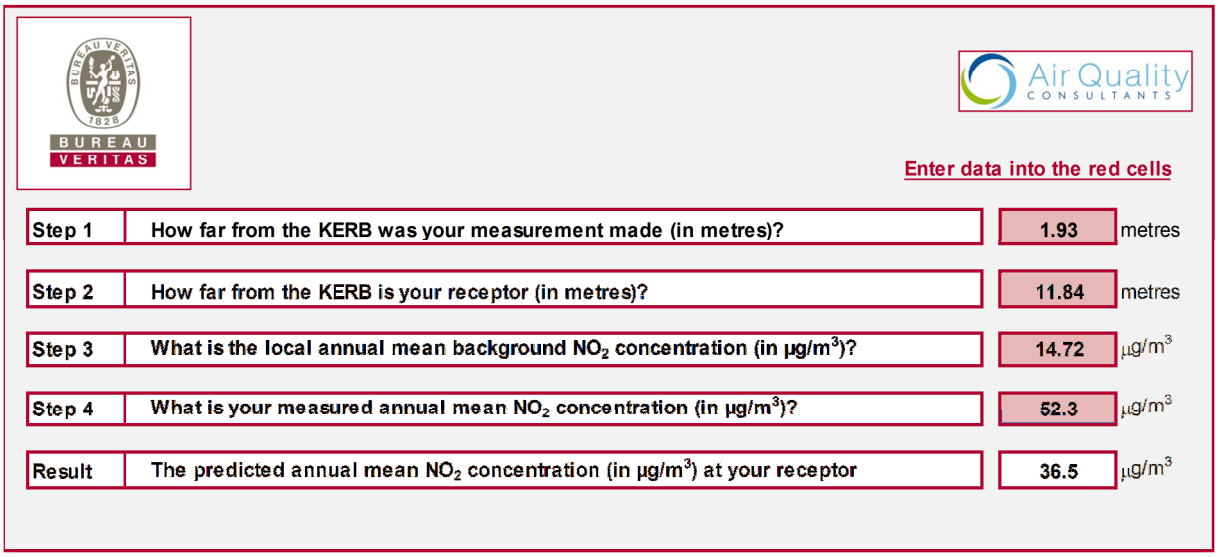
WMD1 Walkmill Drive junction, Wychbold



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	2.66	metres
Step 2	How far from the KERB is your receptor (in metres)?	7.6	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	14.72	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	46.28	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	38.0	µg/m^3

WyAQ1/2/3 Automatic Monitor Triplicate



Enter data into the red cells

Step 1	How far from the KERB was your measurement made (in metres)?	1.93	metres
Step 2	How far from the KERB is your receptor (in metres)?	11.84	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	14.72	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	52.3	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	36.5	µg/m^3

Automatic Air Quality Monitoring Data QA/QC

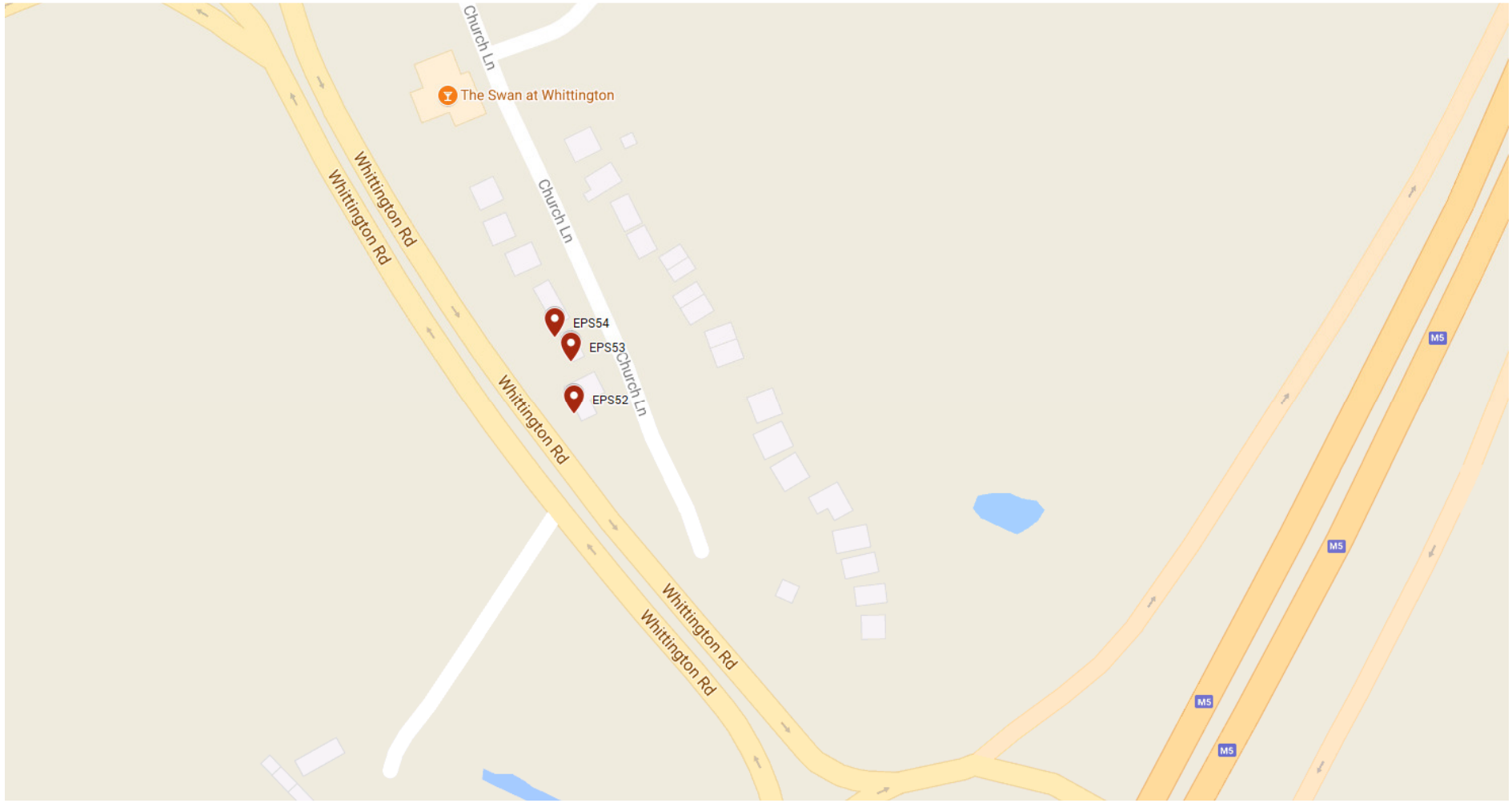
A chemiluminescent automatic analyser was installed at Worcester Road, Wychbold and operated between 23rd March 2016 and 29th September 2016. The monitor was used to continuous monitor levels of nitrogen dioxide (NO_2) and is based on the chemiluminescent reaction between nitrogen oxide (NO) and ozone (O_3). Calibration

was undertaken by officers at Worcestershire Regulatory Services and data management by Air Quality Data Management (AQDM) Ltd.

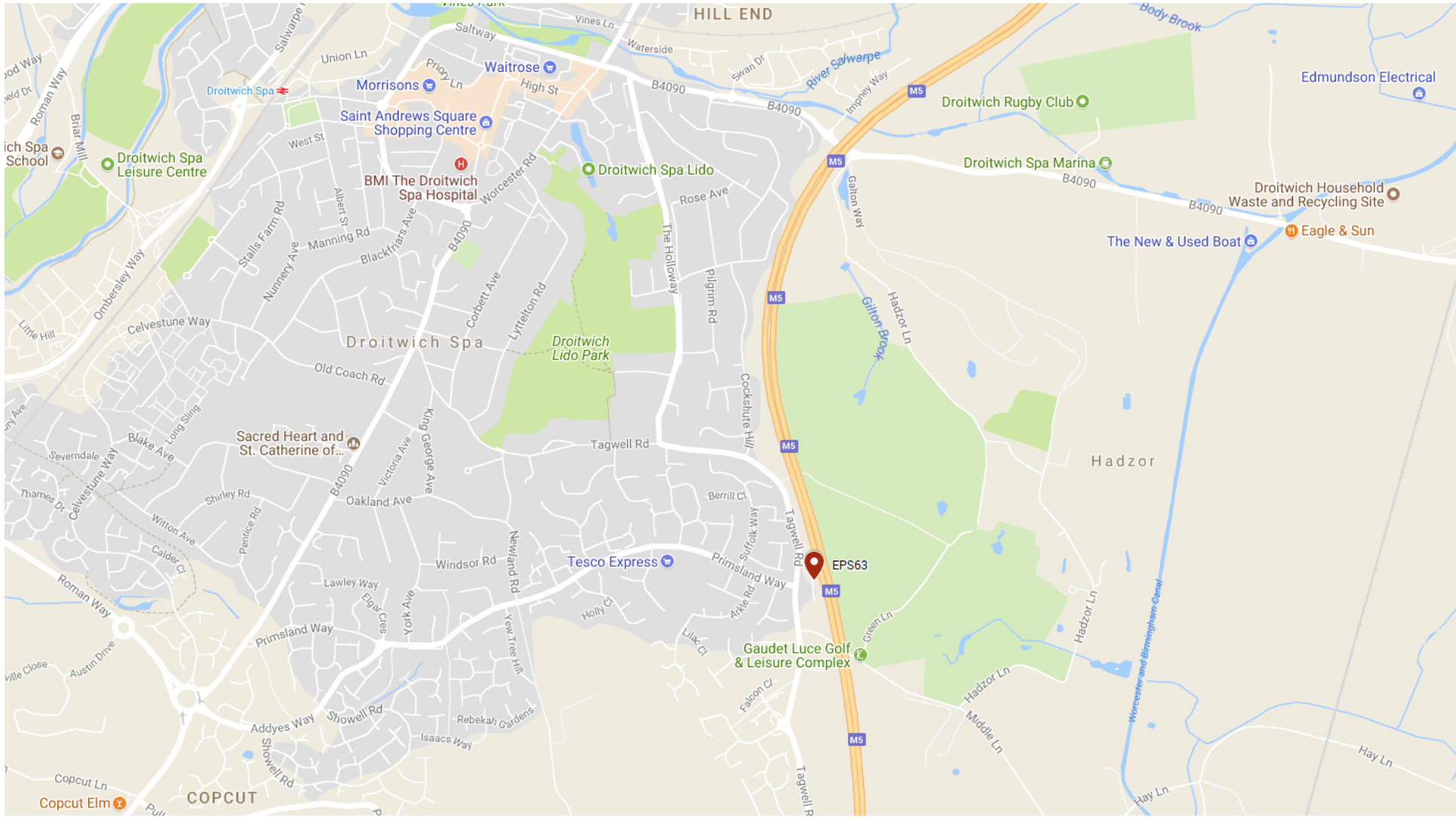
Short-term to Long-term Data Adjustment - Annualisation

WyAQCM					
Site	**Site Type**		**2016 Annual Mean**	**Period Mean**	**Ratio**
Birmingham Acocks Green	Urban Background		21	15.7	1.3
Birmingham Tyburn	Urban Background		29	22.3	1.3
Coventry Allesley	Urban Background		22	16.7	1.3
Leamington Spa	Urban Background		21	15	1.4
				Adjsutment factor	1.3
				WyAQCM result	51
				WyAQCM result annualised	66.3

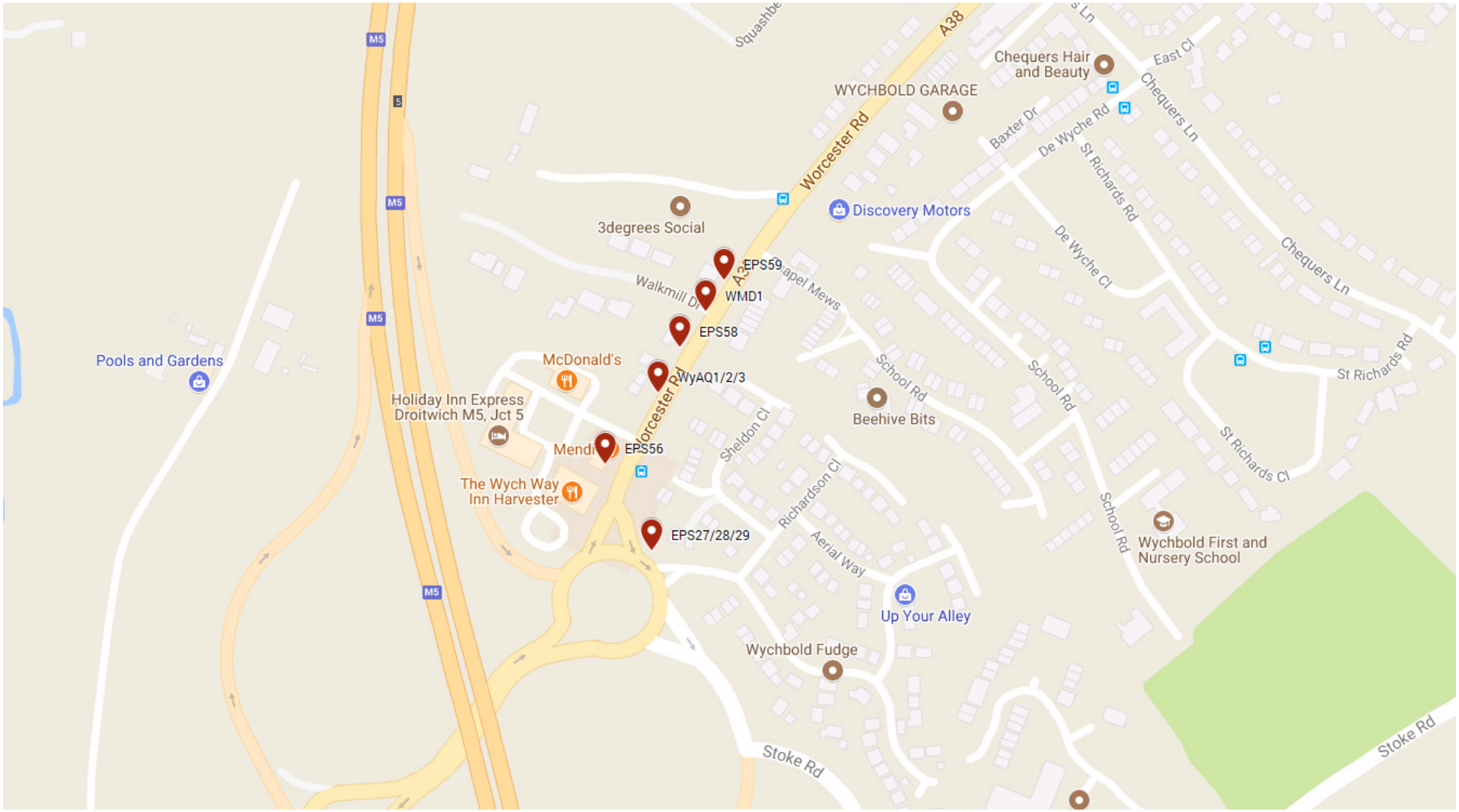
Appendix D: Map(s) of Monitoring Locations and AQMAs



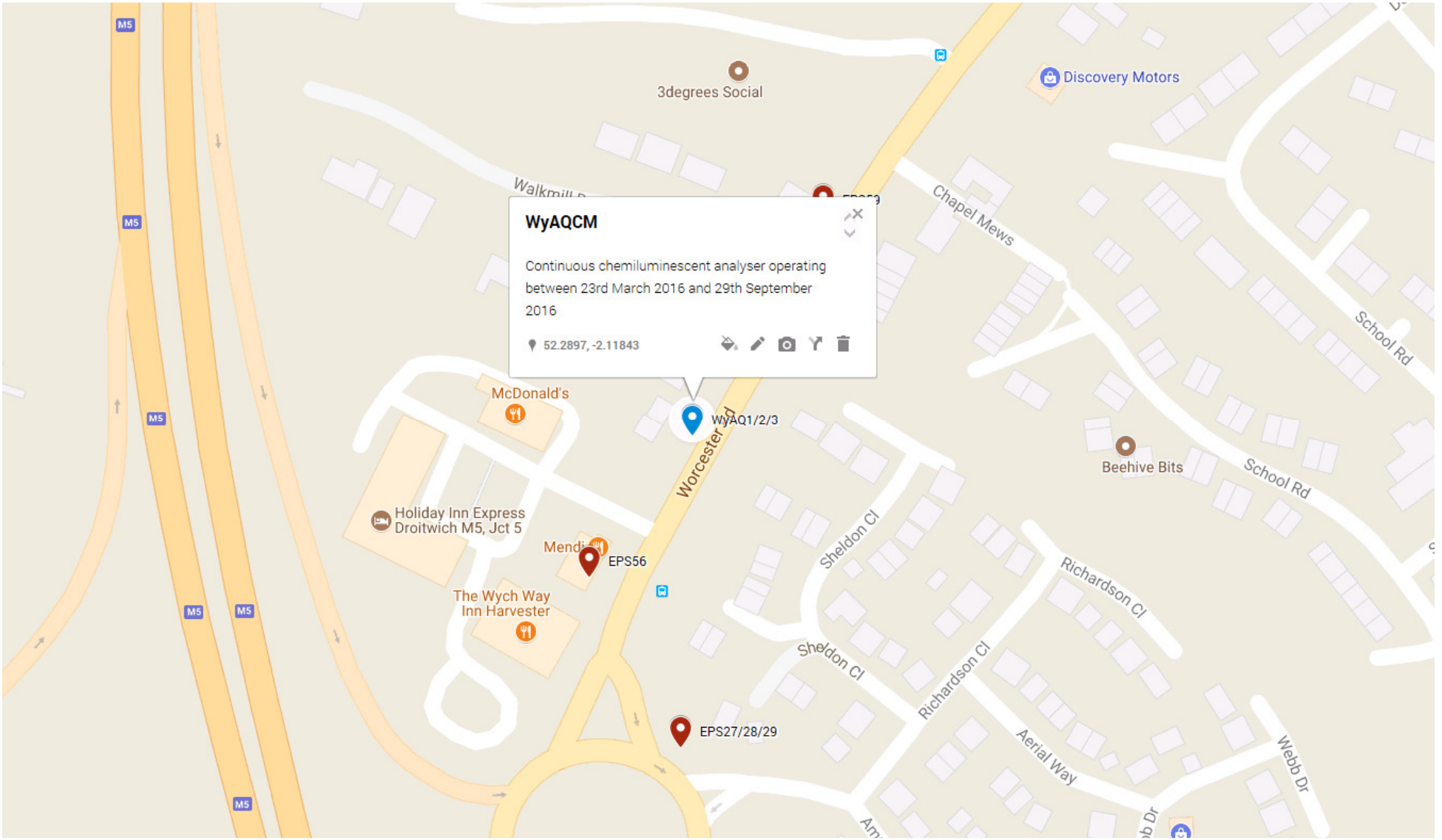
Map data © 2018 Google



Map data © 2018 Google

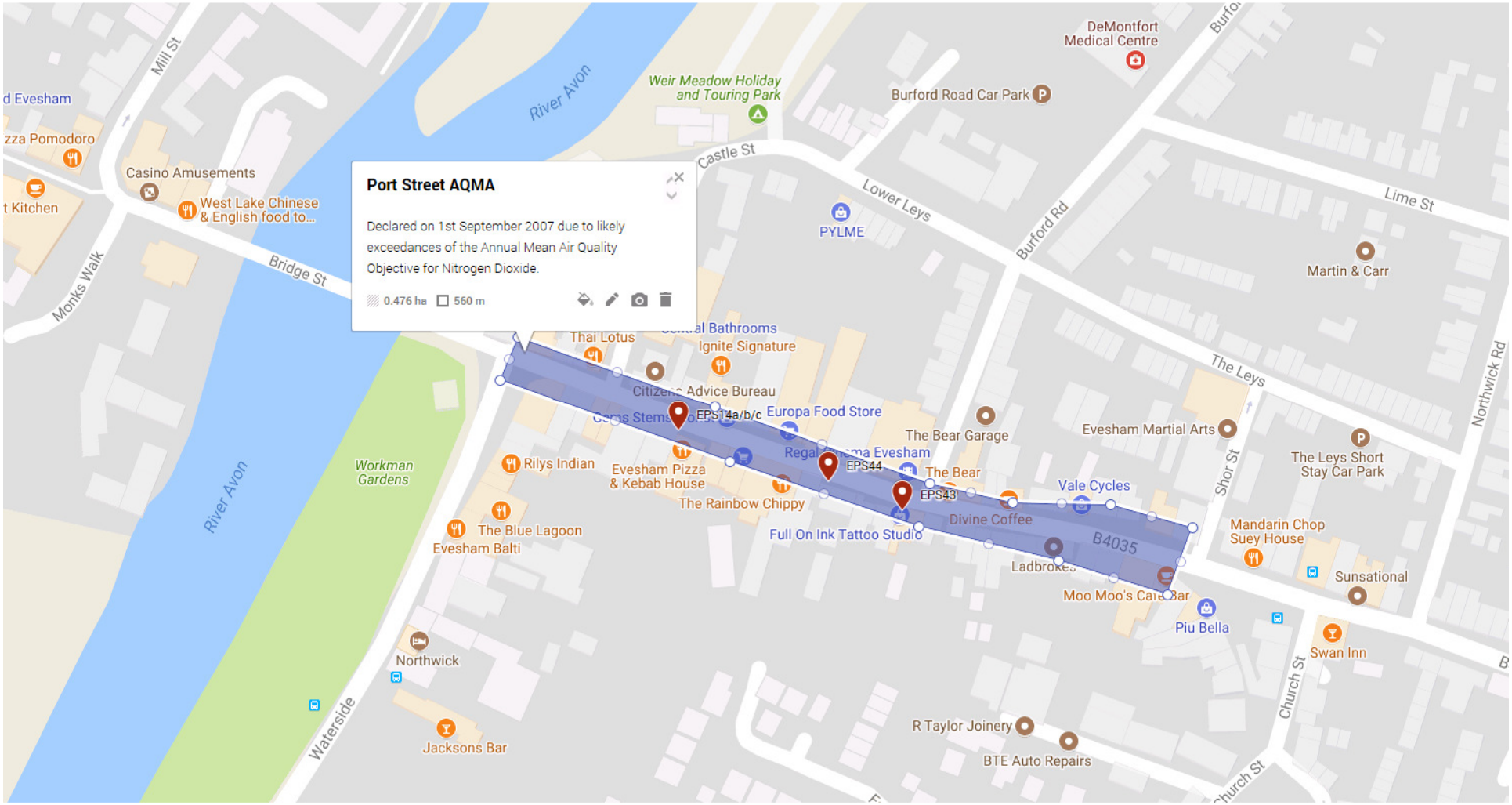


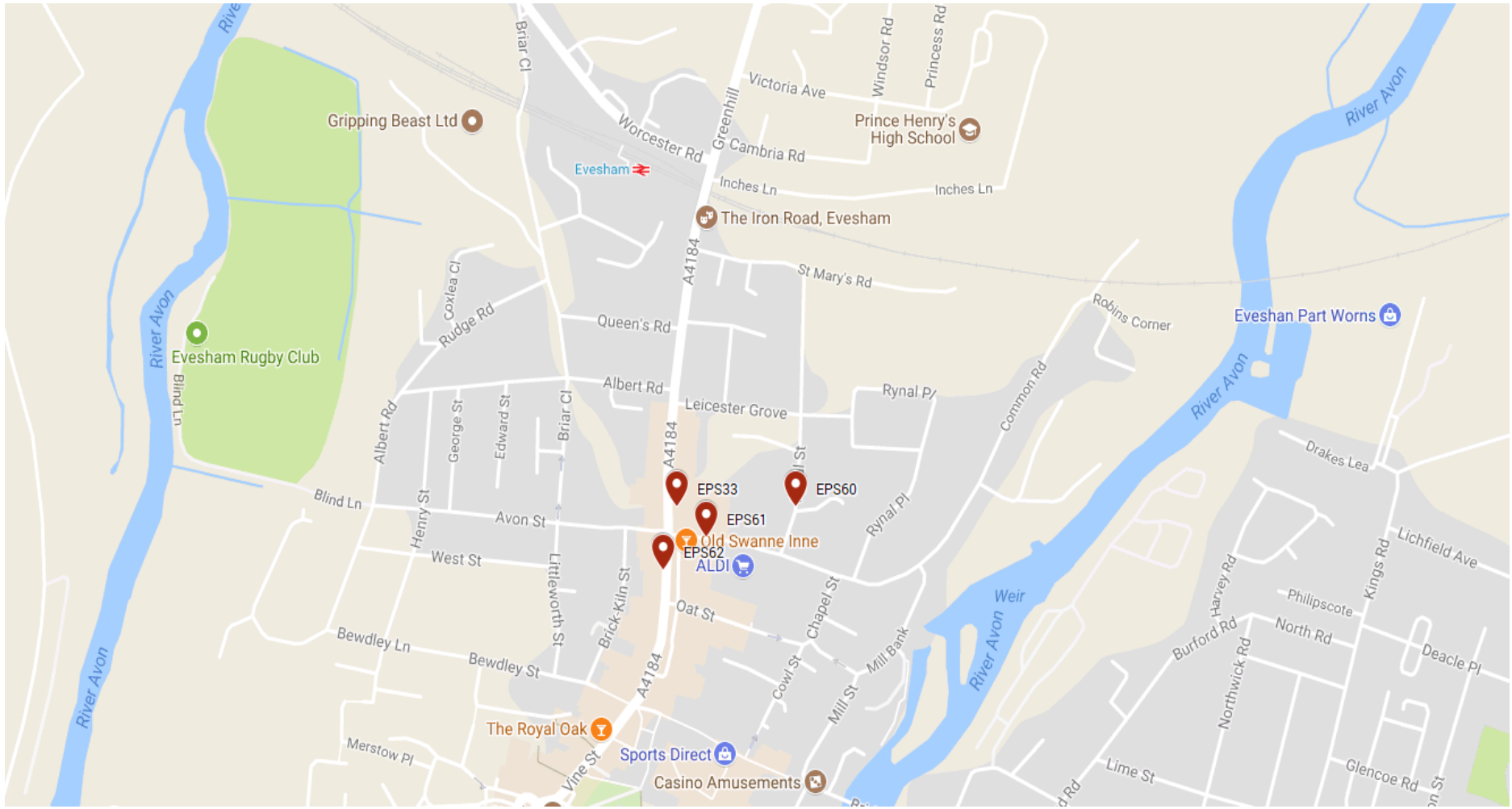
Map data © 2018 Google



Map data © 2018 Google

Map data © 2018 Google


Port Street AQMA
Declared on 1st September 2007 due to likely exceedances of the Annual Mean Air Quality Objective for Nitrogen Dioxide.
0.476 ha
560 m
EPS14a/b/c
EPS44
EPS43
River Avon
Mill St
Bridge St
Monks Walk
Castle St
Lower Leys
Burford Rd
Lime St
The Leys
Northwick Rd
Shor St
Church St
Waterside
B4035
Weir Meadow Holiday and Touring Park
Burford Road Car Park
DeMontfort Medical Centre
PYLME
Martin & Carr
Thai Lotus
Ignite Signature
Citizens Advice Bureau
Europa Food Store
The Bear Garage
Evesham Martial Arts
The Leys Short Stay Car Park
Rilys Indian
Evesham Pizza & Kebab House
The Rainbow Chippy
The Bear
Vale Cycles
Divine Coffee
Full On Ink Tattoo Studio
Ladbrokes
Mandarin Chop Suey House
Sunsational
Moo Moo's Cafe Bar
Piu Bella
Swan Inn
The Blue Lagoon Evesham Balti
Workman Gardens
Northwick
Jacksons Bar
R Taylor Joinery
BTE Auto Repairs
Casino Amusements
West Lake Chinese & English food to...
Map data © 2018 Google



Map data © 2018 Google

Appendix E: Summary of Air Quality Objectives in England

Table E.3 – Air Quality Objectives in England

Pollutant	Air Quality Objective[6]	
	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

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

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority 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	Air quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
EU	European Union
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide
WDC	Wychavon District Council
WRS	Worcestershire Regulatory Services

References

DEFRA (2016) 'Local Air Quality Management Policy Guidance LAQM PG.(16)'

DEFRA (2016) 'Local Air Quality Management Technical Guidance LAQM TG.(16)'

Worcestershire Regulatory Services (2013) 'Air Quality Action Plan for Worcestershire'

Worcestershire Regulatory Services (2015) 'Air Quality Action Plan Progress Report for Worcestershire April 2013-April 2015'

Worcestershire Regulatory Services (2016) 'Air Quality Action Plan Progress Report for Worcestershire April 2015 – March 2016'

Worcestershire Regulatory Services (2016) '2016 Annual Air Quality Status Report' WDC/ASR/2016

Worcestershire Regulatory Services (2017) 'Worcester Road, Wychbold Dispersion Modelling Assessment 2016' WDC/WORCSRD/DA/2017

Worcestershire Regulatory Services (2017) 'Port Street, Evesham AQMA Revocation Screening Assessment' WDC/PORTST/REV/2017