Crawley Borough Council

2016 Air Quality Annual Status Report (ASR)

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

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Executive Summary: Air Quality in Our Area

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].

Air Quality in Crawley Borough Council

Crawley is located in the north of the County of West Sussex, with Gatwick airport lying along its northern boundary with Surrey and the borough of Reigate and Banstead, and the M23 along its eastern border.

As part of the Local Air Quality Management process (LAQM) required by the Environment Act 1995, the council carries out an annual review and assessment of air quality in the borough, which helps us to identify local air quality hot spots, and relate these to pollution sources. If the council finds areas where air quality objectives are not being achieved, it is required to designate an Air Quality Management Area (AQMA) and produce an action plan (AQAP) detailing measures to improve air quality in that area.

Air Quality in Crawley is mainly good, with national targets being met for all pollutants(4), with the exception of the annual mean objective for nitrogen dioxide along some busy roads in the borough. Road traffic is the main source of nitrogen dioxide in Crawley, and our network of monitoring sites records levels along busy roads as well as at background locations and areas of specific interest, in order to get a broad picture of pollution levels across the borough.

[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
[4] Appendix E (The air quality objectives are set out in the Air Quality (England) Regulations 2015)

Monitoring results for 2015 show that there were no exceedences of the air quality objectives at residential receptors in 2015 and nitrogen dioxide levels fell at all locations across Crawley in this year. In addition, long term monitoring data indicates a downward trend at roadside as well as background sites since 2011, despite significant housing and commercial development over the same period. These improvements reflect the pattern of reduction in pollution levels seen regionally and are driven by weather patterns in 2015 as well as decreases in regional sources. European legislation is gradually bringing about improvements in emissions through refined engine technologies and local and regional initiatives implemented by local authorities and Highways authorities to encourage sustainable modes of transport such as walking, cycling, car sharing and public transport, helps to reduce private car usage and improve air quality.

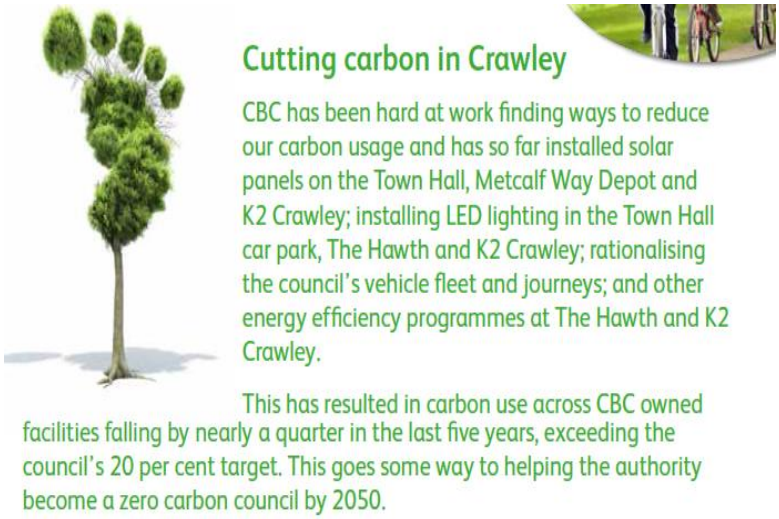
Despite these improvements, emissions from road traffic sources has, in previous years, been exceeding the air quality objectives for nitrogen dioxide along the main route between the M23, the town centre and Manor Royal Business district, resulting in the designation of an Air Quality Management Area for the Crawley Avenue (A2011) corridor and the area surrounding Hazelwick Roundabout. Even though the downward trend in NO_2 levels at residential locations within the AQMA is encouraging, current levels are still high and the full impact from the development of the new Forgewood neighbourhood needs to be assessed in the long term. Therefore Crawley Borough Council has no current plans to amend the existing AQMA, although there is no evidence to suggest any further new AQMAs are required.

The council intends to build upon the improving air quality picture across the borough by developing its air quality action plan and continuing to work in partnership with colleagues in Planning, Highways and Public Health as well as engaging its staff, the public and local businesses to further improve air quality in the area.

Actions to Improve Air Quality

Crawley Borough Council has taken forward a number of measures during 2015 designed to improve local air quality and increase sustainability.

The Council has recently published the adopted Local Plan for 2015-2030. This will guide the location, scale and type of future development in Crawley Borough up to 2030, as well as providing detailed development policies used in determining planning applications. Development should seek to protect, and where possible, improve upon the environment of existing and future residents. The most effective way of achieving this is to ensure that air quality is considered at the earliest stages of the planning and design process to avoid the introduction of new residential development to an area of poor air quality, or to allow development that would worsen the air quality for existing residents in an area. In determining whether or not a development will have a material negative impact, the developer is referred to the criteria set out in the Sussex Air Quality and Emissions Mitigation Guidance document.



In addition to planning policy, a number of actions have been introduced to improve air quality: In 2015 the council completed a range of initiatives to reduce emissions, including rationalizing its vehicle fleet and improving its energy efficiency. It aims to implement further measures to improve air quality emissions in the future, including the introduction of a district heating scheme using lower emission and renewable energy plant and extending the provision of current public charge points to other sites across the borough.

In addition to planning policy, a range of measures to improve air quality have been introduced through promotion of travel alternatives such as cycling, walking, work

and school travel planning, flexible and home working, and financial incentives for staff commuting by public transport. Improved traffic management at major road junctions have been implemented to improve traffic flow and reduce emissions from congestion and idling vehicles. Promoting low emissions transport, has involved providing public charge points at Crawley Town Hall in convenient locations with zero parking charge for plugged in electric vehicles, and the council's taxi licensing conditions give reduced fee incentives to low emission vehicles.

There are also ongoing public transport improvements through collaboration with Local Enterprise Partnership (Coast to Capital) to deliver major interchange improvements at Crawley, Three Bridges and Gatwick railways stations for both buses and cyclists and to extend the bus priority lanes through Manor Royal Business district and Gatwick airport.

Crawley Town Hall Rapid Charger

Fastway Metro buses using priority bus lanes from Three Bridges Station to Manor Royal and Gatwick Airport

Local Priorities and Challenges

Crawley Borough Council's priorities for the coming year are:

- To complete the Action Plan for the Hazelwick AQMA.
- To continue monitoring at existing sites within the borough and identify additional sites, as necessary, where exceedences of the air quality objectives look likely.
- To use the planning process to guide and mitigate the effects of development within the borough.

The council may face a number of challenges associated with these aims. In drawing up actions to improve air quality within the AQMA, there may be limited measures that can be identified which will bring about significant reductions in vehicle emissions in the short term. However, a range of actions which have a smaller impact may be effective over a longer time span in bringing about modal shift and have an accumulative effect on improving air quality in this area.

It is expected that the pressure to develop on land close to major roads will increase as other available potential development sites are exhausted. The challenge will be to ensure that all such development is considered carefully to ensure that it does not result in a material negative air quality impact and to help developers achieve this through mitigating measures.

How to Get Involved

As vehicle emissions are the main source of pollution in Crawley, we can all take steps to help improve local air quality. A quarter of car journeys are under two miles and more than half are less than five miles, so if these journeys can be made by using sustainable transport options such as walking, cycling, public transport or car sharing it can significantly help reduce emissions.

Business fleet operators and individuals considering buying new vehicles may wish to consider a petrol, hybrid or electric vehicle instead of diesel. Alternatively, eco-style driving is recognised as improving fuel economy and reducing emissions, so by

making a few minor changes to our driving style, we can save money as well as helping the environment:

- Avoid vigorous acceleration and braking
- Driving at 50mph uses 30 per cent less fuel than driving at 70mph
- Driving in fifth gear uses 25 per cent less fuel than third gear
- Keeping windows closed as opening the windows increases 'drag' and fuel consumption
- Reduce excess weight if not needed (such as roof racks)
- Keep tyres inflated to the right pressure and balanced
- Avoid idling engines when stationery

Further information on air quality where you live and how to reduce emissions are available at the Sussex-air Website: http://www.sussex-air.net/AQNearMe/

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1 Local Air Quality Management

This report provides an overview of air quality in Crawley during 2015. 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 Crawley Borough 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.1 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 the objectives.

A summary of the AQMA declared by Crawley Borough Council can be found in **Error! Reference source not found.**. Further information related to the AQMA, including a map of the AQMA boundaries is available online at:

http://www.crawley.gov.uk/pw/web/PUB266050

http://www.crawley.gov.uk/pw/web/PUB241229

http://uk-air.defra.gov.uk/aqma/list

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Pollutants and Air Quality Objectives	City / Town	One Line Description	Action Plan
Hazelwick AQMA	• NO_2 annual mean	Crawley	A designated area surrounding the Hazelwick roundabout, including land and properties bordering the roads from the roundabout.	The Action Plan is currently being developed.

2.2 Progress and Impact of Measures to address Air Quality in Crawley

Crawley Borough Council has taken forward a number of measures during the current reporting year of 2015 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2. More detail on these measures can be found in Crawley Borough Council's:

- Local Plan 2015-30
- Local Transport Strategy
- Carbon and waste reduction strategy 2012
- West Sussex Transport Plan 2011-26 (LTP3)

Key completed measures are:

- The Town Hall Rapid Charging Point (50 kWh) for electric vehicles: This was commissioned 2015 and installed in 2016. It became fully operational in September 2016 and data on its usage, as a key performance indicator, has shown that, the number of charges has increased form the 141 charges in the first quarter to 396 charges in the second quarter, representing a180% increase in usage since becoming operational.
- WSCC has completed delivery (2015) of the school keep clear (SKC) Traffic Regulation Order (TRO) programme covering all schools in East and West Crawley. This scheme provides the enforcement ability to help keep school entrances clear of traffic and parked cars to improve visibility. This plays an important role building confidence in sustainable travel choice, since one of the main disincentives for walking and cycling is fear of risk or perception of danger.
- The Crawley Bike it scheme has been the most sustained and successful Bike it project in West Sussex and currently is the only Bike it initiative in the county. During the academic year 2015/16 the officer in Crawley delivered 144 activities across schools engaged with the project. These activities attracted a

total of 10,810 attendances by pupils, and resulted the percentage of pupils reporting they cycle to school weekly increased 9 percentage points from 9% at baseline to 18% at the end of year four.

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

- The completion of the Hazelwick Air Quality Action Plan,
- The Travel study for the Manor Royal Business District identifying options to be taken forward for implementation, including: parking enforcement, increased bus frequency and upgrades/improvements to pathways for cycling and walking.
- The development of a Low Emissions Strategy for Manor Royal Business Park

Crawley Borough Council's priorities for the coming year are to continue with measures to address air quality within the borough that are currently underway (see Table 2.2) and to further consider options for the emerging Action Plan to reduce the impacts of poor air quality in the Air Quality Management Area.

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	EU Category	EU Classification	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date	Comments
	Air Quality and Emissions Mitigation Guidance for Sussex	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	CBC with Sussex-air	2011/12	2013/ongoing	Conditions on planning applications to require emissions mitigation		Air Quality and Mitigation Guidance to be incorporated into the Crawley Local Plan due to be published 2016	ongoing	
1	Three Bridges and Gatwick railways stations Interchange improvement schemes	Transport Planning and Infrastructure	Public transport improvements-interchanges stations and services	CBC	2011	Ongoing	Modal Shift		working with LEP and partners to deliver major interchange improvements at Crawley, Three Bridges and Gatwick railways stations for both buses and cyclists	Nearing completion	
2	Crawley Cycle Network	Transport Planning and Infrastructure	Cycle Network	CBC	Completed	ongoing	Modal shift	No Target set	New cycle schemes in the Town through Sec. 106 funds as well as improving existing schemes	2018	
3	Manor Royal Business Park Travel Plans	Promoting Travel Alternatives	Workplace Travel Planning	Crawley Borough Council (CBC)	complete	ongoing	% staff travelling by sustainable means	No Target set	Requirement for Travel plans to be integrated into design and occupation of new development on Business District	Ongoing	Helps reduce emissions during morning rush hour

Measure No.	Measure	EU Category	EU Classification	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date	Comments
4	School Travel plans	Promoting Travel Alternatives	School Travel Plans	West Sussex County Council (WSCC)	complete	ongoing	% children travelling to school by sustainable means	Helps reduce emissions during morning rush hour	Increase % Uptake	Ongoing	Helps reduce emissions during morning rush hour
5	CBC Travel Plans	Promoting Travel Alternatives	Workplace Travel Planning	CBC	complete	ongoing	% staff travelling by sustainable means	No Target set	Increase % Uptake	Ongoing	
6	easit discount on staff commuting on rail and bus also available to business on Manor Royal.	Promoting Travel Alternatives	Promote use of rail and bus	CBC	Completed	ongoing	% staff travelling by sustainable means	No Target set	Discount of 15% on staff commuting, also available to every business on Manor Royal	Ongoing	Council originally involved in funding the setting up of the scheme
7	Crawley car club scheme with private sector partner	Promoting Travel Alternatives	Personalised Travel Planning	CBC	2015	2018	Reduction in private vehicle ownership	No Target set	Procurement due 2017/ Launch 2018	Ongoing	
8	Cycle Crawley campaign	Promoting Travel Alternatives	Promotion of Cycling	CBC	2011	ongoing	Modal shift	No Target set	Events, activities and materials that support uptake and promotion of cycling in Crawley.	Ongoing	Undertaken in partnership with the Crawley Cycle Forum
9	Living Streets campaign	Promoting Travel Alternatives	Promotion of Walking	CBC	2014	2015	Modal shift	No Target set	Information, events, and activities to promote walking amongst council staff and local businesses	Ongoing	
10	Residential travel plans	Promoting Travel Alternatives	Residential travel plans	CBC	2015	ongoing	% residents using sustainable transport modes	No Target set	Developments of certain size required to implement Travel Plan	Ongoing	

Measure No.	Measure	EU Category	EU Classification	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date	Comments
11	Fastway Route Crawley to Gatwick via Manor Royal	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	WSCC/ CBC	completed	completed	Increase frequency of bus service. Modal shift for commuters into Manor Royal and Gatwick	Air Quality Improvement: Variable depending on scheme, and busses operating along that route	Increased Fastway service through Manor Royal: Service 10 every 8mins Service 100 every 15min	completed	
12	Priority Bus routes within borough	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	WSCC/ CBC	Completed	completed	Improved journey times and timetable accuracy	Air Quality Improvement: Variable depending on scheme, and busses operating along that route	Improved flow/ reliability of bus timetables leading to increased commuter uptake.	ongoing	
13	Town Hall Rapid Charging Point (50 kWh) for electric vehicles	Promoting Low Emissions Transport	Procuring alternative refueling infrastructure to promote Low Emission Vehicles, EV recharging, gas fuel recharging	CBC	2014	2016	Growth in number of charges and kWh of electricity supplied indicating increased EV usage.	Air Quality Improvement: Variable depending on uptake of electric vehicles	180% increase in demand recorded (141 hits in first quarter increased to 396 hits in second quarter)	completed	

Measure No.	Measure	EU Category	EU Classification	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date	Comments
14	Council Vehicle procurement code requires information on vehicle emissions and consideration of LEVs	Promoting Low Emissions Transport	Company/public Vehicle Procurement - Prioritising uptake of low emission vehicles	CBC	Completed	ongoing	Minimum CO_2 level of < 150 g/kg.	No Target set	100% uptake for vehicle procurement and staff car loan applications	Ongoing	
15	CBC Staff Bicycle Loan Scheme	Promoting Low Emissions Transport	Prioritising uptake of low emission vehicles	CBC	2015	ongoing	Modal shift from private vehicle to bicycle	No Target set	5 loans awarded	ongoing	
16	Council has home-working Policy	Promoting Travel Alternatives	Encourage / Facilitate home-working	CBC	Completed	completed	% annual working from home	No Target set	Positive staff uptake (numbers variable)	ongoing	
17	Taxi License Fee Discount Scheme for LEVs	Promoting Low Emissions Transport	Taxi emission incentives	CBC	Completed	ongoing	% uptake	No Target set	Gatwick Cars currently using 5 Tesla Electric vehicle taxis and planning on 100% hybrid/electric vehicle fleet by 2020	ongoing	
18	Manor Royal Business District Eco-driver training	Vehicle Fleet Efficiency	Driver training and ECO driving aids	CBC	2015/16	2017	Fuel economy/ reduction in vehicle emission	No Target set	Awaiting decision on grant funding	2018	
19	Solar Panel Installation Program	Promoting Low Emission Plant	Shift to installations using low emission fuels	CBC	2010	2011-16	25% Reduction in CO_2 Emissions	25% reduction overall	400 solar panels installed at K2 Crawley, 225 Crawley Homes properties fitted with solar panels and LED lighting installed at Orchard Street car park – resulting in 25% reduction in CO_2 Emissions in last 5 years	completed	

Measure No.	Measure	EU Category	EU Classification	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date	Comments
20	airAlert Pollution Warning Service for vulnerable groups	Public Information	Via other mechanisms SMS/ Mobile phone App/ Email	CBC with Sussex Air Quality Partnership SAQP /CBC	2008	ongoing	Uptake: Number of people receiving forecasting alert	No Target set	Over 800 registered subscribers	ongoing	
	Energise Network	Promoting Low Emission Transport	Procuring alternative refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	SAQP/ CBC	2011	2013/14	Uptake: Number of charges	No Target set	Refuelling infrastructure Network throughout East and West Sussex	ongoing	
	Sussex Air website	Public Information	Via the Internet	SAQP	-	ongoing	-	-	-	-	
	Air Quality Strategic Plan 2010	Policy Guidance and Development Control	Regional Groups Coordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	SAQP	-	2010 - 2015	-	No Target set	-	ongoing	

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 is no direct monitoring of $PM_{2.5}$ in Crawley. However, using the correction factor in TG(16) it is possible to estimate concentrations from our local monitoring of PM_{10}. This method suggests that $PM_{2.5}$ levels in Crawley are in the region of 10.5µg/m^3. The annual average EU limit for $PM_{2.5}$ is 25µg/m^3 so the risk of exceedance is negligible. However, the council is still committed to reducing emissions and exposure to this pollutant and is taking the following measures to address $PM_{2.5}$:

1. Regulation of Industrial Process through the environmental permitting regime to control emissions of $PM_{2.5}$ from mineral processes such as concrete batching, concrete rushing and road-stone coating.
2. Working in partnership with other authorities in Sussex through the Sussex Air Quality working group to set up the Energise Network of electric vehicle charging points throughout the county.
3. Policy measures to which will help reduce $PM_{2.5,}$ including planning policy, local transport planning and the development of the Air Quality Action Plan.

- Local Plan Policy: Requirement to adhere to the Sussex Air Quality and Emissions Mitigation Guidance document
- Local Transport Plan: Traffic management measures to reduce congestion and improve traffic flow, which should also bring about a reduction in road traffic pollutant emissions (including $PM_{2.5}$ emissions).
- Air Quality Action Plan: the emerging action plan will include the promotion of low emission travel alternatives (e.g. cycling, walking, electric vehicles, lift sharing etc).

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.

Crawley Borough Council undertook automatic (continuous) monitoring at one site during 2015 Table A.1 in Appendix A shows the details of this site. National monitoring results are available at https://uk-air.defra.gov.uk/

A map showing the location of the monitoring site is 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

Crawley Borough Council undertook non- automatic (passive) monitoring of NO_2 at 27 sites during 2015. 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) and bias adjustment for the diffusion tubes are included in Appendix C.

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for “annualisation” and bias. 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 2015 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.

Passive monitoring (Diffusion Tube) NO_2: Table A.3 data shows that only one location exceeded the 40 µg/m^3 annual mean objective in 2015. This location was adjacent to the Hazelwick roundabout, (CR 63) within the Hazelwick AQMA, and nitrogen dioxide levels were high at 5 other locations within the AQMA with measured concentrations ranging from 36 - 39µg/m^3 at sites CR55, CR69,CR64, CR76 and CR77. However only two of these sites (CR55 and CR69) were located at the point of relevant public exposure, the others were several meters from the house façade and therefore there will be some reduction in levels due to the fall off in concentration with distance from the road. (Appendix C).

Diffusion tubes cannot provide hourly measurements of NO_2; however, Defra Technical Guidance (TG(16)) states that where annual mean NO_2 concentrations measured by diffusion tubes exceed 60 µg/m3 there is a likelihood that the 1-hour objective may be exceeded. No exceedences of 60 µg/m3 were measured at any of the diffusion sites in Crawley in 2015.

Therefore, in 2015 there were no exceedences of annual mean or hourly mean NO_2 at the point of relevant exposure. The general trend in NO_2 concentrations at all locations roadside, background and airport, has also shown a downward trend over the past 5 years in Crawley.

Trends in Annual Mean NO_2 (diffusion tube)

Graphs (Fig 3.1, Fig 3.2 and Fig 3.3) showing trends in NO_2 at long term monitoring sites in Crawley indicate that levels of nitrogen dioxide measured at roadside sites have been falling since 2011. Up until this point the trend in nitrogen dioxide was upwards, but a range of measures at European, national and local level, such as improvements in engine technologies, and gradual shift to more sustainable forms of transport are helping to reduce the level emissions regionally and across the borough, which, over time have resulting in reductions in NO_2.

Graphs showing the trend in NO_2 at long term background sites in Crawley indicate a similar picture, with an upward trend presented from 2003 – 2010 (Fig 3.4), after which levels begin to fall, and from 2011 -2015 the trend is downwards (Fig 3.5).

Although the trend is down for both background and roadside sites in Crawley and there were no exceedences of the objectives in 2015, the levels of nitrogen dioxide measured at locations within the AQMA remain high (Fig 3.6). The downward trend at residential locations within the AQMA since 2011 is an encouraging sign, but in the long term the full impact of the new neighbourhood at Forgewood needs to be assessed and therefore, the council has no current plans to amend the AQMA. The AQMA boundary was originally drawn to include a larger area than just the strict areas of exceedence, and the rationale for this remains sound. However, since none of the monitoring data has shown exceedences of measured nitrogen dioxide concentrations outside of the declared AQMA, no further new AQMAs or expansions to the existing AQMA are recommended.

Fig 3.1

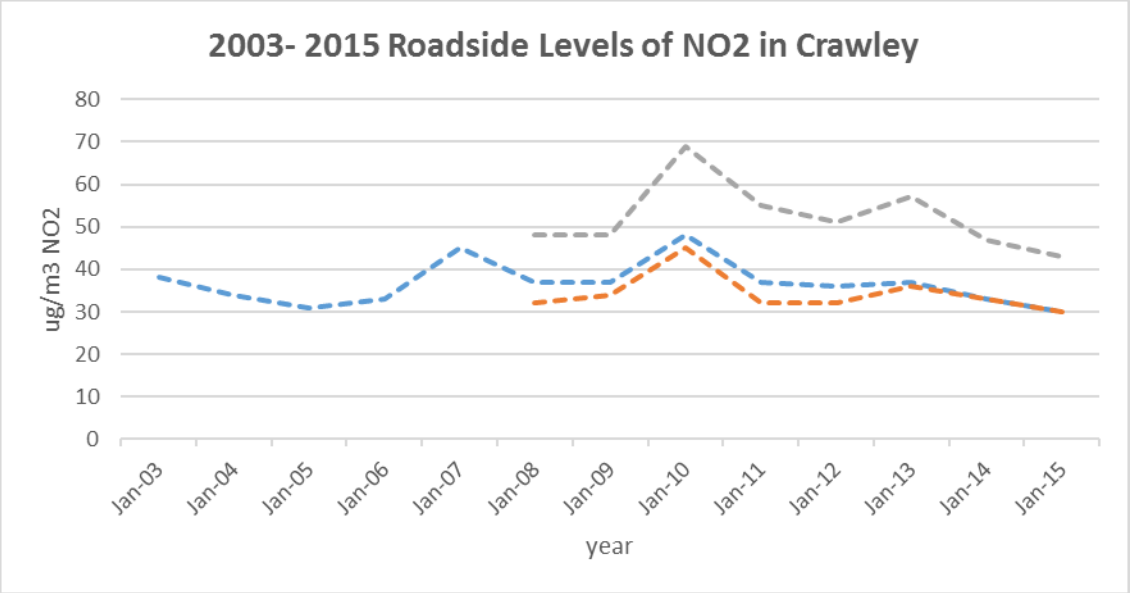

2003- 2015 Roadside Levels of NO2 in Crawley
ug/m3 NO2
80
70
60
50
40
30
20
10
0
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
year

Fig 3.2

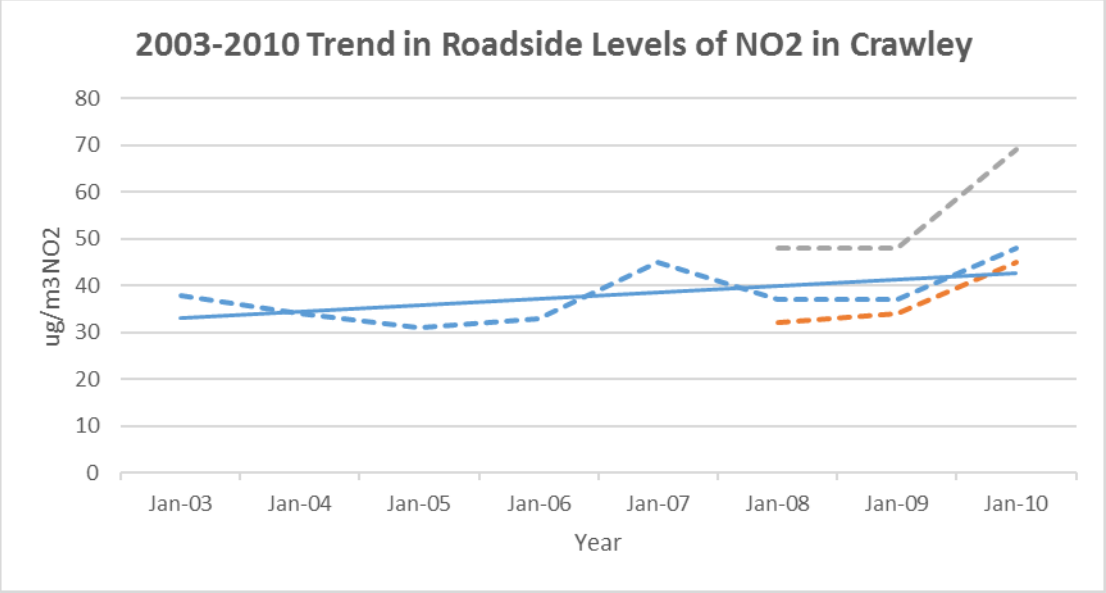

2003-2010 Trend in Roadside Levels of NO2 in Crawley
ug/m3NO2
80
70
60
50
40
30
20
10
0
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Year

Fig 3.3

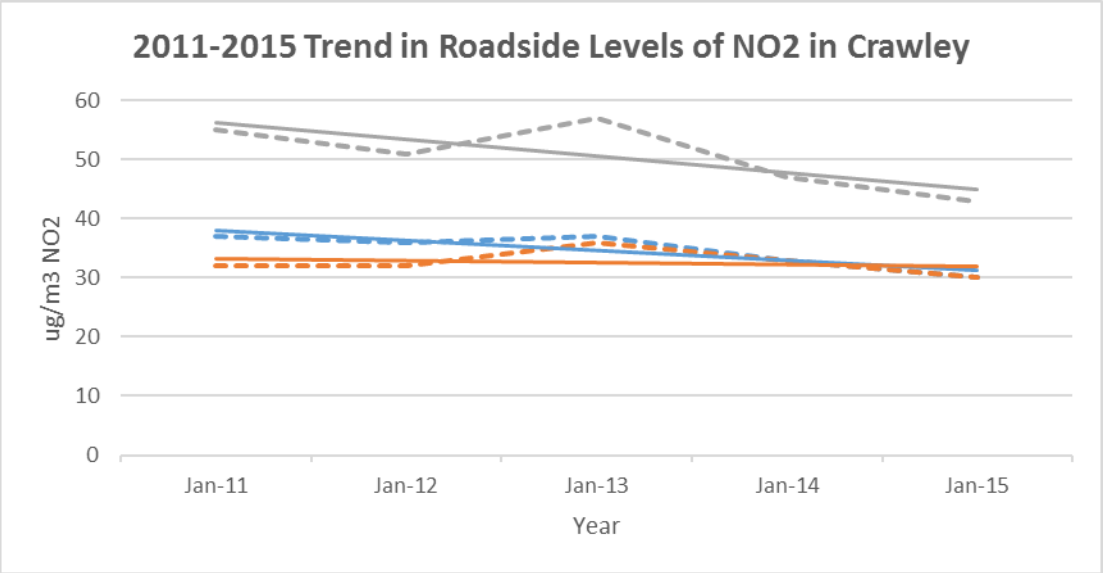

2011-2015 Trend in Roadside Levels of NO2 in Crawley
60
50
40
30
20
10
0
ug/m3 NO2
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Year

Fig 3.4

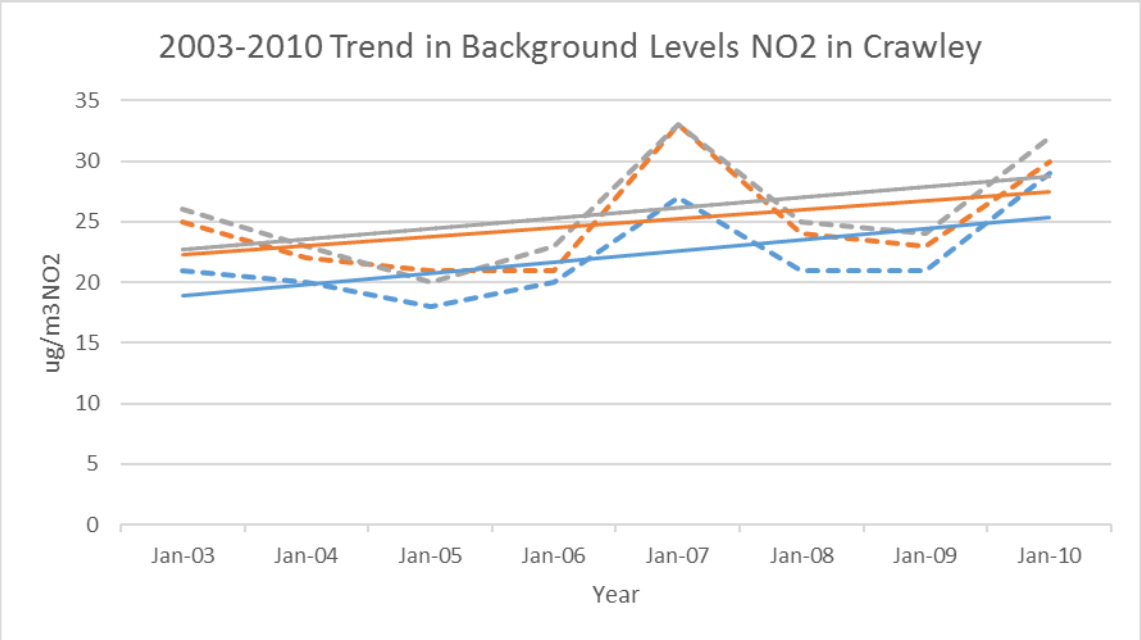

2003-2010 Trend in Background Levels NO2 in Crawley
35
30
25
20
15
10
5
0
ug/m3 NO2
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Year

Fig 3.5

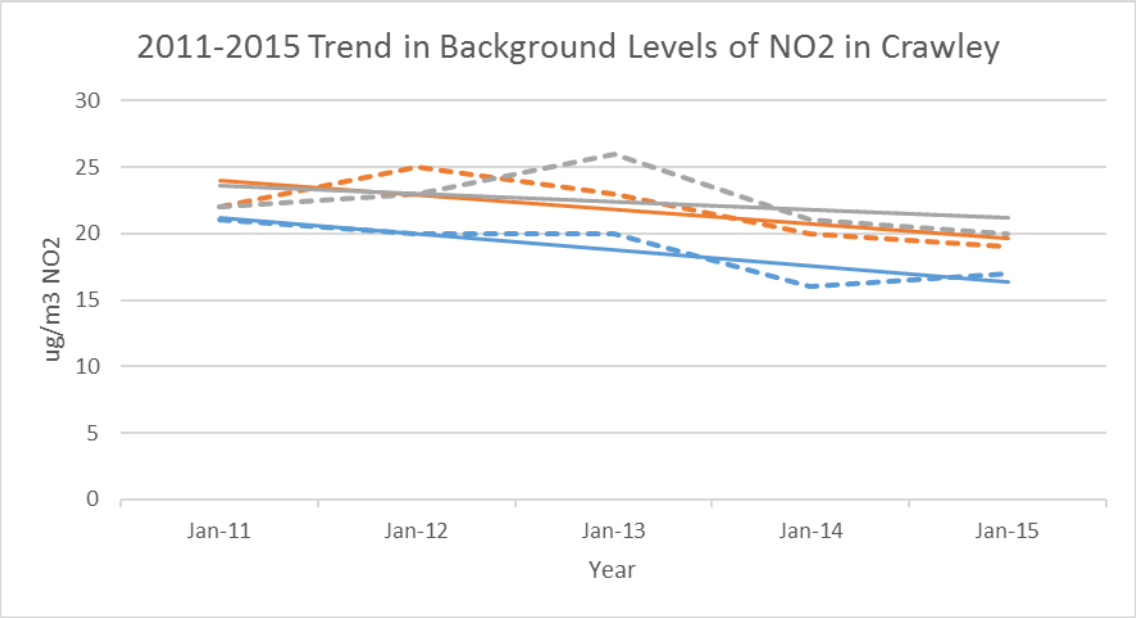
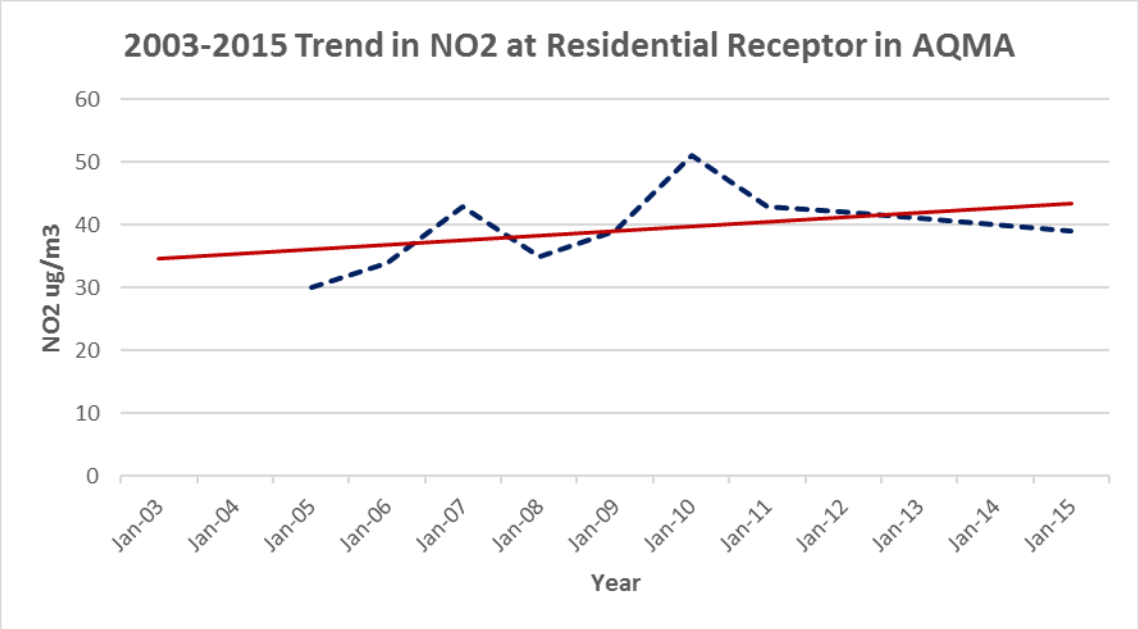

2011-2015 Trend in Background Levels of NO2 in Crawley
ug/m3 NO2
30
25
20
15
10
5
0
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Year

Fig 3.6


2003-2015 Trend in NO2 at Residential Receptor in AQMA
NO2 ug/m3
60
50
40
30
20
10
0
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Year

Automatic (Continuous) Monitoring NO_2: Although equipment failure over 2014/15 resulted in low data capture at the Gatwick East automatic monitoring site (CA2), the adjusted data indicates that there has been significant reduction in NO_2 over the last few years. Annualised data for 2015 recorded an annual mean NO_2 of 22 µg/m^3 at Gatwick East. This is the lowest annual mean recorded at this site since monitoring began in 2004 (Appendix A, Table A.5).

The trend in the long term data for the automatic monitoring site, shows a downward slope of reducing nitrogen dioxide for the past 5 years and there has consistently been zero number of hours measured where nitrogen dioxide concentrations were greater than 200 µg/m^3 over the same period (Table A.4). This trend pattern follows that of the diffusion tube data showing a fall in NO_2 levels since 2011(Fig 3.7 and Fig 3.8).

The trends in nitrogen dioxide from Gatwick airport are shown in Figs 3.9 - 3.11. These graphs compare levels of nitrogen dioxide from the airport's LGW3 site (located at the eastern end of the runway) and residential receptors in Crawley within 1000m of the airport. In 2015 there were no exceedences of annual mean NO_2 at any of these residential receptors, and the results reflect the trends seen at other sites across the borough, with a falling off of NO_2 levels since 2011 reversing the upwards trend seen in previous years.

Fig 3.7

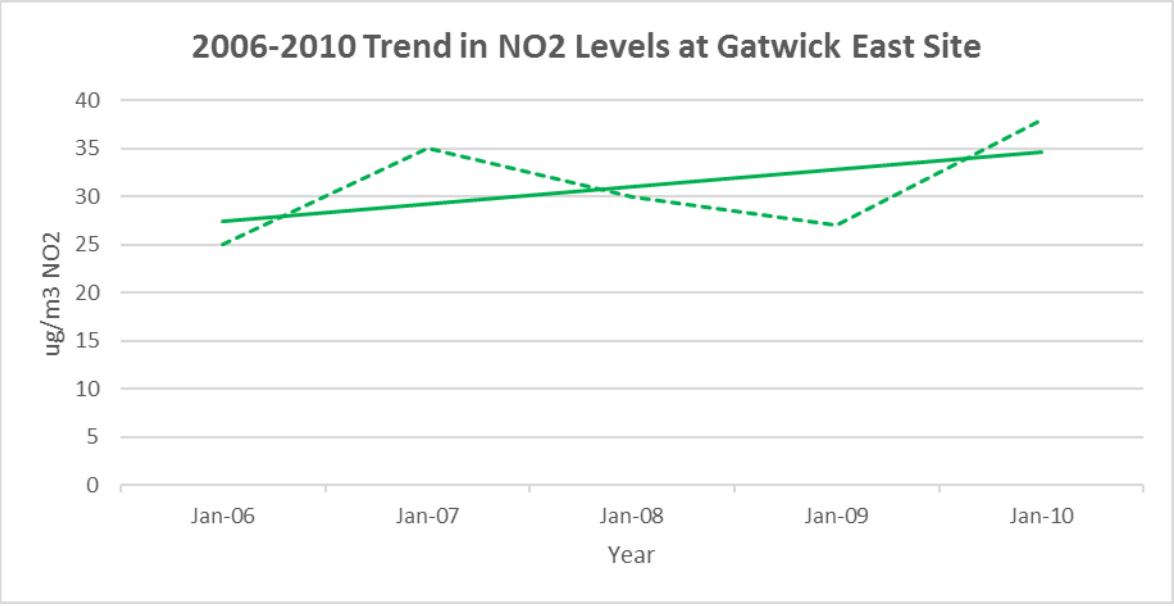


Fig 3.8

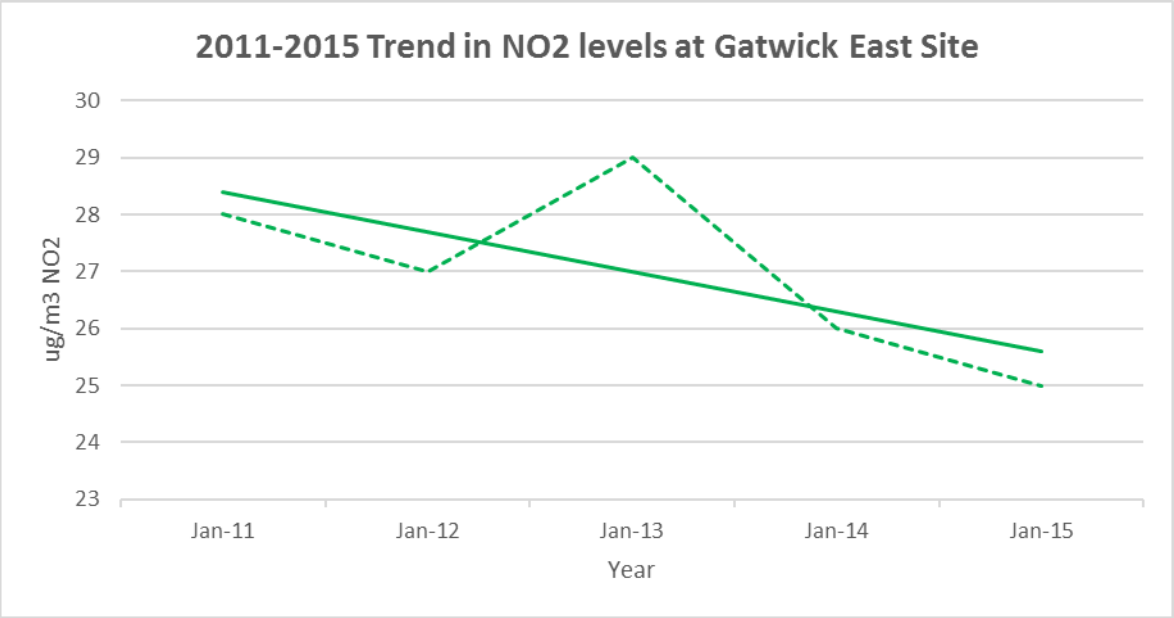

2011-2015 Trend in NO2 levels at Gatwick East Site
30
29
28
27
26
25
24
23
ug/m3 NO2
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Year

Fig 3.9

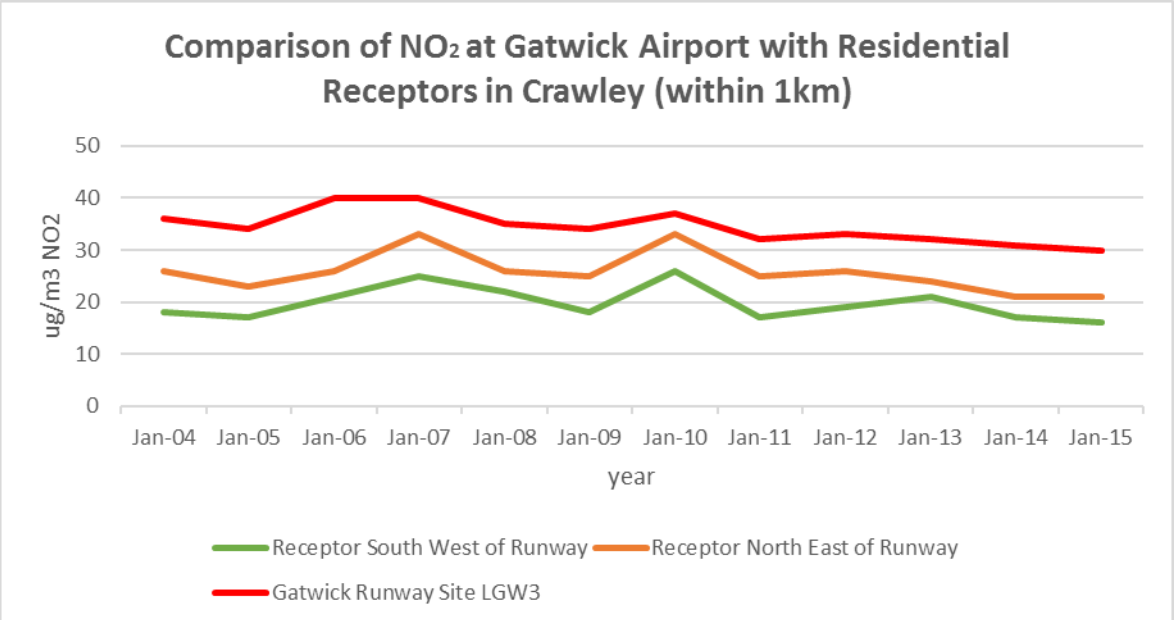

Comparison of NO2 at Gatwick Airport with Residential Receptors in Crawley (within 1km)
50
40
30
20
10
0
ug/m3 NO2
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
year
Receptor South West of Runway
Receptor North East of Runway
Gatwick Runway Site LGW3

Fig 3.10

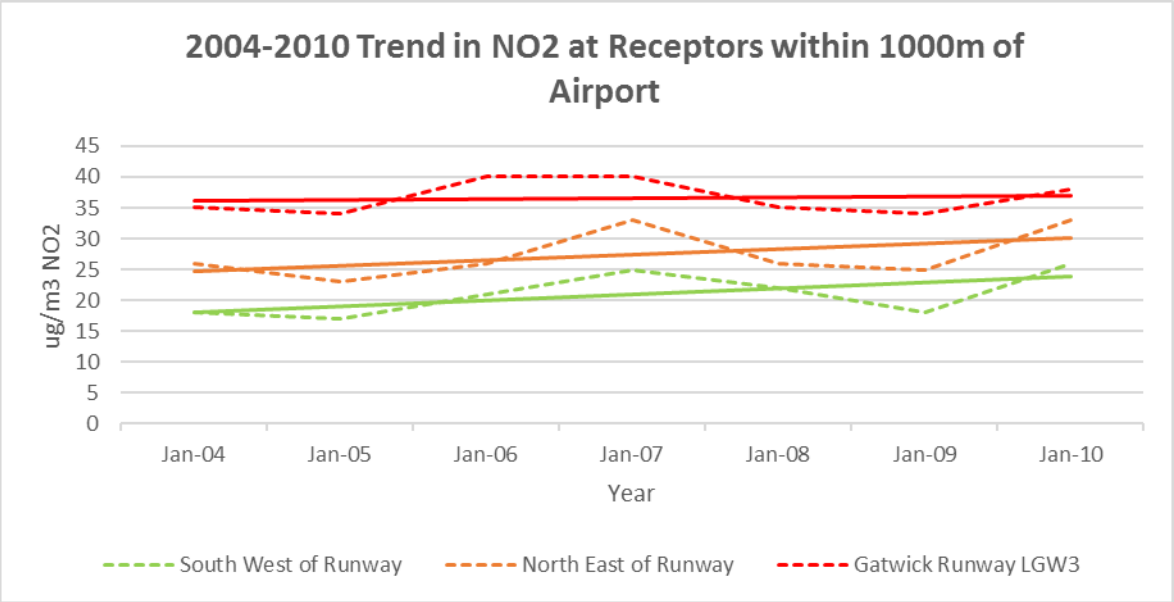
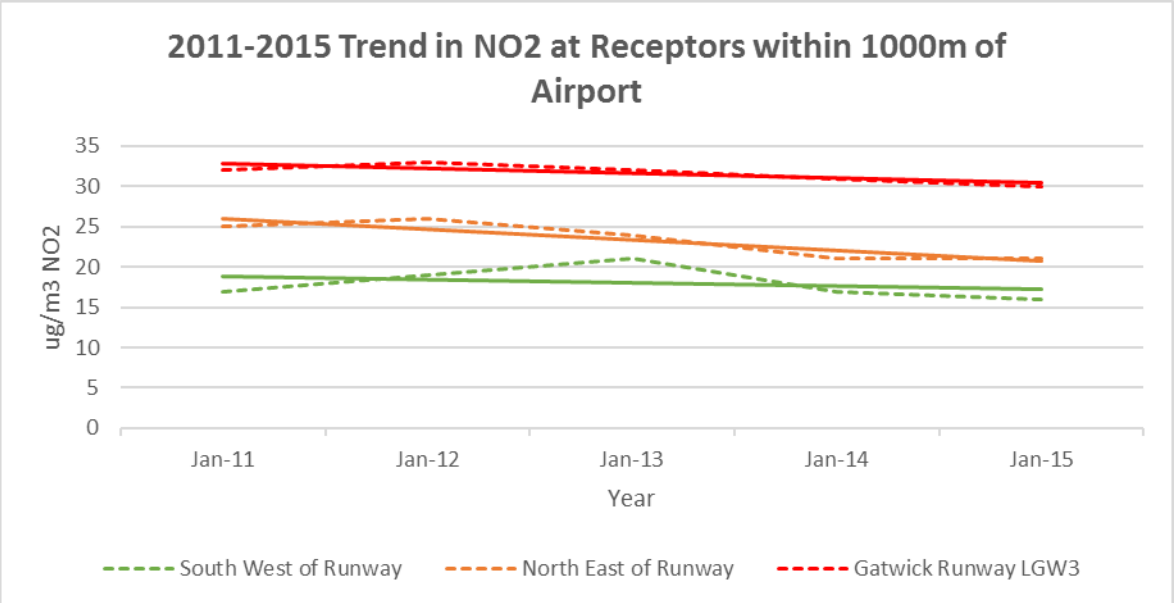


Fig 3.11

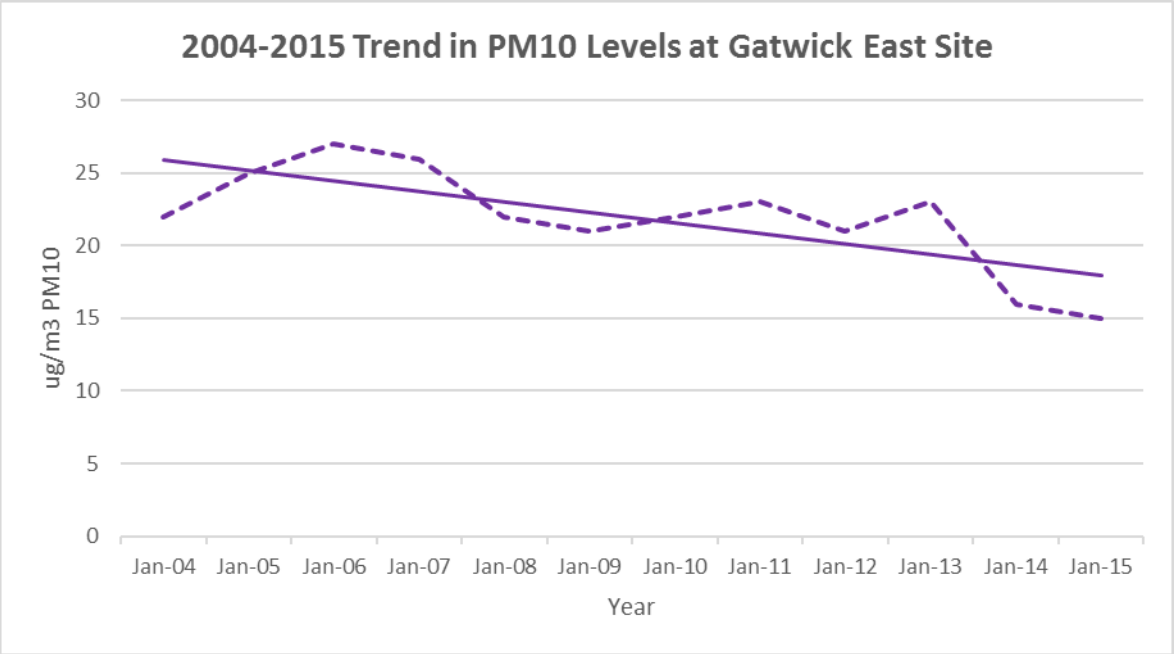


3.2.2 Particulate Matter (PM_{10})

Table A. in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3, and the daily mean concentrations with the air quality objective of 50µg/m^3, not to be exceeded more than 35 times per year.

The 2015 results show that annual mean PM_{10} concentrations fell in 2015 from the previous year (from 16µg/m^3 to 15µg/m^3), and there were no measured exceedences of the annual mean or daily mean objective at the Crawley automatic monitoring site. The long-term trend in annual concentrations for PM_{10} has declined significantly since monitoring began at this site in 2004 (Fig 3.12)
Since no exceedences of the PM10 objectives have occurred, no recommendation for AQMAs is required for this pollutant.

Fig 3.12



Appendices

Appendix A: Monitoring Results

Appendix B: Full Monthly Diffusion Tube Results for 2015

Appendix C: Supporting Technical Information/
Air Quality Monitoring Data QA/QC

Appendix D: Map of Monitoring Locations

Appendix E: Summary of Air Quality Objectives in England

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)
CA2	Gatwick East	Urban background	529394	141446	NO_2; PM_{10}	N	Chemiluminescent; Grav TEOM	130m	0.5	2.5

(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)
CR1	High Street	Roadside	528153	137912	NO_2	N	19.42m	1.5m	N	2.5
CR 99	Furnace Farm Road	Urban background	528153	137871	NO_2	N	14.80m	0.5m	N	2.5
CR3	Birch Lea	Urban background	526743	136349	NO_2	N	15.30m	1.5m	N	2.5
CR4	Headley Close	Urban background	526599	136638	NO_2	N	14.80m	0.5m	N	2.5

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)
CR48	Lynhurst Cottage	Urban background	526752	136420	NO_2	N	3.80m	14m	N	2.5
CR49	Charlwood Nursery	Urban background	525530	138472	NO_2	N	0m	36m	N	2.5
CR50	Rowley Cottage	Urban background	526285	138495	NO_2	N	0m	75m	N	2.5
CR51	Balcombe Road	Urban background	529335	139589	NO_2	N	0.50m	24m	N	2.5
CR52 - CR54	Gatwick East, Tri-location)	Urban background	529394	141446	NO_2	N	130m	0.5m	Y	2.5
CR 55	Tinsley Close Façade (11)	Urban background	528276	137828	NO_2	Y	0m	6.m	N	2.5
CR69	Tinsley Close Fence(11)	Urban background	528276	137828	NO_2	Y	1.5m	5.68	N	2.0

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)
CR62	Tinsley Close (10)	Urban background	528362	137713	NO_2	Y	0m	5.68m	N	2.5
CR71	Tinsley Close (6)	Urban background	528153	137912	NO_2	Y	12m	7.18m	N	2.5
CR 60	Peglar Way	Roadside	528153	137871	NO_2	N	* 6.5m	18m	N	2.5
CR63	Woodfield Lodge (R'bout)	Roadside	526743	136349	NO_2	Y	35m	1.8m	N	2.5
CR64	Woodfield Lodge (N'gteAve)	Roadside	526599	136638	NO_2	Y	11.40m	24m	N	2.5
CR66	Brighton Rd (Rail crossing)	Roadside	526752	136420	NO_2	N	Planned residential 2m	0.5m	N	2.5
CR67	West	Roadside	525530	138472	NO_2	N	Planned residential10m	30m	N	2.5

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)
	Green Dr									
CR68	5 High Street	Roadside	526285	138495	NO_2	N	2m	5.68m	N	2.5
CR72	Burlands	Urban background	529335	139589	NO_2	N	5.4m	7.18m	N	2.5
CR73	Cherry Lane	Urban background	528978	139599	NO_2	N	8.4m	18m	N	2.5
CR74	Tinsley Green	Roadside	528362	137713	NO_2	N	19.2	8.8m	N	2.5
CR75	Steers Lane	Roadside	528276	137828	NO_2	N	Planned residential10m	2m	N	2.5
CR76	Hazelwick Court	Urban background	528153	137912	NO_2	Y	12.30m	9.9m	N	2.5
CR77	Hazelwick Ave (Bays)	Urban background	528153	137871	NO_2	Y	4.5m	4.6m	N	2.5

(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 2015 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2011	2012	2013	2014	2015
CR1	Roadside	Diffusion Tube	n/a	100	37	36	37	33	30
CR 99	Urban background	Diffusion Tube	n/a	100	21	20	20	16	17
CR3	Urban background	Diffusion Tube	n/a	100	22	25	23	20	20
CR4	Urban background	Diffusion Tube	n/a	92	22	23	26	21	21
CR48	Urban background	Diffusion Tube	n/a	100	24	26	27	23	24
CR49	Urban background	Diffusion Tube	n/a	100	17	19	21	17	16
CR50	Urban background	Diffusion Tube	n/a	100	20	21	24	18	19
CR51	Urban background	Diffusion Tube	n/a	100	25	26	24	21	21

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2015 (%) [2]	NO_2 Annual Mean Concentration ($\mu g/m^3$) [3]				
					2011	2012	2013	2014	2015
CR52 – CR54 Mean Trilocated	Urban background	Diffusion Tube	n/a	100	28	27	29	26	25
CR 55	Urban background	Diffusion Tube	n/a	100	**44**	**42**	**41**	37	36
CR69	Urban background	Diffusion Tube	n/a	100	**43**	**42**	**41**	**40**	39
CR62	Urban background	Diffusion Tube	n/a	100	**40**	38	39	36	31
CR71	Urban background	Diffusion Tube	n/a	100	35	33	33	31	30
CR 60	Roadside	Diffusion Tube	n/a	100	32	32	36	33	31
CR63	Roadside	Diffusion Tube	n/a	100	**55**	**51**	**57**	**47**	**44**
CR64	Roadside	Diffusion Tube	n/a	100	**41**	39	**40**	37	37
CR66	Roadside	Diffusion Tube	n/a	100	38	37	35	31	27
CR67	Roadside	Diffusion Tube	n/a	100	28	27	28	26	24
CR68	Roadside	Diffusion Tube		100	31	33	34	29	28

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2011	2012	2013	2014	2015
CR72	Urban background	Diffusion Tube		100	-	-	-	14(1) (9 months data)	13
CR73	Urban background	Diffusion Tube		100	-	-	-	17(1) (9 months data)	16
CR74	Roadside	Diffusion Tube		100	-	-	-	30 (1) (9 months data)	26
CR75	Roadside	Diffusion Tube		83	-	-	-	20 (1) (9 months data)	20
CR76	Urban background	Diffusion Tube		100	-	-	-	**40**(1) (9 months data)	36
CR77	Urban background	Diffusion Tube		91	-	-	-	35(1) (9 months data)	36
CA2	Urban background	Automatic	99	66	28*	28	31	26*	22 (3)

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

NO_2 annual means exceeding $60\mu g/m^3$, 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.

* Values taken from tri-located diffusion tube as no valid data available from automatic monitor due to equipment failure

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

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
					2011	2012	2013	2014	2015
CA2	Urban Background	Automatic	95	66	*(5)	0	0	*(0)	(0)

Notes: * No valid data available from automatic monitor due to equipment failure

(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.

Table A.5 Automatic Monitoring for Nitrogen Dioxide at Gatwick Sites: CA2 (Crawley Gatwick East) and LGW3 (Adjacent to Runway Gatwick airport) Objective

Site ID	Location	% Data Capture for monitoring period 2013	Annual mean concentrations (µg/m^3)											
			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CA2	Gatwick East	99	35	32	26	35	30	29	38*	(28)*	28	31	(26)*	22
LGW3	Gatwick Airport	99	36	34	**40**	**40**	35	34	37	32	33	32	31	30

* Analyser failure – adjusted value in brackets taken from tri-located tubes

Table A.6 – Annual Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	PM_{10} Annual Mean Concentration ($\mu g/m^3$) (3)				
				2011	2012	2013	2014	2015
CA2	Urban Background	99	99	23	21	23	16[3]	15

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

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

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

(3) All means have been "annualised" as per Technical Guidance LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Table A.7 – 24-Hour Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	PM_{10} 24-Hour Means > $50\mu g/m^3$ (3)				
				2011	2012	2013	2014	2015
CA2	Urban Background	99	99	13	3	5	(0)	1

Notes: Exceedances of the PM_{10} 24-hour mean objective ($50\mu g/m^3$ not to be exceeded more than 35 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 90.4th percentile of 24-hour means is provided in brackets.

Appendix B: Full Monthly Diffusion Tube Results for 2015

Table B.1 – NO_2 Monthly Diffusion Tube Results 2015

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)
CR1	32	**41**	35	32	30	29	28	31	34	35	36	34	32	30
CR 99	20	29	20	21	15	12	12	13	16	19	18	17	18	17
CR3	24	36	23	21	16	16	15	17	20	22	25	19	21	20
CR4	23	33	25	22	19	16	15	16	23	27	23	19	22	21
CR48	30	39	29	22	21	23	21	22	27	28	23	27	26	24
CR49	14	24	17	18	18	16	11	12	21	21	18	13	17	16
CR50	19	34	23	23	16	15	14	15	22	22	26	15	20	19
CR51	27	29	28	23	18	20	20	21	23	23	18	25	23	21
CR52	32	35	31	28	18	24	24	23	29	30	29	24	27	25
CR53	27	36	30	22	23	24	23	23	27	29	27	25	26	24
CR54	29	35	31	20	23	23	24	23	29	31	27	27	27	25
CR 55	34	**41**	**40**	38	33	35	**40**	**40**	**40**	**45**	**46**	39	39	36

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 (1)
CR69	39	**42**	**43**	**41**	37	35	**45**	**41**	**41**	**45**	**47**	**43**	**42**	39
CR62	37	38	**42**	26	32	30	37	36	39	**40**	**42**	**38**	33	31
CR71	30	39	35	28	28	26	34	32	32	36	33	28	32	30
CR 60	28	39	39	30	29	26	30	33	33	35	36	35	33	31
CR63	**47**	**63**	**50**	**43**	**40**	**44**	37	**44**	**47**	**59**	**49**	**43**	**47**	**44**
CR64	27	**53**	**43**	37	37	39	**43**	35	**43**	**45**	**42**	**33**	**40**	37
CR66	27	39	32	24	28	25	27	26	29	34	31	30	29	27
CR67	26	33	30	25	24	20	22	22	28	32	31	20	26	24
CR68	34	39	34	26	26	28	32	23	31	32	31	23	30	28
CR72	15	23	18	16	12	9	8	11	13	15	17	13	14	13
CR73	18	25	20	18	14	13	11	14	18	20	23	14	17	16
CR74	29	**42**	23	26	24	31	27	25	29	33	23	27	28	26
CR75	21	29	24	-	16	19	18	19	23	-	24	17	21	20
CR76	**40**	**53**	**47**	29	36	35	39	36	37	**46**	**43**	38	39	36

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 (1)
CR77	38	**53**	**43**	32	26	-	39	35	38	**43**	**45**	39	39	36

(1) See Appendix C for details on bias adjustment (0.93)

Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC

C.1: QA/QC Diffusion Tube Monitoring Data (NO_2)

All diffusion tube monitoring data has been ratified following the methods described in LAQM.TG(09) A quality assurance/quality control (QA/QC) programme including field duplicates and blanks and instrument calibration with standard gases has been followed (AEAT, 2000).

The NO_2 diffusion tube analysis was carried out and analysed by Gradko Environmental (part of Gradko International Ltd) .The QA/QC methodology for Gradko Environmental Ltd is given below:

Tube Preparation: The preparation of the tubes is done using 20% Triethanolamine / 80% Deionised Water. The preparation procedures adhere to the guidance detailed in the document 'Diffusion Tubes for Ambient NO2 Monitoring: Practical Guidance for Laboratories and Users', Issue 1a Feb.2008 (issued by AEA Energy and Environment).

Analysis Methods: Analysis of the NO2 diffusion tubes is carried out using colorimetric techniques in accordance with Gradko International Ltd UKAS accredited (ISO/IEC 17025) internal laboratory procedures. The details in these procedures adhere to the DEFRA 'Diffusion Tubes for Ambient NO2 Monitoring: Practical Guidance for Laboratories and Users, Issue 1a Feb 2008', issued by AEA Energy and Environment.

Quality Control Procedures: All tube components are maintained in a high state of cleanliness. New absorbents are prepared by the Laboratory and checked for levels of contamination.

The diffusion tubes are prepared in a dedicated clean laboratory and stored under refrigerated conditions to maintain stability. A sample of each batch of tubes prepared is checked by the analyst for blank levels. If the tubes are stored for more than one week, a further sample is taken and checked for any increases in blank levels. If the levels reach a pre-determined value, the batch of tubes is discarded.

Method Calibration: A full five to seven (dependant on range of concentrations being measured) point calibration is carried out monthly using NIST certified nitrite standards. The linear graph acceptance is $r^2 = 0.999$. At the start of every batch of tubes analysed, two nitrite standards are run to check the accuracy of the calibration graph, this is repeated at the end of the analysis run. Statistical graphs are maintained using the plots of the daily standard results and the acceptance criteria achieved before an analysis run is made. An instrument calibration is run every two months using certified optical filters plus an annual preventative maintenance programme carried out by an external engineer is in operation.

Quality Assurance: The laboratory has a fully documented Quality Management System which has been assessed and accredited by UKAS (Accreditation No. 2187). A copy of the Quality Manual Contents Index is available on request.

Quality Control Procedures are supplemented by the use of external proficiency schemes such as W.A.S.P administered by Health and Safety Laboratories at Buxton and the NETCEN U.K. NO2 Field Inter-comparison project administered by National Physical Laboratories (NPL), Teddington.

C.2: NO_2 Diffusion Tube Precision, Accuracy and Bias Correction

Diffusion tube monitoring has inherent errors. In order to minimise these, a bias-adjustment factor is applied to the measurements to improve the accuracy of the results. This factor is obtained by co-locating three diffusion tubes at a continuous monitoring site.

The co-location study in Crawley is at the Gatwick East Site (CA2), where triplicate tubes (prepared and analysed by Gradko) are located next to the inlet of the chemiluminescence analyser. Using the results of this study, the average values from the monthly exposed tubes for a given year can be compared directly to the corresponding continuously monitored values; allowing the local authority to calculate the precision of their tubes as well as the bias.

Precision of the Crawley Co-location Site Diffusion Tubes: Precision is the ability of a measurement to be consistently reproduced; and the diffusion tube precision is therefore calculated by determining the coefficient of variation CV. Where the CV is <20% for 8 or more periods in a year, then the Tube Precision is considered to be “Good”. Tube precision was calculated using the calculator tool (version 04) on the laqm review and assessment support website (www.airquality.co.uk/archive/laqm/tools.php). The results for the Crawley co-location study are shown in Table A1 and A2 below. Overall Precision was “Good”

Table C.1 2015 Precision Assessment of Triplicate Tubes (from calculator tool (version 04) on the LAQM Review and Assessment Support Website)

Site Name/ ID:	GATWICK EAST SITE (CA2)								
2015 Co-Location Diffusion Tubes Measurements									
Period	**Start Date**	**End Date**	**Tube 1** μgm^{-3}	**Tube 2** μgm^{-3}	**Tube 3** μgm^{-3}	**Triplicate Mean**	**Standard Deviation**	**Coefficient of Variation (CV)**	**95% CI of mean**
1	01/01/2015	31/01/2015	32	27	29	29	2.5	9	6.3
2	01/02/2015	28/02/2015	35	36	35	35	0.6	2	1.4
3	01/03/2015	31/03/2015	31	30	31	31	0.6	2	1.4
4	01/04/2015	30/04/2015	28	22	20	23	4.2	18	10.3
5	01/05/2015	30/05/2015	18	23	23	21	2.9	14	7.2
6	01/06/2015	31/06/2015	24	24	23	24	0.6	2	1.4
7	01/07/2015	31/07/2015	24	23	24	24	0.6	2	1.4
8	01/08/2015	31/08/2015	23	23	23	23	0.0	0	0.0
9	01/09/2015	30/09/2015	29	27	29	28	1.2	4	2.9
10	01/10/2015	31/10/2015	30	29	31	30	1.0	3	2.5
11	01/11/2015	30/11/2015	29	27	27	28	1.2	4	2.9
12	01/12/2015	31/12/2015	24	25	27	25	1.5	6	3.8
13	01/01/2016	31/01/2016	30	25	27	27	2.5	9	6.3
Precision			**13 out of 13 periods have a CV smaller than 20%**						

Table C.2 2015 Co-location Overall Tube Precision and data Capture (from calculator tool (version 04) on the LAQM Review and Assessment Support Website)

2015 Automatic Monitoring Data (Gatwick CR1)		Data Quality Check	
Period Mean	**Data Capture (% DC)**	**Tubes Precision Check**	**Automatic Monitor Data Capture Check**
-	0	Good	Poor
-	0	Good	Poor
-	0	Good	Poor
21	20	Good	Poor
22	100	Good	Good
19	94	Good	Good
19	74	Good	Poor
23	100	Good	Good
34	100	Good	Good
31	100	Good	Good
20	100	Good	Good
18	100	Good	Good
29	100	Good	Good
Overall survey		**Good precision**	**Overall Poor Data Capture**

Diffusion Tube Bias Adjustment Factors: Bias represents the overall tendency of the diffusion tubes to depart from the true value, ie to under or over-read relative to the reference method (chemiluminescence analyser). The bias can be corrected, using the appropriate bias correction factor, to improve the accuracy of the diffusion tube results. Local bias adjustment factors are obtained by co-locating three diffusion tubes at a continuous monitoring site in the local authority and national factors are derived from the mean value of a number of different local authority studies. The derivation of the National and Local bias adjustment factors are shown below. (Tables C.3 – C.6).

Local Bias Adjustment factor for Crawley: Crawley has a co-location study located at the Gatwick East Site (CA2). A local bias adjustment factor was calculated using data from triplicate tubes (prepared and analysed by Gradko) mounted next to the inlet of the analyser during 4-week periods throughout the year. The 2015 local bias correction for Crawley was calculated using the method described in LAQM.TG(09) Section3 and the spread sheet tool provided in www.airquality.co.uk/archive/laqm/tools.php . The bias value (B) derived from the tube data *without* CV > 20% was used to calculate the locally derived bias adjustment factor for Crawley (following the method in foot note 4 on this web-page).

Table C.3: Bias and Accuracy - Calculated without periods with CV > 20% (with 95% confidence interval)	
Bias calculated using 8 periods of data Bias factor A Bias B	 0.95 (0.81 – 1.15) 5% (-13% - 24%)
Diffusion Tube Means Mean CV (Precision)	26 µg/m^3 5
Automatic Mean Data capture for periods used	25 µg/m^3 99%
Adjusted Tubes Mean	25(21-30) µg/m^3

Table C.4: Bias and Accuracy - Calculated with all data including periods with CV > 20% (with 95% confidence interval)	
Bias calculated using 8 periods of data Bias factor A Bias B	 0.95 (0.81 – 1.15) 5% (-13% - 24%)
Diffusion Tube Means Mean CV (Precision)	26 µg/m^3 5
Automatic Mean Data capture for periods used	25 µg/m^3 99%
Adjusted Tubes Mean	25(21-30) µg/m^3

Table C.5 Bias Correction Factor for NO_2 diffusion Tube from Locally Derived 2015 Co-location data Following foot note [4] of the Precision and Accuracy calculator tool LAQM Helpdesk Website (version 03/16)	
Bias (B) value	**= 5%**
Bias value expressed as a factor	**= 0.05**
Bias value, expressed as a factor + 1	**= 0.05 + 1 = 1.05**
The inverse of 0.98 = The Bias Adjustment Factor	**= 1/1.05**
2015 Local Bias Correction Factor for Crawley	**= 0.952**

National Bias Adjustment Factor: Data from co-location studies are used to calculate the Bias Adjustment Factor. Not all local authorities carry out their own co-location studies, therefore Defra collates the UK co-location study results, and from these calculated the mean value for each laboratory, to provide a national bias adjustment value for the users of each laboratory. The National Bias Adjustment Factor (Gradko) is shown below.

Table C.6 National Bias Correction Factor for 2015 NO_2 diffusion Tube data from Gradko Co-location Studies. The full spread sheet data for all 28 studies can be view at the LAQM Review and Assessment Support Website http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html)	
2015 National Bias Adjustment Factor (Gradko 29 Studies)	**0.91**

Choice of Factor for Bias Adjustment: The annual mean NO_2 for the triplicate co-located tubes and the automatic monitoring data at the CA2 Gatwick site were very close in value. This was reflected in the locally derived bias adjustment figure of 0.95, indicating good correlation over the data capture period.

The national bias adjustment value was 0.91. Since the Crawley data appeared from the results to be more closely correlated it would have been preferable to use the locally derived value. However, taking into account that the data capture was low due to equipment problems in the first three months, it was decided to take the mean value of the local and national factors. Consequently all conclusions and recommendations made in this report were based on monitoring results adjusted with the 2015 mean bias adjustment figure of 0.93

Table C.7 Summary of 2015 Bias Adjustment Factors	
	Bias Adjustment Factor 2015
Local Bias Adjustment Factor	0.95
National Bias Adjustment Factor	0.91
Average of Local and National	**0.93**

C.3: Annualising NO_2 Continuous Monitoring Data (where data capture is < 75%)

Where data capture is below 75%, it is necessary to annualise the data as described in Box 7.9 of the LAQM Technical Guidance TG(16). The reason for annualisation is that the concentration varies throughout the year, and the instrument may have been operational for a period of above or below average concentrations.

Due to equipment failure at the continuous automatic monitor (CA2) east of Gatwick airport, the data capture for 2015 was only 66%. It was therefore necessary to carry out an annualisation calculation for this data.

Methodology:

- Data was available for 8 full calendar months from May – December 2015.
- The measured mean concentration **M** for this period is **M** = 23µg/m^3.
- Identify 2-4 nearby, long-term, continuous monitoring sites: Background (Urban Background, Suburban or Rural) sites, with ≥ 85% data capture.
- Take the annual means, $\mathbf{A_m}$, for the calendar year for these sites.
- Calculate the period means, $\mathbf{P_m}$, for the period of interest, (May- Dec)
- Calculate the ratio, **R**, of the annual mean to the period mean ($\mathbf{A_m/P_m}$) for each of the sites.
- Calculate the average of these ratios, $\mathbf{R_a}$. This is then the annualisation factor.
- Multiply the measured period mean concentration **M** by this annualisation factor $\mathbf{R_a}$ to give the estimate of the annual mean for 2015.

Table C.8 Annualising Continuous Monitoring data where data capture is <75%

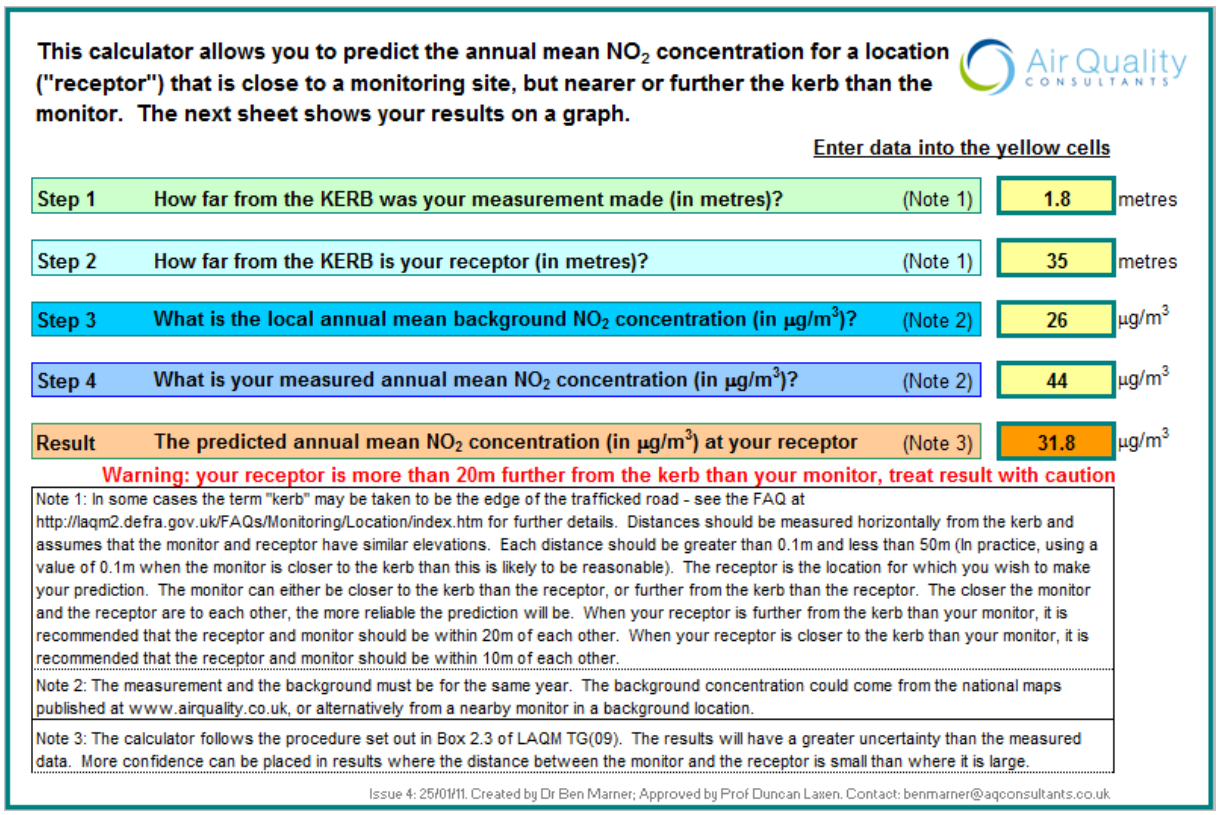
Background Site	Annual Mean 2015 (A_m)	Period Mean 2015 (P_m)	Ratio (A_m/P_m)
Co-located Tube 1 (CR52)	25	25	1.00
Co-located Tube 2 (CR53)	24	25	0.960
Co-located Tube 3 (CR54)	25	26	0.962
		Average (R_a)	0.974

The estimate for the annual mean for the continuous monitor CA2 in 2015 will be:

$\mathbf{M \times R_a} = 23 \times 0.974 = 22.402$ µg/m^3

C.4: Fall off with Distance Calculator for NO_2 Annual Mean

This calculation allows the prediction of annual mean NO_2 concentration for a location "receptor" that is close to a monitoring site, but further from the road than the monitor.



This calculator allows you to predict the annual mean NO_2 concentration for a location ("receptor") that is close to a monitoring site, but nearer or further the kerb than the monitor. The next sheet shows your results on a graph.

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Enter data into the yellow cells

Step 1	How far from the KERB was your measurement made (in metres)?	(Note 1)	1.8	metres
Step 2	How far from the KERB is your receptor (in metres)?	(Note 1)	35	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	(Note 2)	26	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	(Note 2)	44	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	(Note 3)	31.8	$\mu g/m^3$

Warning: your receptor is more than 20m further from the kerb than your monitor, treat result with caution

Note 1: In some cases the term "kerb" may be taken to be the edge of the trafficked road - see the FAQ at http://laqm2.defra.gov.uk/FAQs/Monitoring/Location/index.htm for further details. Distances should be measured horizontally from the kerb and assumes that the monitor and receptor have similar elevations. Each distance should be greater than 0.1m and less than 50m (In practice, using a value of 0.1m when the monitor is closer to the kerb than this is likely to be reasonable). The receptor is the location for which you wish to make your prediction. The monitor can either be closer to the kerb than the receptor, or further from the kerb than the receptor. The closer the monitor and the receptor are to each other, the more reliable the prediction will be. When your receptor is further from the kerb than your monitor, it is recommended that the receptor and monitor should be within 20m of each other. When your receptor is closer to the kerb than your monitor, it is recommended that the receptor and monitor should be within 10m of each other.

Note 2: The measurement and the background must be for the same year. The background concentration could come from the national maps published at www.airquality.co.uk, or alternatively from a nearby monitor in a background location.

Note 3: The calculator follows the procedure set out in Box 2.3 of LAQM TG(09). The results will have a greater uncertainty than the measured data. More confidence can be placed in results where the distance between the monitor and the receptor is small than where it is large.

Issue 4: 25/01/11. Created by Dr Ben Marner; Approved by Prof Duncan Laxen. Contact: benmarner@aqconsultants.co.uk

Table C.9: Hazelwick Roundabout: Fall off with Distance Adjustment for NO_2 Annual Mean

Site with potential for Exceedence	**(CR 63) HAZELWICK ROUNDABOUT, WOODFIELD LODGE (528153 137912)**				
Year	**Distance of Monitoring Site from Receptor**		**Local Annual Mean Background Concentration ($\mu g/m^3$)**	**Measured Annual Mean NO_2 at Mon Site (bias adjusted) C_Y ($\mu g/m^3$)**	**Estimated Annual Mean NO_2 at Receptor (adjusted for fall off with distance)**
	Dist (m) Mon Site to Kerb D_Y	**Dist (m) Receptor to Kerb D_Z**			
2015	1.8	35.00	26	**44**	**32**

C.5: Adjustment of PM_{10} Monitoring Data Using Volatile Correction Model (VCM)

For the TEOM data the Volatile Correction Model (VCM) was used to adjust the data for the gravimetric equivalent concentration. VCM corrected data for the Gatwick East data is shown in Table C.10 below.

Table C.10: Gatwick East PM_{10} Monitoring Adjustment using Volatile Correction Model (VCM) (from Kings College London ERG vcm web portal)

Local Measurement Data for VCM correctio		**2015 Measured Data**	
Site	Gatwick East, Crawley	TEOM Annual Mean PM_{10} (uncorrected) $\mu g/m^3$	15.00
Year	2015 (1/01/15-31/12/15)		
Timescale	Daily Mean		
Monitor	TEOM		
EPA Constant A	3		
EPA Constant B	1.03		
Instrument Temp ^oC	25		
Instrument Pressure mbar	1013		
Reports to local ambient readings	No	No of exceedences of the 50µg/m^{3}in Daily Mean in 2015 >35	1
Pressure Site	Reigate and Banstead - Horley (RG1)	VCM Corrected Annual Mean PM_{10} $\mu g/m^3$	14.93
Temperature Site	Camden - Shaftesbury Avenue(CD3)		
FDMS Sites	1. Reigate and Banstead (RG5) 2. Greenwich - Blackheath (GR7) 3. Average of remaining sites*. * Correction includes unratified data		

C.6: Estimating $PM_{2.5}$ Concentrations from Nationally Derived Correction Ratio - TG(16) Method

Where no appropriate local sites measuring both PM10 and PM2.5 are available, then it may not be possible to use a locally derived ratio. In this situation, a nationally derived correction ratio of 0.7 can be used.

This factor was calculated as the average of all ratios of PM2.5/PM10 found for years 2010 to 2014 for forty sites within the AURN where both PM10 and PM2.5 are measured on an hourly basis.

Crawley annual Average PM_{10} (CA2 site Gatwick East) = 15 µg/m^3 (VCM)

$PM_{2.5}$ = 15 x 0.7µg/m^3

$PM_{2.5}$ = 10.5µg/m^3

C.7: New Pollution Sources and New Developments

There are a number of significant ongoing new developments within the borough which may cumulatively contribute to pollution sources in the area. These include:

- Manor Royal business district: major redevelopment works, including expansion of the County Oak retail park/Astral Towers site to include two new super markets and conversion of office block to residential apartments. Manor Royal is adjacent to the Hazelwick AQMA.

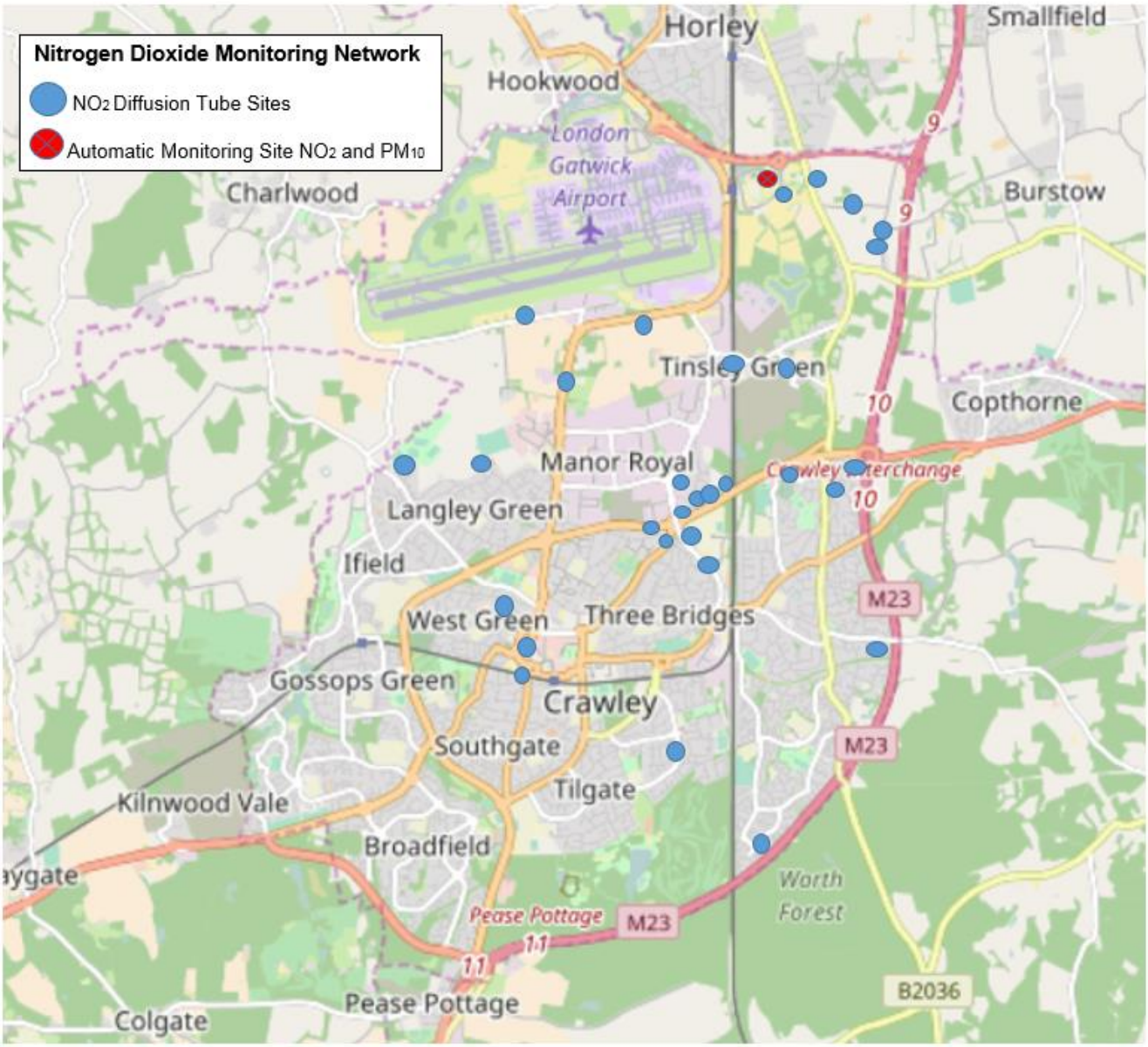
- Forgewood Residential neighbourhood: Ongoing development of new neighbourhood, including 2000 new residential units, local shops, amenities, community centre, school and realignment of surrounding roads. The Forge wood development is adjacent to the Hazelwick AQMA.

All new developments are examined through the planning system and where necessary air quality assessments and mitigation are required in order to offset the impacts of existing and new sources of pollution on future residents.

The Forgewood neighbourhood development was decided on planning appeal before the AQMA was designated and conditions were set by the planning inspectorate. The

development is still in the building phase and the full impact from the development will not be known until fully operational. However, monitoring at existing diffusion tube locations at the AQMA and surrounding areas will measure the effect of the developments as it progresses and allow the council to assess long term trends. These results are reported annually through the LAQM process.

Appendix D: Map(s) of Monitoring Locations



Appendix E: Summary of Air Quality Objectives in England

Table E.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).

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
SAQP	Sussex Air Quality Partnership
WSCC	West Sussex County Council

References

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

Sussex Air Quality Emissions Mitigation Guidance 2013

Crawley Borough Council Local Plan 2015

National bias adjustment factor spreadsheet:
http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

Tube precision spreadsheet:
www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

Volatile Correction Model website:

http://www.volatile-correction-model.info/

Air Quality Consultants: Nitrogen Dioxide Distance from Road Calculator (Issue 4)