

Air Quality Monitoring: Joint Report by RBBC and BAAG for 2012.

1. The following report presents the results from the 2012 air pollution monitoring program undertaken on, and in the vicinity of, Gatwick Airport.
2. Committee members are reminded that details of:
 - the legislation,
 - the rationale for the monitoring of certain pollutants,
 - and factors to bear in mind when examining the data e.g. the impact of the weather, and / or changes in the source of a pollutant, were covered in a separate report to the GP sub committee on 11th January 2007.

Off Airport Monitoring at Relevant Receptors on the Horley Gardens Estate. Annual Compliance Monitoring – Nitrogen Dioxide.

3. The annual average concentration of nitrogen dioxide across the Horley Gardens Estate in 2012 is shown in Figure 1.
4. Concentrations were below the UK annual average objective of $40 \mu\text{g m}^{-3}$ (micrograms per cubic metre), and so the UK air quality standards were met within the Horley air quality management area (AQMA) in 2012.
5. The highest concentration measured on the Horley Gardens Estate was $33 \mu\text{g m}^{-3}$ at three sites, two towards the southern end of The Crescent next to the 'worst case' receptor at RB59, and one on Cheyne Walk. This compares to the highest concentration in 2011 of $29 \mu\text{g m}^{-3}$.
6. Local sources of pollution on the estate remained unchanged throughout 2012, and so the results are comparable to previous years monitoring work.
7. Data capture from the real time monitoring site RG1 was 99.5 %, and from site RG2 85.1 %, and so the data from these sites along with the diffusion tube data is valid for compliance monitoring purposes. As data capture at the RG2 site was less than 90 % the values here cannot be compared to the hourly air quality standard, but as the annual average standard is the main cause for concern the slightly lower data capture at RG2 has no impact on the findings of this report.
8. The results from 2012 are in line with the predicted distribution of nitrogen dioxide concentrations for the Horley Gardens Estate, with the highest concentrations found towards the southeast corner of the estate. Concentrations in 2012 were typically around 4 to $5 \mu\text{g m}^{-3}$ higher than in 2011 across much of the Gardens Estate, although similar increases were seen elsewhere across Reigate and Banstead. Thus the deterioration in air quality seen in the vicinity of the airport reflects the natural year to year variation due to the weather and / or regional changes rather than a specific change related to the airport.
9. Despite the increase in nitrogen dioxide concentrations at all of the sites near the airport and elsewhere, pollutant concentrations in Charlwood and Smallfield declined by $2 \mu\text{g m}^{-3}$ in 2012.
10. Passenger numbers and aircraft movements at Gatwick increased by 1.7 % and fell by 1.6 % respectively in 2012 compared to 2011 (Appendix A). However passenger numbers and aircraft movements still remain below the 2007 peak by 2.8 % and 7.3 % respectively, which reduces nitrogen dioxide concentrations¹ at the worst affected properties by 1 to $2 \mu\text{g m}^{-3}$. Traffic flows on the M23 spur remain 12 % below the 2006 peak.

¹ Netcen FAST modelling for GAL (2006). Modelling approach has since changed but the original model is still appropriate for indicative values.

Annual Compliance Monitoring – PM₁₀.

11. The PM₁₀ air quality standard was met on the Horley Gardens Estate in 2012, with an annual average concentration at RG1 of 19 µg m⁻³, which was within the expected range of 18 to 23 µg m⁻³. Although concentrations in 2012 were slightly lower than in 2011 this decrease reflects year to year changes due to the prevailing weather conditions rather than any decrease in local sources of PM₁₀.

Trends in Pollutant Concentrations.

Nitrogen dioxide.

12. A three year rolling average concentration is used in the trend analysis work, to help remove the year to year fluctuations in concentrations caused by the prevailing weather conditions. The data to date (Figure 2) shows that the long term downward trend in annual average nitrogen dioxide concentrations at the RG1 site has continued in 2012, after the slight 'pause' in 2010.
13. At the 'worst case' receptors closer to the airport (RG2, RB59) the downward trend has levelled off in 2012, although this may well be temporary as with the RG1 site in 2010. The cause of the general convergence of the RB59 and the RG2 concentrations in recent years is unknown, although it is worth noting that computer modelling has consistently suggested a difference of no more than 1 to 2 µg m⁻³ between these two sites as has been the case in practice in recent years.
14. The overall downward trend at RG1 and RG2/RB59 is as expected given that computer modelling indicates that non airport sources of nitrogen dioxide and airport related road traffic emissions are predicted to fall until 2015², and to a lesser extent 2025³, driven mainly by improvements in road vehicle engine technology. In addition the significant falls in aircraft movements and to a lesser extent passenger numbers at Gatwick since the 2007 peak will have lead to further improvements in air quality especially at the RG2/RB59 sites.

PM₁₀.

15. It is important to note that the airport is not a significant source of PM₁₀, and computer modelling⁴ consistently indicates that the airport is responsible for no more than 1 – 2 µg m⁻³ of the total PM₁₀ concentration at the worst affected properties on the Horley Gardens Estate.
16. The main purpose of monitoring PM₁₀ on the Horley Gardens Estate is to examine trends in the PM₁₀ concentration, as the UK Government is aiming to reduce people's exposure to particulate matter in the longer term even where the air quality standards are met.
17. Using a three year rolling average to examine the trends in the data there is evidence of an overall downward trend from 2003 to 2010, with concentrations of 23.9 µg m⁻³ in 2003 and 19.5 µg m⁻³ in 2010 (Figure 3), although much of this improvement in non airport PM₁₀ to date has occurred between 2007 and 2010. The levelling off in the trend since 2010 (or slight rise using the volatile correction methodology) at present could be an artefact of the elevated concentration measured in 2011 rather than an overall change in the long term trend.

² Gatwick Air Quality Assessment for 2010 (AEAT/ENV/R/2795/Issue 1 – June 2009)

³ Gatwick Airport Master Plan: Air Quality Assessment 2024/25 (AEAT/ENV/R/3139/Issue 1 – 18th May 2011)

⁴ Gatwick Air Quality Assessment for 2010 (AEAT/ENV/R/2795/Issue 1 – June 2009)

Figure 2: Three year Rolling Annual Average Nitrogen Dioxide Concentration at RG1, Michael Crescent Horley (Blue diamond), RG2, The Crescent Horley (Purple square), and RB59 (Red triangle).

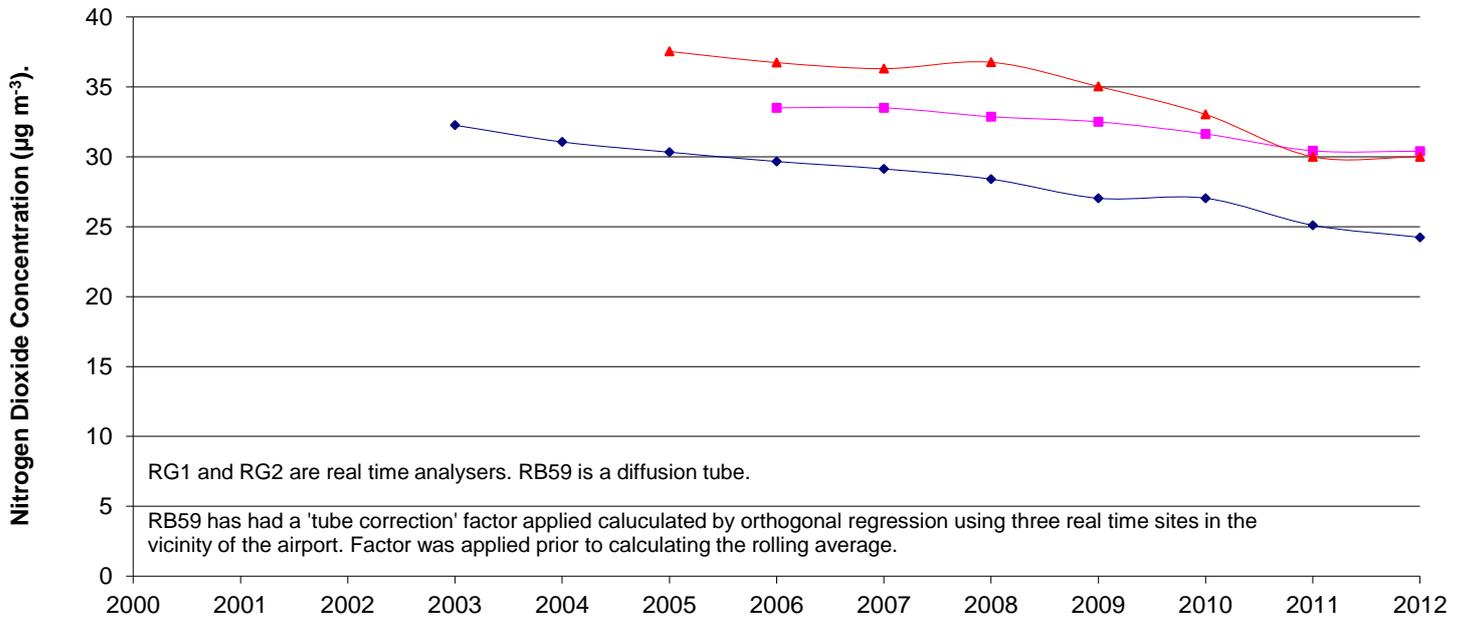
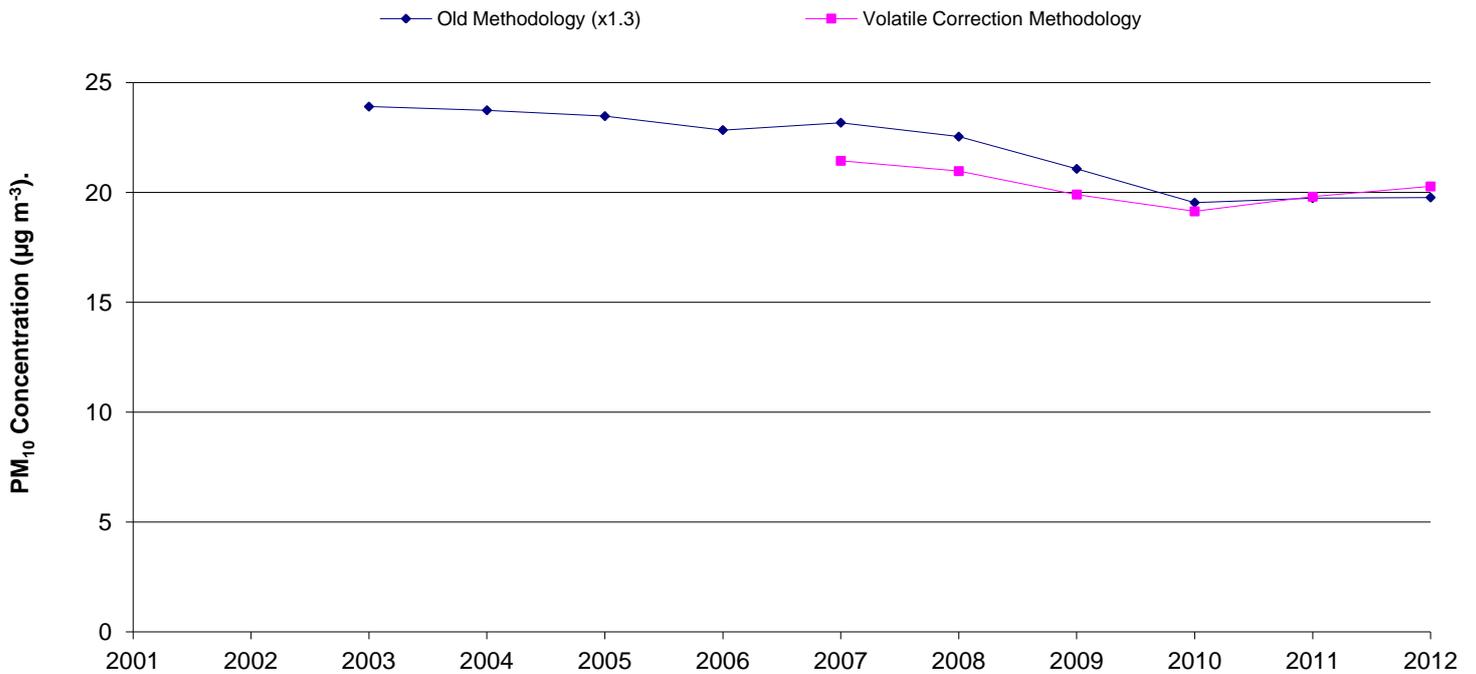


Figure 3: Three Year Rolling Annual Average PM₁₀ Concentration at RG1, Michael Crescent, Horley.



On Airport Monitoring.

18. In the absence of relevant receptors⁵ at the airport monitoring site, it is largely academic whether or not the air quality standards are breached. However the monitoring results from 2012 (Table 1) indicate that the standards were met at the LGW3 monitoring station for PM₁₀ and nitrogen dioxide.
19. Carbon monoxide is no longer monitored at LGW3 as the monitor failed on 18/6/12 and has not been replaced, given that the carbon monoxide standard has consistently been met at this site and it is not considered a pollutant of concern either at or in the vicinity of the airport.

	On Airport (LGW3)	Standard	Standard Met?
Annual Average nitrogen dioxide Concentration	33.4	40	Yes
Nitrogen Dioxide: No. of hours over 200 $\mu\text{g m}^{-3}$	0	18	Yes
Annual Average PM ₁₀ Concentration (Volatile Correction Method)	21.9 (22.0)	40	Yes
PM ₁₀ : No. of days over 50 $\mu\text{g m}^{-3}$ (Volatile Correction Method)	6 (15)	35	Yes
All concentrations are in $\mu\text{g m}^{-3}$. Data Capture: Nitrogen Dioxide 94.7 %, PM ₁₀ 98.9 %.			

Table 1: Nitrogen Dioxide and PM₁₀ Concentrations on Airport in 2012.

20. It should be pointed out that while the LGW3 monitor is of limited use for compliance monitoring, it is of particular use for verifying the computer modelling work used to make forward predictions about air quality at the airport.
21. During 2012 there were no changes of note in the on airport sources of air pollution, aside from a small increase in passenger numbers and a small decrease in aircraft movements, and thus the results are comparable to 2011.

On Airport Pollutant Trends.

22. Figure 4 shows the 3 year rolling average nitrogen dioxide concentration at the on airport monitor LGW3, and the data from the residential monitor RG1 for comparison. The graph shows a steady improvement in nitrogen dioxide concentrations at the LGW3 monitor, with a significant improvement from 2003 onwards, followed by a subsequent increase in 2007 and 2008, while concentrations from 2009 to date continue to follow the long term downward trend.
23. The sudden fall in the annual average nitrogen dioxide concentrations in 2004 and 2005 (Table 2), which is reflected in the 3 year rolling average data (Figure 4), was noted but unexplained in the 2005 monitoring report (GP sub committee January 2007). Subsequent work indicated that the falls in 2004 and 2005 were more likely to have been due to the change in contractor servicing the equipment in 2003, than 'real' improvements in air quality on airport (GP sub committee June 2007), and this appeared to be confirmed by a rise in concentrations in 2006 when the original servicing agent was reappointed.
24. Annual mean nitrogen dioxide concentrations at LGW3 increased by 1.1 $\mu\text{g m}^{-3}$ in 2012 although the on airport increase was comparable to that seen elsewhere in Reigate and Banstead, as with the decrease of 4.5 $\mu\text{g m}^{-3}$ in 2011, and so reflects a regional increase in pollution driven by the weather and / or regional sources rather than a increase due to activities on the airport.
25. Figure 5 shows the three year rolling annual average PM₁₀ concentrations at the airport monitor, and PM₁₀ data from the residential monitor for comparison. The graph shows a steady improvement in PM₁₀ concentrations on airport until 2006, at which point concentrations remained largely static for a few years before resuming a downward trend which has continued in 2012.

⁵ 'Relevant receptors' were discussed in the outline air quality paper presented to the GP sub committee in January 2007. However, for the purposes of this of this report relevant exposure can be taken as residential housing, or in the case of the 1 hour nitrogen dioxide objective where a member of the public might be present for 1 hour or more.

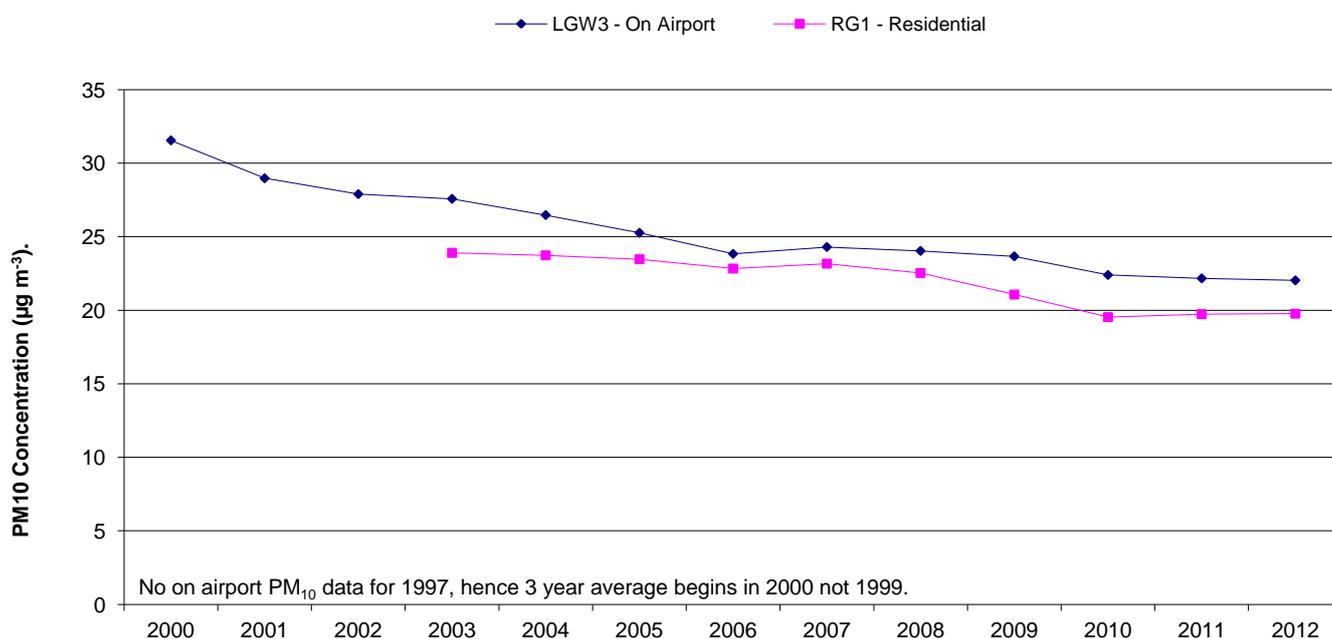
Figure 4: Three Year Rolling Annual Average Nitrogen Dioxide Concentration at LGW3, Gatwick Airport.



Table 2: Annual and Three Year Annual Average Nitrogen Dioxide Concentrations (µg m⁻³).

LGW3	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Annual Average	53.8	52.6	52.3	49.2	49.1	47.0	46.0	35.5	34.2	40.3	40.0	34.8	34.3	36.8	32.3	33.4
Data Capture	94.9	89.2	93.3	93.4	93.5	96.1	94.0	95.4	96.7	96.3	94.2	96.8	93.7	99.2	96.4	94.7
Hours Over 200 µg m ⁻³	2	0	1	1	0	0	2	0	0	0	1	0	0	0	0	0
3 Year Rolling Average	LGW3		52.9	51.4	50.2	48.5	47.4	42.9	38.6	36.7	38.2	38.4	36.4	35.3	34.5	34.2
3 Year Rolling Average	RG1						32.3	31.1	30.3	29.6	29.1	28.4	27.0	27.0	25.1	24.2

Figure 5: Three Year Rolling Annual Average PM₁₀ Concentration at LGW3, Gatwick Airport.



26. On the 8th April 2013 pier 1 was closed for redevelopment, and so 2012 is the last year for which data from LGW3 will be directly comparable to previous years, given the proximity of the LGW3 site to pier 1.

Benzene Monitoring Data.

27. The concentration of benzene is measured at one residential site (RB11) on the Horley Gardens Estate and on airport at LGW3.
28. As expected measurements met the air quality standard in 2012 (Table 3), and were slightly lower than those measured in 2011. Due to the nature of the measurement technique it is difficult to compare values over the long term, but it is worth noting that residential benzene concentrations have fallen year on year since 2007.

	Concentration ($\mu\text{g m}^{-3}$)	Standard	Standard Met?
Annual Average Benzene Concentration: Residential	1.0	5	Yes
Annual Average Benzene Concentration: On Airport	0.4	5	Yes

Table 3: Annual Average Benzene Concentrations on the Horley Gardens Estate at RB11 and Gatwick Airport (LGW3) in 2012 (Non pumped BTEX Tubes).

Additional Monitoring Data.

Ozone.

29. Ozone monitoring began to the SW of the airport in 2005 at the RG3 site in Poles Lane Crawley. The aim of this site is to monitor long term trends in ozone concentrations in the vicinity of the airport.
30. Although the airport is not responsible for local ozone pollution, ozone plays an important role in the formation of nitrogen dioxide, which is the main pollutant of concern in the vicinity of the airport. Therefore examining the long term ozone trend is important for understanding nitrogen dioxide concentrations in both the short and longer term.
31. At present there are six years of data from the ozone monitor and based on a three year rolling average the overall trend to date is flat (data not shown).
32. Compared to the air quality standards ozone concentrations failed to meet the UK ozone objective for the 7th consecutive year, although the EU standard (which is less strict) was met in 2012 (Table 4).

	Number of exceedences.	Standard Met?	
		UK ^a	EU ^b
RG3: Poles Lane Crawley.	18 / 7 ^b	No	Yes
Standards:			
UK: Daily Max. of running 8 hour mean of $100 \mu\text{g m}^{-3}$.	10 max.	-	-
EU: Daily Max. of running 8 hour mean of $120 \mu\text{g m}^{-3}$ (averaged over 3 years).	25 max.	-	-
^a in 2012			
^b The EU standard is averaged over 3 years i.e. 2010, 2011, and 2012.			

Table 4: Number of exceedences of the Ozone standard in 2012.

Summary.

33. In summary:

- i) The annual average air quality standard for nitrogen dioxide was met at relevant receptors in the vicinity of the airport during 2012 (Table 5), as were the air quality standards for other pollutants under the local authority air quality management regime (Table 5).
- ii) Ozone concentrations in the vicinity of the airport did not meet the UK air quality standard for the 7th consecutive year, although the airport is not responsible for local ozone pollution.
- iii) Trend analysis of the nitrogen dioxide concentrations at properties most at risk of breaching the air quality objective (RB59) shows that the previous downward trend levelled off in 2012, while the long term downward trend at the 'background' site (RG1) continued. The long term decrease in pollution at the background site is most likely due to improvements in road vehicle emissions, while the more recent falls at the worst case receptor(s) reflect the significant falls in aircraft movements and passenger numbers between 2008 and 2010 together with the background improvements seen at RG1. The cause of the current flat trend at the worst case receptors is unclear, although the long term downward trend at the RG1 site is in line with predictions for non airport nitrogen dioxide pollution at Gatwick and across the southeast.
- iv) The concentration of nitrogen dioxide measured on airport in 2012 at LGW3 meets the UK air quality objective of 40 $\mu\text{g m}^{-3}$. The concentrations of the other pollutants measured at LGW3 also met the relevant air quality standards.
- v) The three year rolling annual average trend analysis of the on airport nitrogen dioxide concentrations shows a decrease in concentrations between 2008 and 2012, with concentrations in 2012 the lowest to date.
- vi) The average PM₁₀ concentration measured on airport in 2012 showed a slight decrease compared to 2011, although this decrease is unlikely to be related to the decrease in aircraft movements at the airport as a similar decrease was seen off airport.

	Measured value	Standard	Standard Met?
Nitrogen Dioxide:			
Highest measured annual average residential concentration.	33	40	Yes
Annual Average nitrogen dioxide concentration Airport monitor.	33.4	40	Yes
PM₁₀:			
Annual Average PM ₁₀ Concentration: Residential Monitor. (VCM value)	19.8 (19.4)	40	Yes
PM ₁₀ : No. of days over 50 $\mu\text{g m}^{-3}$: Residential Monitor. (VCM value)	2 (7)	35	Yes
Annual Average PM ₁₀ Concentration: Airport Monitor. (VCM value)	21.9 (22.0)	40	Yes
PM ₁₀ : No. of days over 50 $\mu\text{g m}^{-3}$: Airport Monitor. (VCM value)	6 (15)	35	Yes
Benzene:			
Residential Benzene Monitor (Site RB 11).	1.0	5	Yes
Ozone:			
RG3 Monitor to SW of Airport (Number of exceedences).	18	10	No
All concentrations are in $\mu\text{g m}^{-3}$.			

Table 5: Summary of Air Quality in the Vicinity of Gatwick Airport in 2012.

Figure A.1: Passenger and Aircraft Movement Trends at Gatwick Airport.

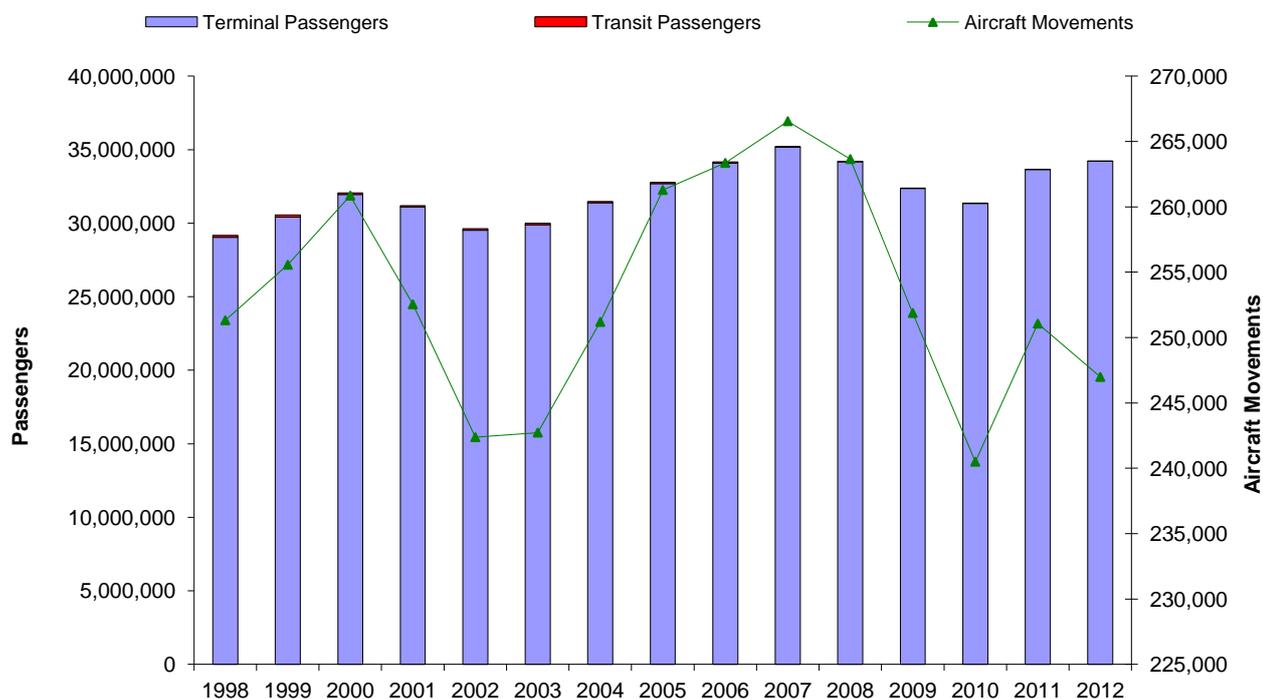


Table A.1: Annual Passenger Numbers and Aircraft Movements at Gatwick Airport.

	Number of Passengers			No. of Aircraft Movements
	Terminal	Transit	Total	
1998	29,032,838	140,292	29,173,130	251,321
1999	30,409,860	153,761	30,563,621	255,570
2000	31,947,524	119,601	32,067,125	260,859
2001	31,096,563	85,207	31,181,770	252,543
2002	29,517,894	109,515	29,627,409	242,379
2003	29,893,288	111,974	30,005,262	242,731
2004	31,391,352	75,418	31,466,770	251,195
2005	32,693,005	82,690	32,775,695	261,292
2006	34,080,345	83,234	34,163,579	263,363
2007	35,165,404	50,709	35,216,113	266,550
2008	34,162,014	43,873	34,205,887	263,653
2009	32,360,773	31,747	32,392,520	251,879
2010	31,342,263	33,027	31,375,290	240,500
2011	33,643,989	30,275	33,674,264	251,067
2012	34,218,668	17,314	34,235,982	246,987

Data from Civil Aviation Authority. www.caa.co.uk/default.aspx?catid=80&pagetype=90

Appendix B: Summary of Annual Monitoring Results 1999 to 2012.

Nitrogen Dioxide

Site	Parameter	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
RG1	Ann. Average ($\mu\text{g m}^{-3}$)	-	-	34.1	31.3	31.4	30.5	29.1	29.4	28.9	26.9	25.3	28.9	21.1	22.7
RG2	Ann. Average ($\mu\text{g m}^{-3}$)	-	-	-	-	-	33.8	34.3	32.4	33.8	32.4	31.3	31.2	28.8	31.2
RG3	Ann. Average ($\mu\text{g m}^{-3}$)	-	-	-	-	-	-	-	19.4	20.9	18.9	18.2	20.5	17.8	23.2
LGW3	Ann. Average ($\mu\text{g m}^{-3}$)	52.3	49.2	49.1	47.0	46.0	35.5	34.2	40.3	40	34.8	34.3	36.8	32.3	33.4
RB59	Ann. Average ($\mu\text{g m}^{-3}$)	-	-	-	-	40	39	34	37	38	35	32	32	26	32
RG1	Data Capture (%)	-	-	99.0	100.0	99.7	99.6	98.0	98.5	99.1	99.4	100.0	91.4	99	99.5
RG2	Data Capture (%)	-	-	-	-	-	89.0	97.0	96.0	96.3	92.8	95.0	92.4	88.5	85.1
RG3	Data Capture (%)	-	-	-	-	-	-	-	97.8	98.8	99.2	99.0	97.5	92.3	99.4
LGW3	Data Capture (%)	93.3	93.4	93.5	96.1	94.0	95.4	96.7	96.3	94.3	96.8	93.7	99.2	96.4	94.7
RB59	Data Capture (%)	-	-	-	-	91.6	100	91.6	100	100	100	100	100	91.6	100
RG1	Hours Over $200 \mu\text{g m}^{-3}$	-	-	0	0	0	0	0	0	0	0	0	0	0	0
RG2	Hours Over $200 \mu\text{g m}^{-3}$	-	-	-	-	-	0	0	0	0	0	0	0	0 ^b	0 ^b
RG3	Hours Over $200 \mu\text{g m}^{-3}$	-	-	-	-	-	-	-	0	0	0	0	0	0	0
LGW3	Hours Over $200 \mu\text{g m}^{-3}$	1	1	0	0	2	0	0	0	1	0	0	0	0	0
RB59	Hours Over $200 \mu\text{g m}^{-3}$	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Particulate Matter (PM₁₀)

RG1	Ann. Average ($\mu\text{g m}^{-3}$)	-	-	22.8	23.2	25.7	22.3	22.4	23.8	23.3	20.5	19.4	18.7 ^a	21.1	19.5
	Ann. Average VCM* ($\mu\text{g m}^{-3}$)								21.2	22.0	19.7	18.0	19.7	21.7	19.4
LGW3	Ann. Average ($\mu\text{g m}^{-3}$)	31.0	28.7	27.2	27.8	27.8 ^{***}	23.8 ^{***}	24.2 ^{***}	23.3	25.3	23.4	22.3	21.6	22.7	21.9
	Ann. Average VCM* ($\mu\text{g m}^{-3}$)								21.1	23.7	21.8	20.9	22.0	23.0	22.0
RG1	Data Capture (%)	-	-	99.7	100	99.5	100	100	99.4	99.3	99.0	100	73.1	97.8	98.1
	Data Capture VCM** (%)								96.4	98.1	99.0	99.1	73.1	98.6	98.1
LGW3	Data Capture (%)	91.5	92.9	97.3	99.2	97.3	97.3	97.3	96.2	95.1	93.4	85.7	97.2	100	98.9
	Data Capture VCM** (%)								93.6	93.6	93.4	85.7	97.2	99.5	98.9
RG1	No. days over $50 \mu\text{g m}^{-3}$	-	-	6	6	16	0	3	5	9	4	0	0 ^b	1	2
	No. days over $50 \mu\text{g m}^{-3}$ (VCM)								6	18	5	2	0 ^b	9	7
LGW3	No. days over $50 \mu\text{g m}^{-3}$	35	28	20	17	31 ^{***}	10 ^{***}	9 ^{***}	7	18	13	0 ^b	3	1	6
	No. days over $50 \mu\text{g m}^{-3}$ (VCM)								10	23	16	2 ^b	4	19	15

Locations:

RG1 is located on the Horley Gardens Estate in Michael Crescent (NE of the Airport).

RG2 is located on the Horley Gardens Estate in The Crescent (NE of the Airport).

RG3 is located to the SW of the airport in Poles Lane, Crawley.

RB59 is a diffusion tube (not a real time site) located at the southern most end of the Horley Gardens Estate to the NE of the Airport.

*for details on volatile correction methodology see www.volatile-correction-model.info. Spreadsheets downloaded 05/05/09 for values to 2009. From 2009 data direct from London Air Website www.londonair.org.uk.

** as the VCM requires data from three other sites VCM data capture can be lower than from the site of interest.

*** figures have been revised down as data originally supplied for these 3 years was incorrect. Correction made in July 2010 report.

^a data capture under 75 %. Therefore these values cannot be compared to the relevant air quality standard.

^b data capture under 90 %. Therefore these values cannot be compared to the relevant air quality standard. Data shown will be minimum number of hours or days depending on standard.

Abbreviations and Definitions

AQMA	Air Quality Management Area.
CO	Carbon Monoxide.
GAL	Gatwick Airport Limited.
m ³	cubic metre.
mg	milligram (1 thousandth of a gram).
NETCEN	National Environmental Technology Centre, UK.
ng	nanogram (1 billionth of a gram).
nm	nanometre (1 billionth of a metre or 1 millionth of a millimetre)
NO ₂	Nitrogen Dioxide.
NO _x	Oxides of Nitrogen (mainly NO and NO ₂ expressed as NO ₂ equivalent).
O ₃	Ozone.
PM	Particulate Matter.
PM ₁₀	Essentially particles under 10 µm in diameter. Officially defined as the size fraction below 10µm in aerodynamic diameter, which has a cut off point at 50% of the particles which are 10µm in aerodynamic diameter.
ppb	part(s) per billion.
ppm	part(s) per million.
TEOM	Tapered Element Oscillating Microbalance. (Device for measuring PM ₁₀ concentrations in real time).
µg	microgram (1 millionth of a gram).
µg/m ³	microgram(s) per cubic metre
µg m ⁻³	microgram(s) per cubic metre, This scientifically is the correct form to use rather than µg/m ³ , though either can be used.
µm	micrometre (1 millionth of a metre or 1 thousandth of a millimetre)
VCM	Volatile Correction Method. (used to correct PM ₁₀ measurements made using a TEOM. This results in data equivalent to measurements made using the European Union's 'preferred' PM ₁₀ monitoring technique.