Ultrafine Particles in the Vicinity of Gatwick: Report by Reigate and Banstead BC.

1. As reported to the steering group in June 2012 airports have been identified as a significant source of ultrafine particulate pollution[1,2] i.e. particles that are under 0.1 µm in aerodynamic diameter, and that a large proportion of these particles are generated during take-off with the resulting 'spike' in ultrafine particles detected at least 600 m from the airport based on studies at Los Angeles Airport (LAX).

2. As research over the past 10 to 15 years has continually indicated that the finer combustion derived particle fractions, including particles under 0.1 µm in (aerodynamic) diameter, tend to have the biggest biological effects it was agreed that any further work in this area would be reported back to the steering group.

3. Heathrow began short term on and off airport monitoring of ultrafine particles in 2016 which continued in 2019, although to date it is unclear if any measurements of ultrafine particles have been made on airport at Gatwick e.g. as part of equipment tests or inter comparison studies.

4. Gatwick have said that. *'To date, Gatwick is not undertaking UFP monitoring on airport as monitoring standards are still developing, however GAL is participating in an industry project to test suitable affordable and reliable equipment for airport sites.'*

5. Off airport following a successful research bid by King's College and Imperial College in 2017 measurements of ultrafine particle concentrations in the vicinity of Gatwick began in June 2018.

6. Measurements were made initially at the RG1 site for three months and then at the RG3 site to the SW of the airport for three months. Following discussions with the research groups Reigate and Banstead along with Leicester University agreed to joint fund work for a further six months until early July 2019, which was subsequently extended to September 2019.

7. The university research project is still on going as the Gatwick work is one component of a much larger project, and at present the detailed data analysis from this work is likely to be published in 2021. However, the data from the 2019 monitoring at RG1 is shown below (Table 1).

Site	Distance from Source.	Data Capture (%)	Mean Particle Count (Particles / cm^3)	Geometric Mean Diameter (nm)
London – Background (Honor Oak)	n/a	54 %	4,521	55
RG1 Horley	350 m A23 / 610 m Airport	91 %	8,953	50
London – Marylebone Road	1.5 m	27 %	11,587	46
RG1 Horley (Southerly winds only)	As above	As above	14,498	36

Table 1: Mean Particle Number Concentrations 25th January to 10th September 2019.

8. Table 1 indicates that particle number concentrations at the RG1 site on the Horley Gardens Estate are around double those seen at the background site in London, while the geometric mean particle diameter at RG1 is also smaller.

9. However, particle number concentrations at RG1 on average are slightly lower than those measured at Marylebone Road in London, although it is worth noting that the Marylebone Road site is only 1.5 m from the road edge compared to 350 m at RG1 or 610 m from the airport itself. Also as the RG1 monitor is located towards the centre of the Horley Gardens Estate a number of residential premises are also far closer to the airport e.g. RG2(6) and RB59, than the RG1 site and so are likely to see higher exposures than recorded at RG1.

[1] Atmospheric Environment 45 (2011) pp.6526 – 6533.
[2] Atmospheric Environment 50 (2012) pp.328 – 337.

10. In addition to counting the number of particles in the atmosphere the equipment[3] also gives a size distribution for the particles in the range 14 to 661 nm (1 nm = 0.001 µm or 0.000001 mm). As shown in Table 1 the particle size on average at RG1 is smaller than that at the London background site, but slightly larger than those measured on Marylebone Road.

11. However, the average particle size and number varies quite markedly depending on the wind direction at RG1 (Table 2), with a significant increase in particle number and reduction in particle size when winds are from the airport.

Wind Direction	Hours	Mean Particle Count (Particles / cm^3)	Geometric Mean Diameter (nm)
North	631	6,149	63
East	1150	6,018	68
South (from the airport)	1689	14,498	36
West	1550	6,123	48

Table 2: Mean Particle Number Concentrations by Wind Direction - 25th January to 10th September 2019.

12. While Reigate and Banstead was unable to secure sufficient funding from GAL or other sources to continue monitoring this pollutant in Horley, it is worth noting that work elsewhere is beginning to show potential health effects from exposure to ultrafine particulate pollution.

13. Research around Schiphol Airport[4] suggests children suffer more respiratory complaints on days with high exposures to ultrafine particles, while researchers in Canada[5] found a significant association between ultrafine particle exposure in general and an increase in incidence of brain tumours in adults.

[3] TSI SMPS 3080 with DMA 3081, and TSI CPC 3775.
[4] Janssen, N.A.H. *et al.* (2019) Research into the health effects of short-term exposure to ultrafine particles in the vicinity of Schiphol Airport. RIVM report 2019-0084 https://www.rivm.nl/en/bibcite/reference/323511
[5] Weichenthal, S. *et al.* (2020) Within-City Spatial Variations in Ambient Ultrafine Particle Concentrations and Incident Brain Tumors in Adults. *Epidemiology* v.31(2) pp.177-183.

Abbreviations and Definitions.

m^3	cubic metre.
mg	milligram (1 thousandth of a gram).
ng	nanogram (1 billionth of a gram).
ng/m^3	nanogram(s) per cubic metre.
$ng\ m^{-3}$	nanogram(s) per cubic metre. This scientifically is the correct form to use rather than ng/m^3, though either can be used.
nm	nanometre (1 billionth of a metre or 1 millionth of a millimetre)
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.
$PM_{2.5}$	Essentially particles under 2.5 µm in diameter.
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.
Ultrafines	Particles under 0.1 µm (or 100 nm) in diameter.
µm	micrometre (1 millionth of a metre or 1 thousandth of a millimetre)