APPENDIX C

Air Quality Action Plan

Technical Appendices

December 2016

Content of Appendices

Appendix 1 – National Air Quality Objectives

The air quality objectives applicable to London are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table 1. This table shows the objectives in units of micrograms per cubic metre $\mu g.m^{-3}$ and for carbon monoxide in units of milligrams per cubic metre $mg.m^{-3}$). The number of exceedences in each year that are permitted are also listed where applicable).

Table 1 Air Quality Objectives included in Regulations for the purpose of London Local Air Quality Management in London

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu g.m^{-3}$	Running annual mean	31.12.2003
	5.00 $\mu g.m^{-3}$	Annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g.m^{-3}$	Running annual mean	31.12.2003
Carbon monoxide	10 $mg.m^{-3}$	Running 8-hour mean	31.12.2003
Lead	0.50 $\mu g.m^{-3}$	Annual mean	31.12.2004
	0.25 $\mu g.m^{-3}$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g.m^{-3}$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g.m^{-3}$	Annual mean	31.12.2005
Particulate Matter (PM_{10}) (gravimetric)	50 $\mu g.m^{-3}$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g.m^{-3}$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g.m^{-3}$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g.m^{-3}$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g.m^{-3}$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

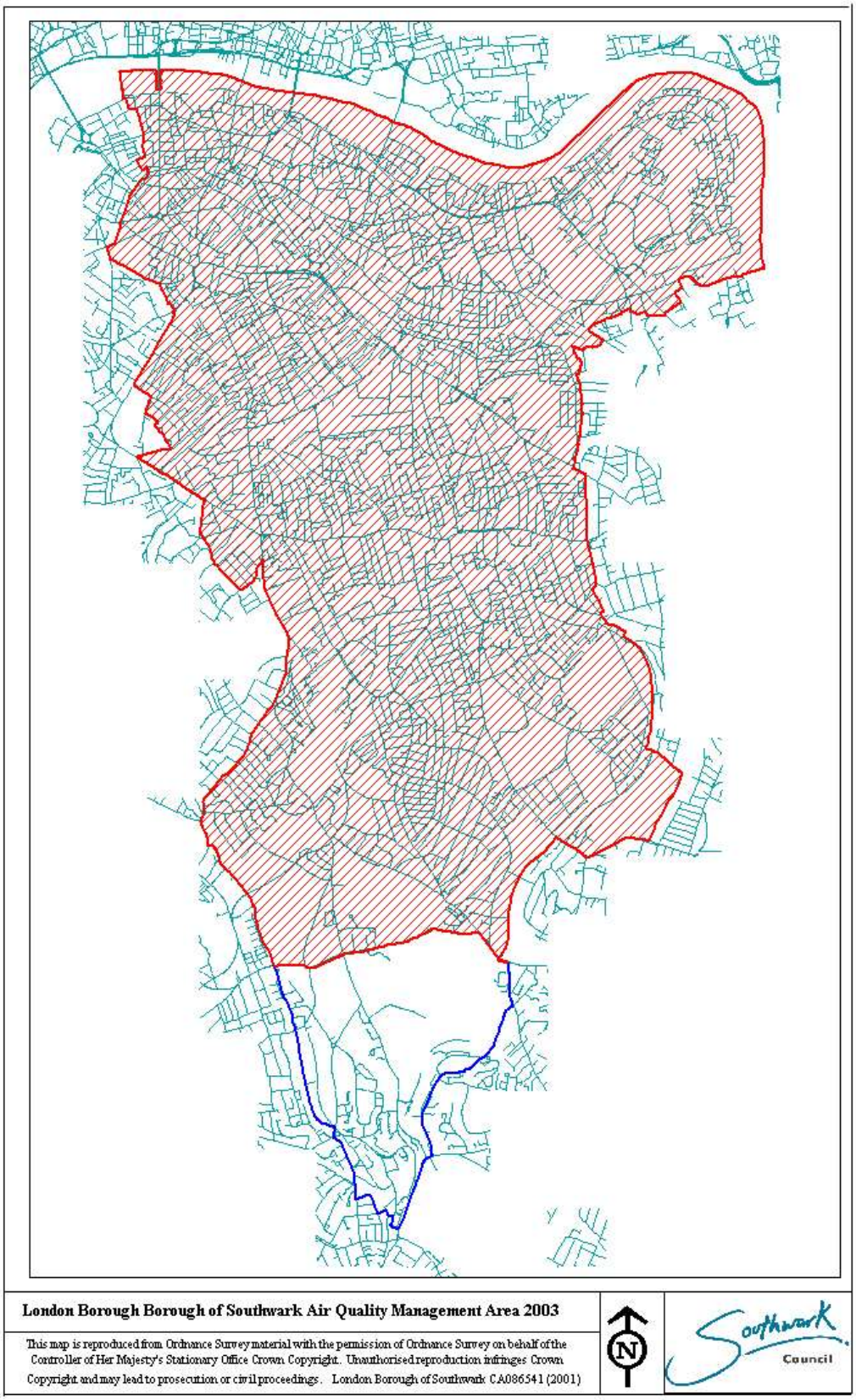


Figure 1 **Map of Air Quality Management Area in the L.B. Southwark**

Appendix 2 – Health Impacts of Air Pollution

Introduction

The health impacts of air pollution are varied, ranging from coughing, worsening of asthma, changes in lung function, increased hospital admissions for respiratory and cardiovascular disease and death.

Meta analysis of several studies provides the evidence of a statistically significant effect. This meta analysis also provides an estimate of the magnitude of the effect. The results are usually expressed as a proportional increase in effects for a $10\mu g.m^{-3}$ change in exposure. For an example, the overall increase in all-cause deaths from an increase in exposure to $PM_{2.5}$ is 6% per $10\mu g.m^{-3}$ change in the annual mean concentration.

In March 2015 the Committee on the Medical Effects of Air Pollutants concluded there is evidence of association of ambient concentrations of NO_2 with a range of effects on health. Studies have shown that to some extent, NO_2 acts as a marker for the effects of other traffic-related pollutants. The epidemiological and mechanistic evidence now suggests that it would be sensible to regard NO_2 as causing some of the health impact found to be associated with it in epidemiological studies.

In July 2015 King's College London calculated that the total mortality burden of long-term exposure to NO_2 is estimated to be up to 88,113 life-years lost, equivalent to 5,879 deaths at typical ages (assuming the WHO value of up to a 30% overlap between the effects of $PM_{2.5}$ and NO_2). Some of this effect may be due to other traffic pollutants. The total mortality burden of anthropogenic $PM_{2.5}$ for the year 2010 is estimated to be 52,630 life-years lost, equivalent to 3,537 deaths at typical ages. The total mortality burden in 2010 from $PM_{2.5}$ and NO_2 can be added to give a range from the 52,630 life-years lost, equivalent to 3,537 deaths at typical ages from $PM_{2.5}$ alone (if only including the most established effects) to as much as 140,743 life-years lost, equivalent to 9,416 deaths at typical ages (assuming a 30% overlap between the effects of $PM_{2.5}$ and NO_2 and comparing with a zero concentration of NO_2).

A study in East London[1] found that traffic-related air pollutants have adverse effects on respiratory and allergic symptoms in school children in the area. This study also demonstrated that was a reduction of lung Forced Vital Capacity with increased exposure to traffic derived pollutants.

[1] Wood HE, Marlin N, Mudway IS, Bremner SA, Cross L, Dundas L et al. (2015) Effects of air pollution and the Introduction of the Low Emission Zone on Prevalence of Respiratory and Allergic Symptoms in Schoolchildren in East London: A Sequential Cross-Sectional Study. Plos One 10(8): e0109121. Doi 10.1371/journal.pone.0109121

The table below shows the summary of the sources and impact of pollutants found in an urban area.

Pollutant	**Sources**	**Health effects**
Nitrogen dioxide	Road transport (especially diesel vehicles), domestic boilers, power stations and industry	Lung irritation and damage
Sulphur dioxide	Power stations, domestic boilers, industry	Coughing, irritation and narrowing of airways. Can make asthma and bronchitis worse
Fine Particulates (PM_{10} and $PM_{2.5}$)	Road transport (mainly diesel vehicles and tyre and brake wear), power stations, domestic boilers	Increased chances of respiratory disease, lung damage, cancer and premature death
Ozone	Produced when sunlight reacts with vehicle exhaust fumes	Irritation to eyes, nose and throat. Can damage lungs and airways

Appendix 3 – Air Monitoring & Modelling Results

Introduction

This section presents the historical and up to date data from the continuous monitoring stations within the Southwark area for Nitrogen Dioxide (NO_2) and Particulate Matter (PM_{10}). The Authority does not present monitor for $PM_{2.5}$ so the average data for all of the London sites has been presented.

After the monitoring data section, there are the modelled annual means for NO_2 , PM_{10} & $PM_{2.5}$ concentrations for the Greater London Area in 2013 maps. The following maps show the modelled annual mean concentrations for 2013 for the Borough.

The final part of this appendix outlines the GLA focus areas in the Greater London and in the Southwark and the areas which are on the border of the borough.

Nitrogen Dioxide

Site ID	Site type	Valid data capture for monitoring period % [a]	Valid data capture 2015 % [b]	Annual Mean Concentration (µg.m^{-3})						
				2009	2010	2011	2012	2013	2014	2015
SWK1[2]	Urban Background	N / A	N / A	**49** (44%)	N / A	N / A	N / A	N / A	N / A	N / A
SWK5	Roadside	69	69	N / A	N / A	**46** (73%)	**52** (80%)	**55** (>90%)	38 (32%)	**42** (69%)
SWK6	Urban Background	80	80	N / A	N / A	N / A	N / A	**42** (85%)	37 (84%)	**41**(80%)
CP1[3]	Roadside	N / A	N / A	**49** (93%)	**47** (56%)	N / A	N / A	N / A	N / A	N / A

Table 2 Annual Mean NO_2 Ratified and Bias-adjusted Monitoring Results (µg.m^{-3})

Notes: Exceedence of the NO_2 annual mean AQO of 40µgm^{-3} are shown in **bold**.
NO_2 annual means in excess of 60µg m^{-3}, indicating a potential exceedence of the NO_2 hourly mean AQS objective are shown in bold and underlined.

The above data shows that at both stations the annual mean concentration is exceeding the objective of 40µg.m^{-3} since 2011. The trends for the monitoring stations in the Southwark area can be seen in Figure 2 below.

[2] This air quality monitoring station was situated at Larcom Street, this station closed in June 2009, due to the council building being disposed off

[3] This air quality monitoring station was installed by a collaboration of Local Authorities (L.B. Bromley, L.B. Croydon L.B. Lambeth, L.B. Lewisham and L.B. Southwark). This station was closed in July 2010 due to reduction in resources to the Local Authorities.

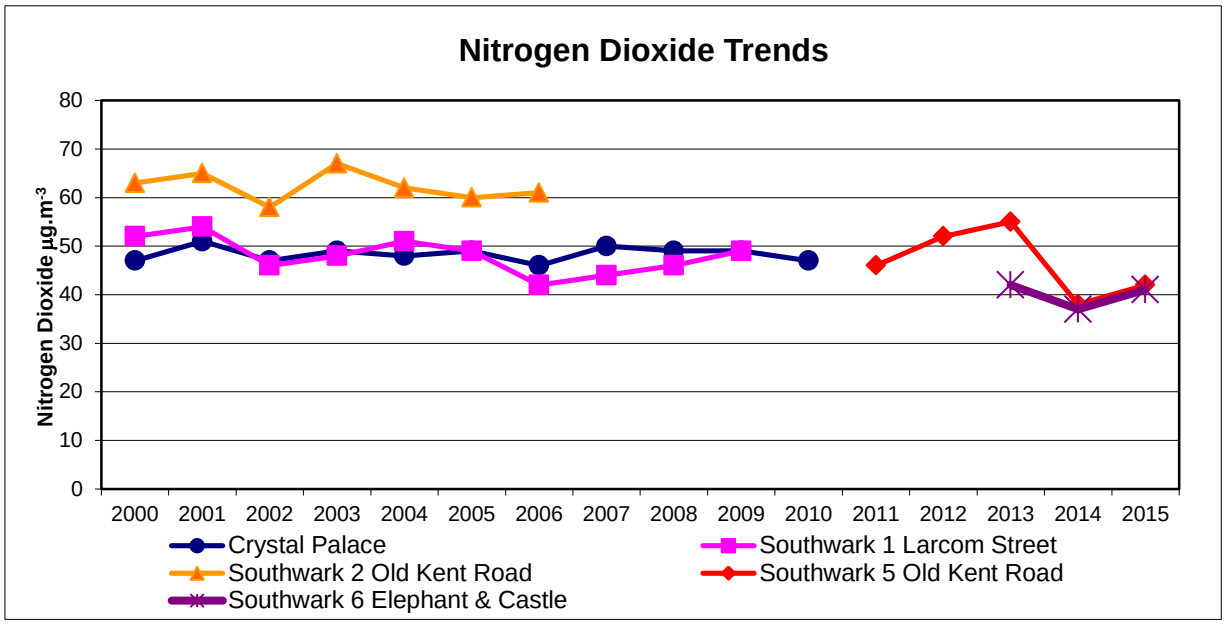


Figure 2 Trends in Annual Mean NO_2 Concentrations at the Borough's Automatic Monitoring Sites

Figure 3 below shows the mean results from all roadside and background monitoring stations within the London Air Quality Network[4]. This shows that the trend for the background sites is showing a gradual reduction to below the objective. However the roadside locations are not reducing and exceed the objective in the region of 7µg.m^{-3} to 20µg.m^{-3}.

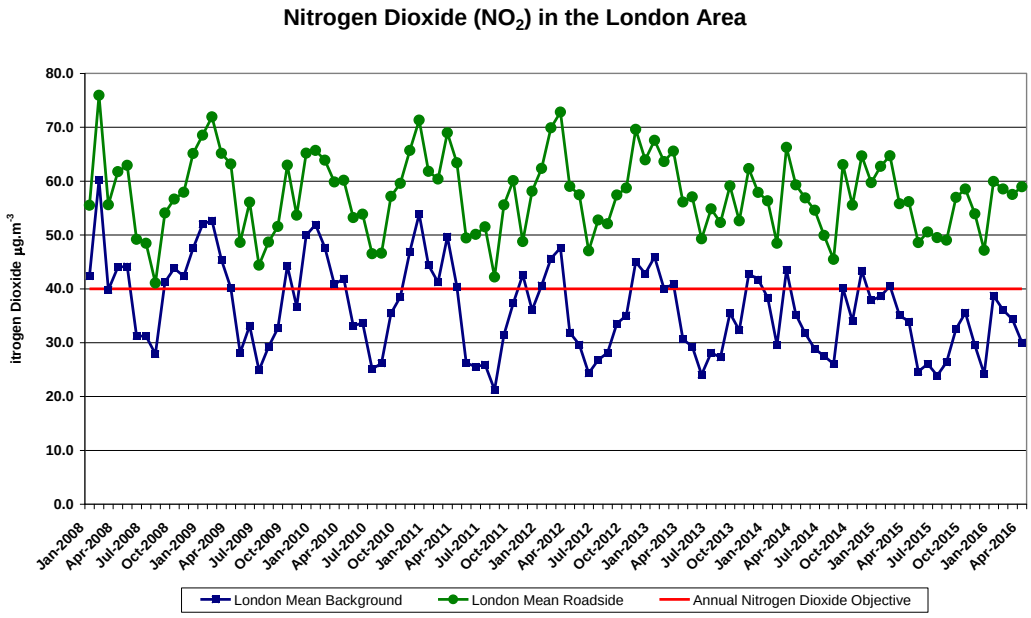


Figure 3 Trends of the monthly mean Nitrogen Dioxide concentrations at roadside and background sites in the London area

[4] London Datastore - London Average Air Quality Levels accessed at http://data.london.gov.uk/dataset/london-average-air-quality-levels

Table 3 Annual Mean PM_{10} Automatic Monitoring Results ($\mu g\ m^{-3}$)

Site ID	Valid data capture for monitoring period %	Valid data capture 2015 %	Annual Mean Concentration ($\mu g.m^{-3}$)						
			2009	2010	2011	2012	2013	2014	2015
SWK1	N / A	N / A	22 (44%)	N / A	N / A	N / A	N / A	N / A	N / A
SWK5	60	60	N / A	29 (8%)	27 (80%)	25 (82%)	30 (85%)	23	21
SWK6	77	77	N / A	N / A	N / A	N / A	23 (80%)	19	20
CP1	N / A	N / A	24(80%)	23 (55%)	N / A	N / A	N / A	N / A	N / A

Notes: Exceedence of the PM_{10} annual mean AQO of $40\mu gm^{-3}$ are shown in **bold**.

The PM_{10} annual mean concentrations at the monitoring stations have met the national air quality objectives. The downward trend of the PM_{10} annual mean concentrations at the monitoring stations is shown in Figure 4. The trends for all the London Air Quality Network roadside and background monitoring stations can be seen in Figure 5, this shows that concentrations are generally below the objective level.

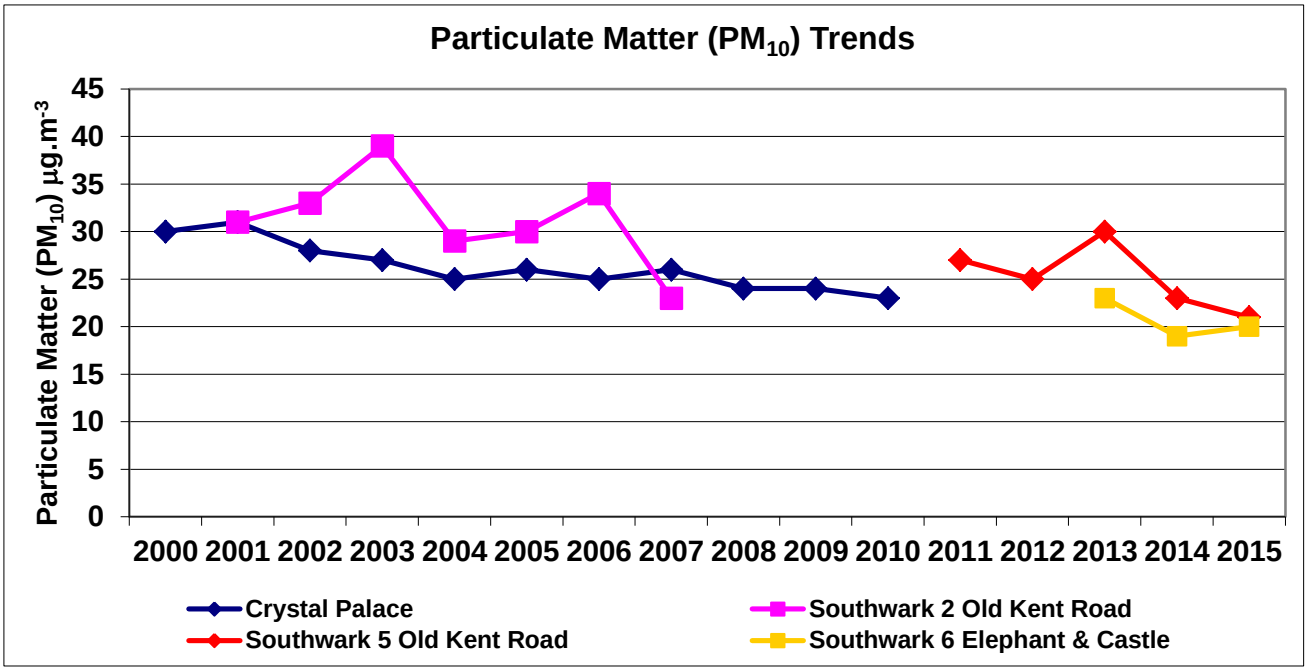


Figure 4 Trends in Annual Mean PM_{10} Concentrations of the Authority's PM_{10} monitoring stations

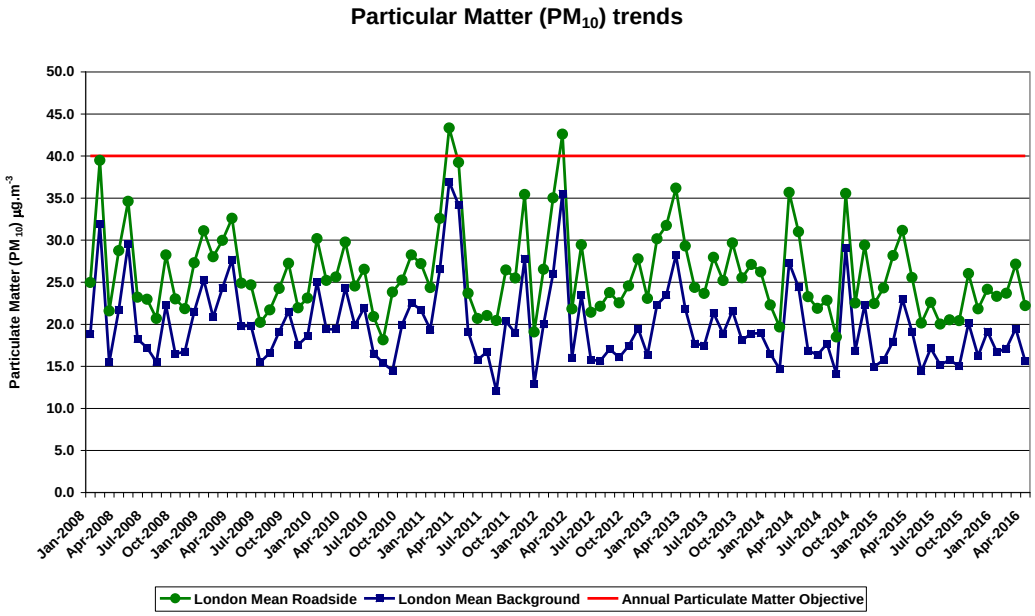


Figure 5 **Trends of the monthly mean Particulate Matter (PM10) concentrations at roadside and background sites in the London area.**

Particulate Matter ($PM_{2.5}$)

The London Borough of Southwark does not monitor for $PM_{2.5}$ in the Borough. Figure 6 shows the concentrations of all the $PM_{2.5}$ roadside and background monitors in the London Air Quality Network. There appears to be a downward trend in the measured concentrations.

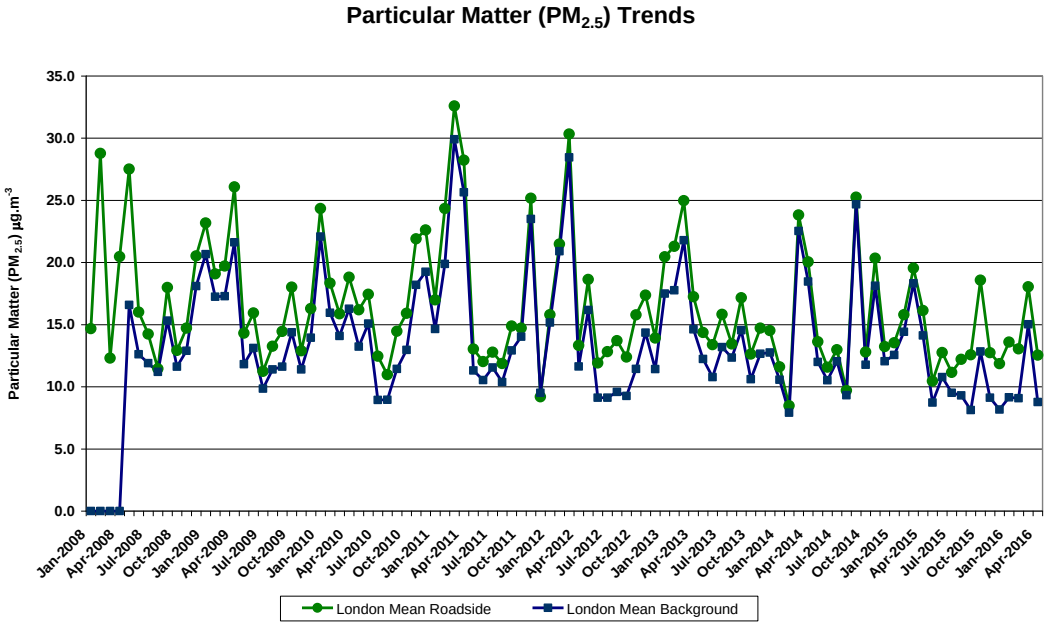
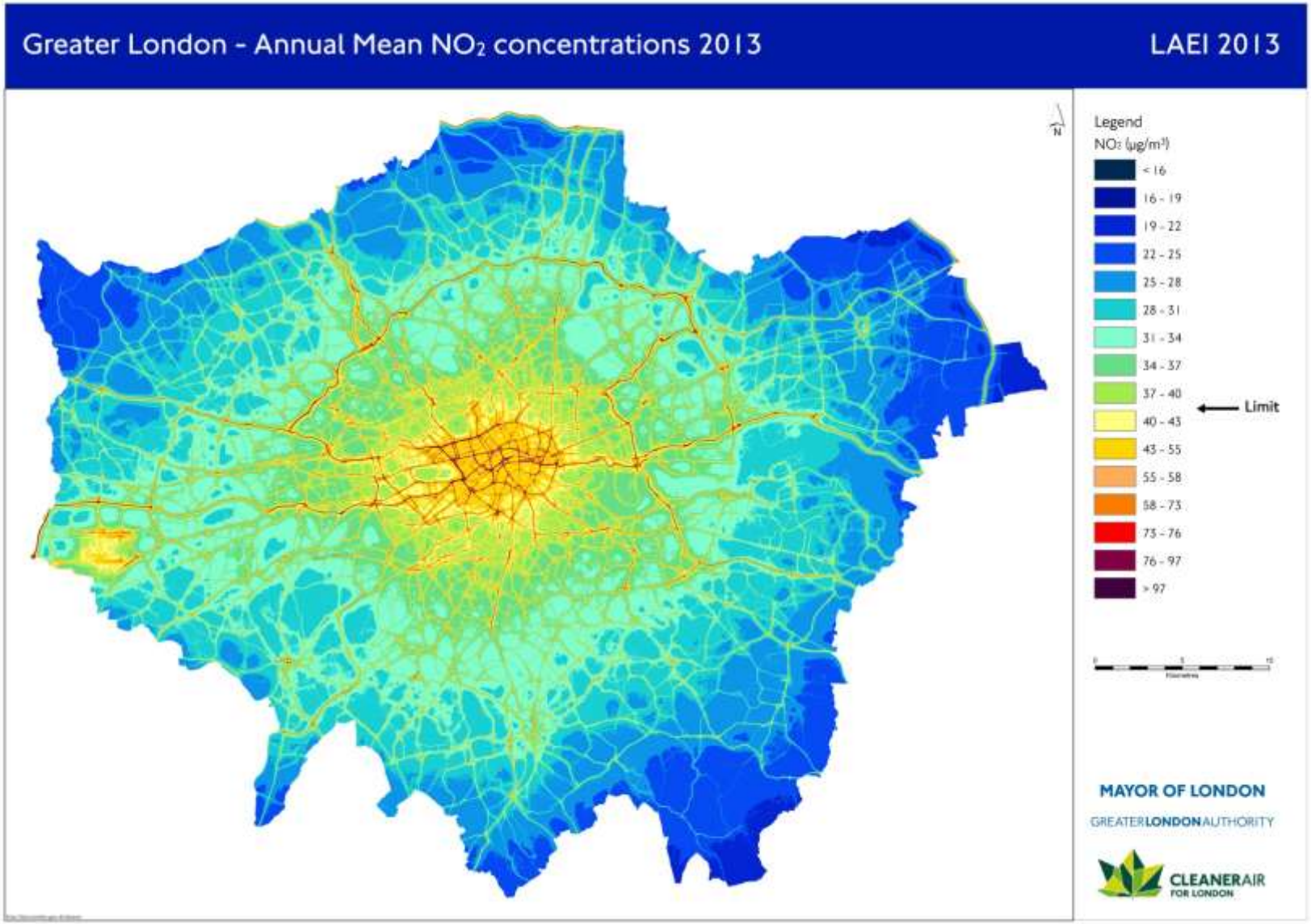
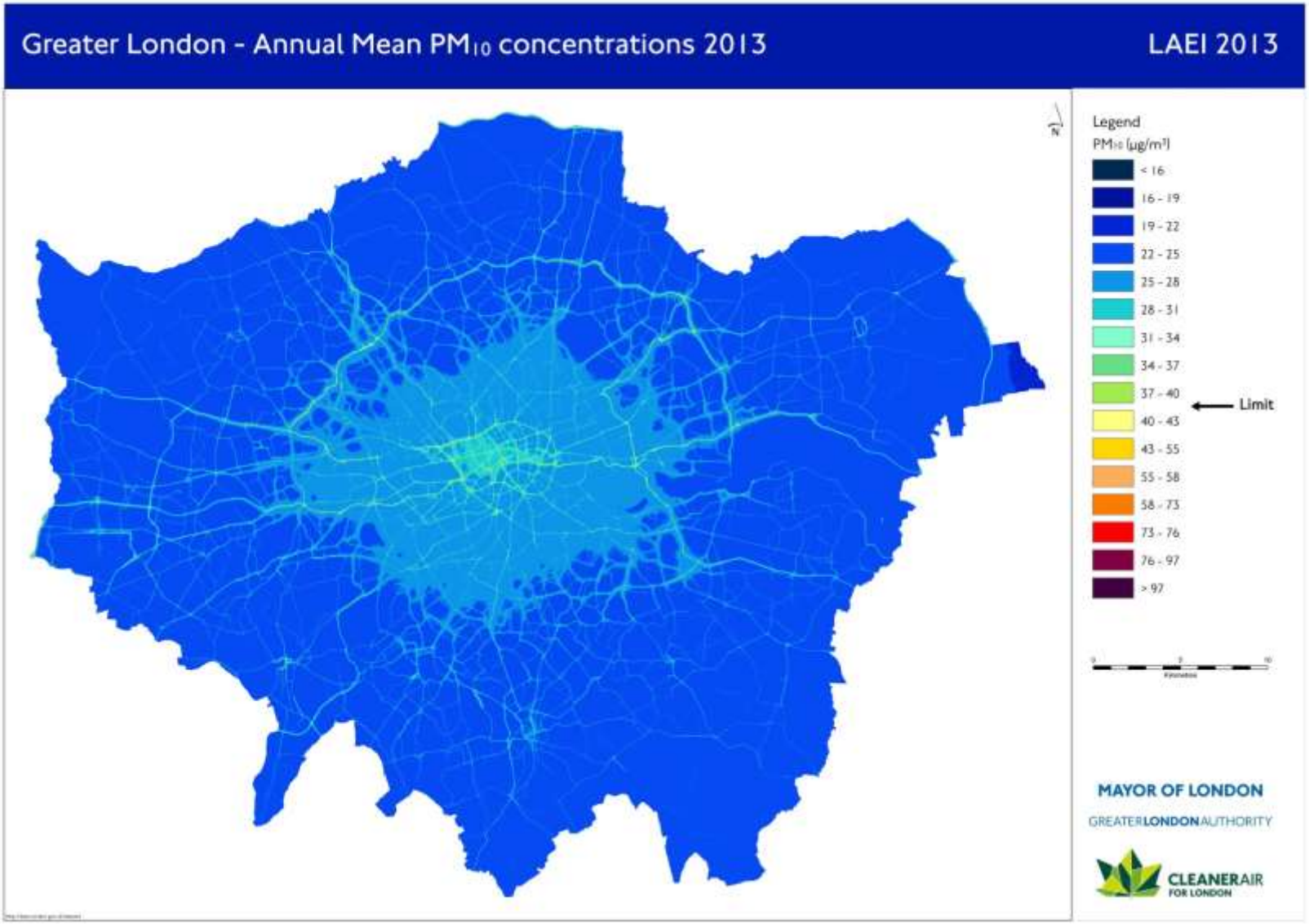
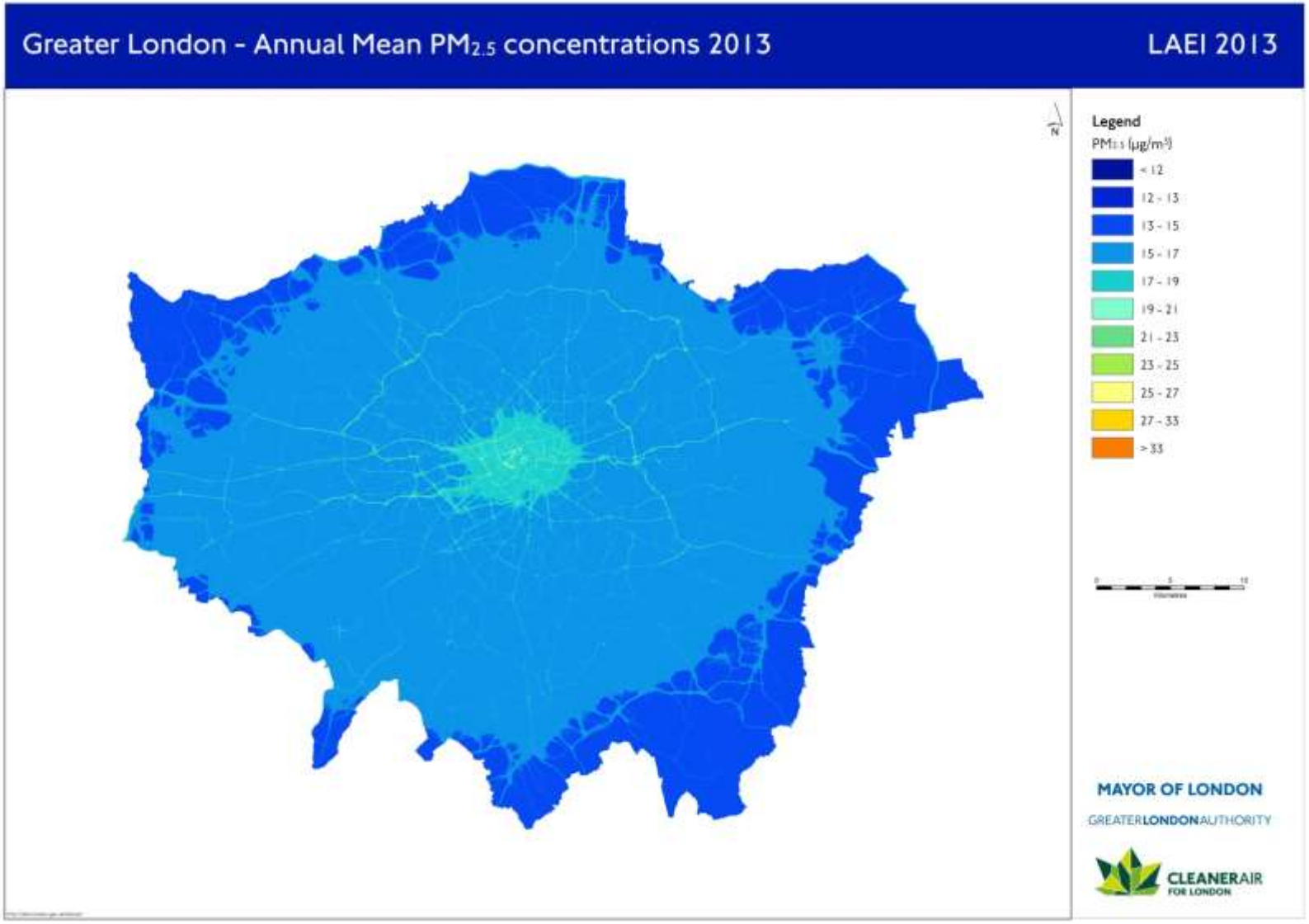
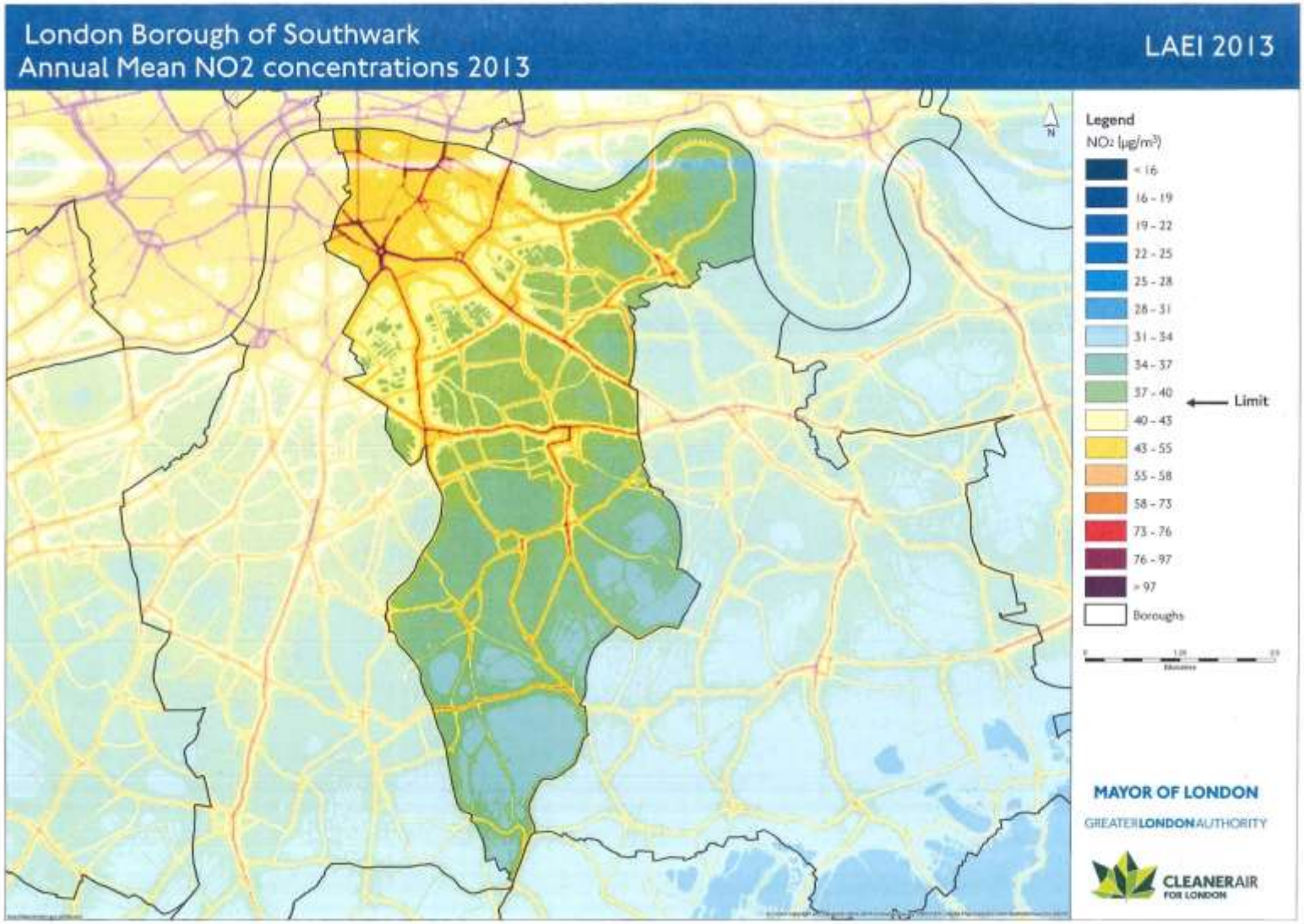


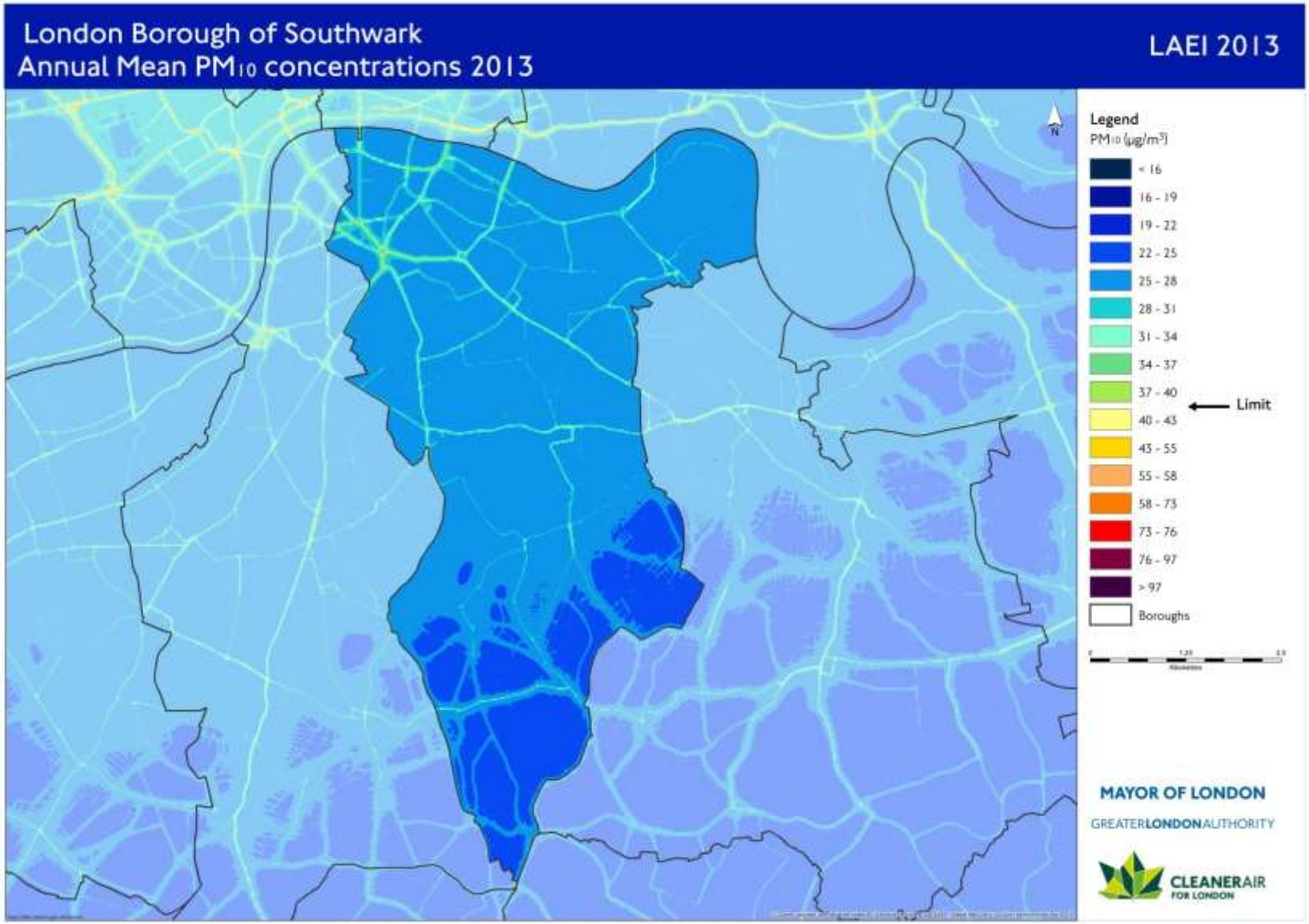
Figure 6 **Trends of the monthly mean Particulate Matter ($PM_{2.5}$) concentrations at roadside and background sites in the London area.**
Source GLA accessed at **http://data.london.gov.uk/dataset/london-average-air-quality-levels**

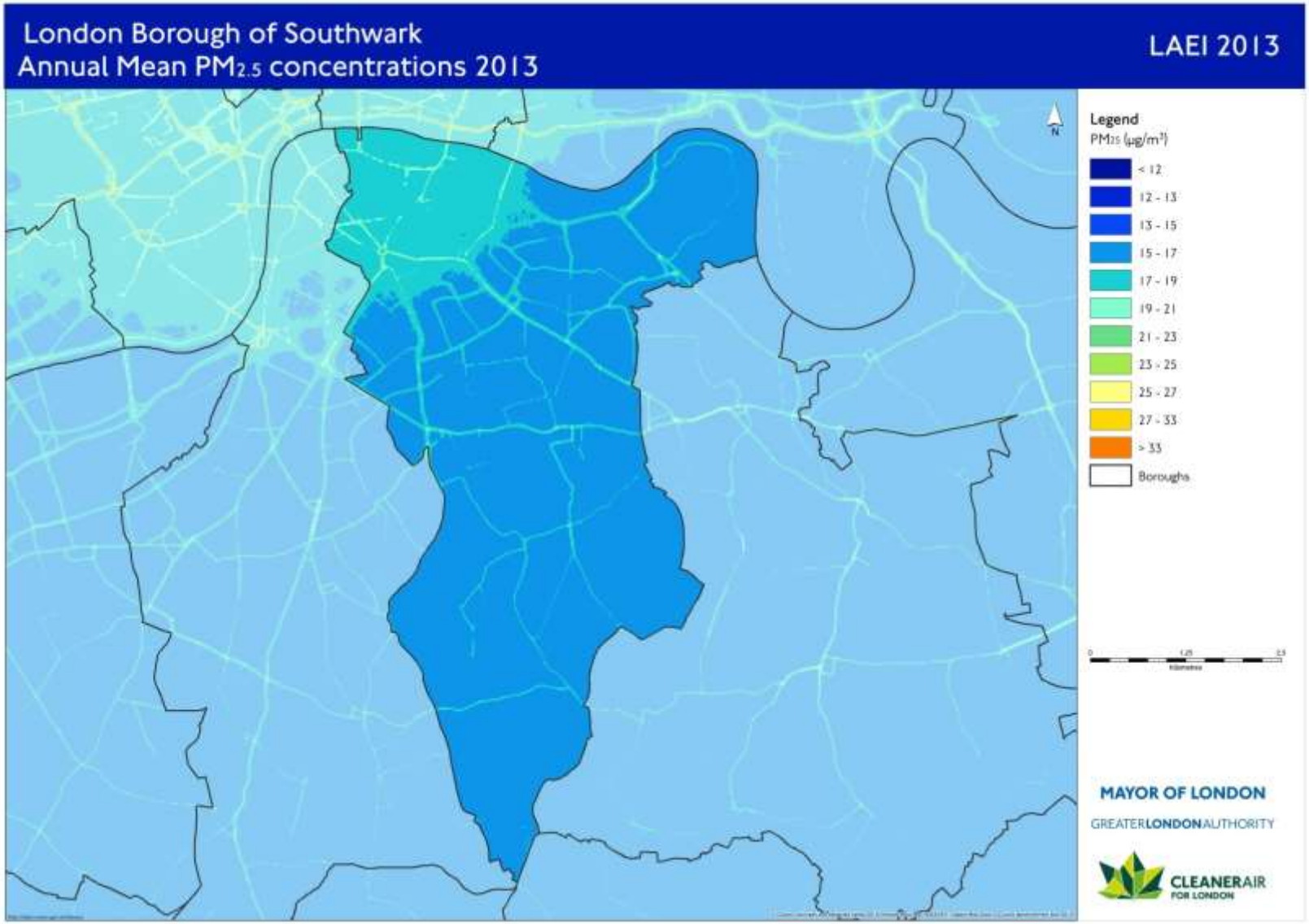

Greater London - Annual Mean NO2 concentrations 2013
LAEI 2013
N
Legend
NO2 (µg/m3)
< 16
16 - 19
19 - 22
22 - 25
25 - 28
28 - 31
31 - 34
34 - 37
37 - 40
Limit
40 - 43
43 - 55
55 - 58
58 - 73
73 - 76
76 - 97
> 97
MAYOR OF LONDON
GREATERLONDONAUTHORITY
CLEANERAIR
FOR LONDON


Greater London - Annual Mean PM10 concentrations 2013
LAEI 2013
Legend
PM10 (µg/m³)
< 16
16 - 19
19 - 22
22 - 25
25 - 28
28 - 31
31 - 34
34 - 37
37 - 40
Limit
40 - 43
43 - 55
55 - 58
58 - 73
73 - 76
76 - 97
> 97
MAYOR OF LONDON
GREATERLONDONAUTHORITY
CLEANERAIR FOR LONDON


Greater London - Annual Mean PM2.5 concentrations 2013
LAEI 2013
Legend
PM2.5 (µg/m3)
< 12
12 - 13
13 - 15
15 - 17
17 - 19
19 - 21
21 - 23
23 - 25
25 - 27
27 - 33
> 33
MAYOR OF LONDON
GREATERLONDONAUTHORITY
CLEANERAIR FOR LONDON

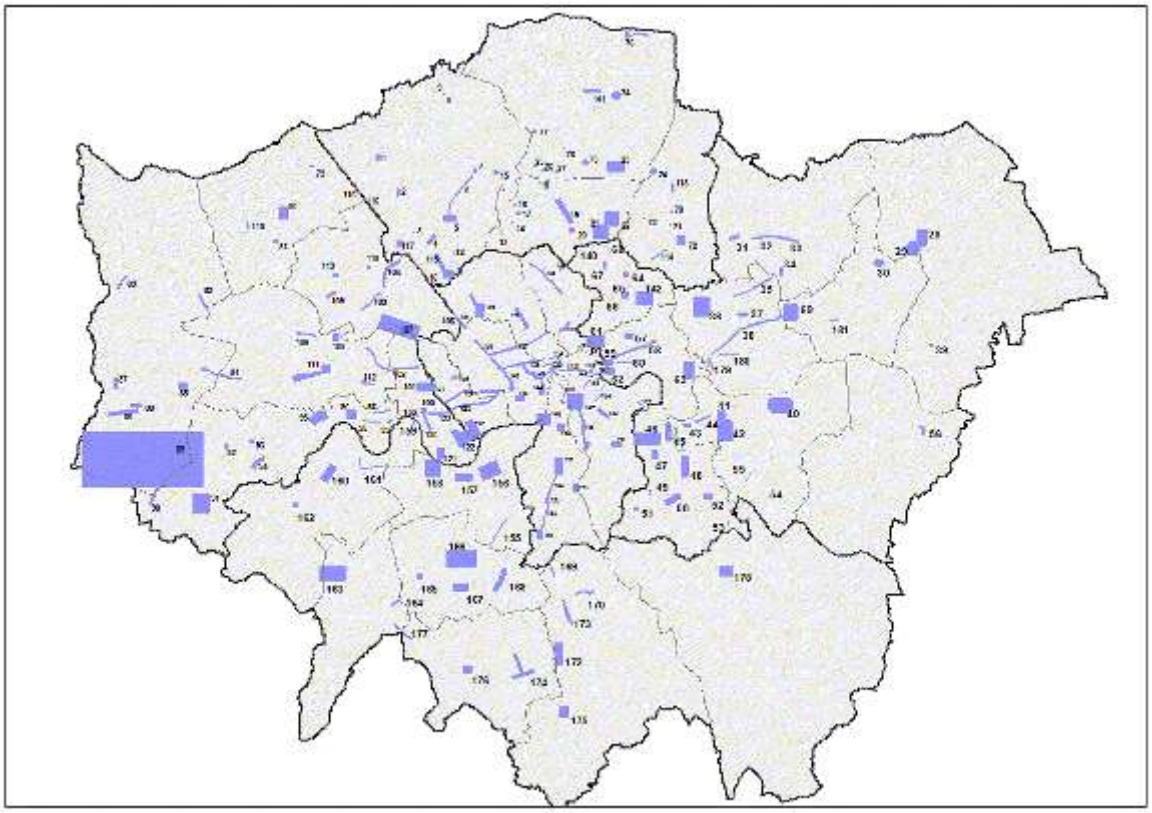

London Borough of Southwark
Annual Mean NO2 concentrations 2013
LAEI 2013
Legend
NO2 (µg/m3)
< 16
16 - 19
19 - 22
22 - 25
25 - 28
28 - 31
31 - 34
34 - 37
37 - 40
Limit
40 - 43
43 - 55
55 - 58
58 - 73
73 - 76
76 - 97
> 97
Boroughs
MAYOR OF LONDON
GREATERLONDONAUTHORITY
CLEANERAIR
FOR LONDON


London Borough of Southwark
Annual Mean PM10 concentrations 2013
LAEI 2013
Legend
PM10 (µg/m3)
< 16
16 - 19
19 - 22
22 - 25
25 - 28
28 - 31
31 - 34
34 - 37
37 - 40
40 - 43
43 - 55
55 - 58
58 - 73
73 - 76
76 - 97
> 97
Limit
Boroughs
MAYOR OF LONDON
GREATERLONDONAUTHORITY
CLEANERAIR FOR LONDON


London Borough of Southwark
Annual Mean PM2.5 concentrations 2013
LAEI 2013
Legend
PM2.5 (µg/m³)
< 12
12 - 13
13 - 15
15 - 17
17 - 19
19 - 21
21 - 23
23 - 25
25 - 27
27 - 33
> 33
Boroughs
MAYOR OF LONDON
GREATERLONDONAUTHORITY
CLEANERAIR FOR LONDON

GLA Air Quality Focus Areas for the Greater London Area.

The London Mayor has introduced a number of Air Quality Focus Areas[5] in the Greater London area**.** See map below.



The process of how the Mayor of London developed these focus areas can be found here

Within Southwark the following areas in have been designated Air Quality Focus Areas by the GLA.

ID	Description of the Air Quality Focus Area
1	London Bridge at Borough High Street
2	Elephant and Castle to St George's Circus
3	Walworth Road / Camberwell Road / Camberwell Green
4	Tower Bridge Road A100
5	A2 Old Kent Road from East Street to Trafalgar Avenue
6	Lower Road A200 Surrey Quays
7	Peckham High Street and Clayton Road

Table 4 Air Quality Focus Areas in the London Borough of Southwark

[5] GLA (2013) Air Quality focus areas data accessed at http://data.london.gov.uk/dataset/air-quality-focus-areas

Figure 7 is a map showing the GLA's Air Quality Focus Areas in Southwark with the Air Quality Focus Areas adjacent to the boundary of the Authority included. Table 4 and Table 5 give descriptions of the air quality focus areas in the borough and the air quality focus areas adjacent to borough's Boundary.

ID	Local Authority	Description of the Air Quality Focus Area
8	Lewisham	New Cross Gate and New Cross
9	Lewisham	Honor Oak Park junction Brockley Road
10	Lewisham	Forest Hill and Perry Vale Junction
11	Lambeth	Herne Hill / Croxted Road / Half Moon Lane / Dulwich Rd / Norwood Rd
12	Lambeth	Kennington Oval and Camberwell New Road
13	Lambeth	Waterloo Road
14	City of London	Farringdon Road and New Bridge Street at Blackfriars
15	City of Westminster	Embankment Charing Cross to Tower Hill
16	Tower Hamlets	Tower Hill / Tower Gateway / Cable St / The Highway

Table 5 Air Quality Focus Areas in the adjacent boroughs

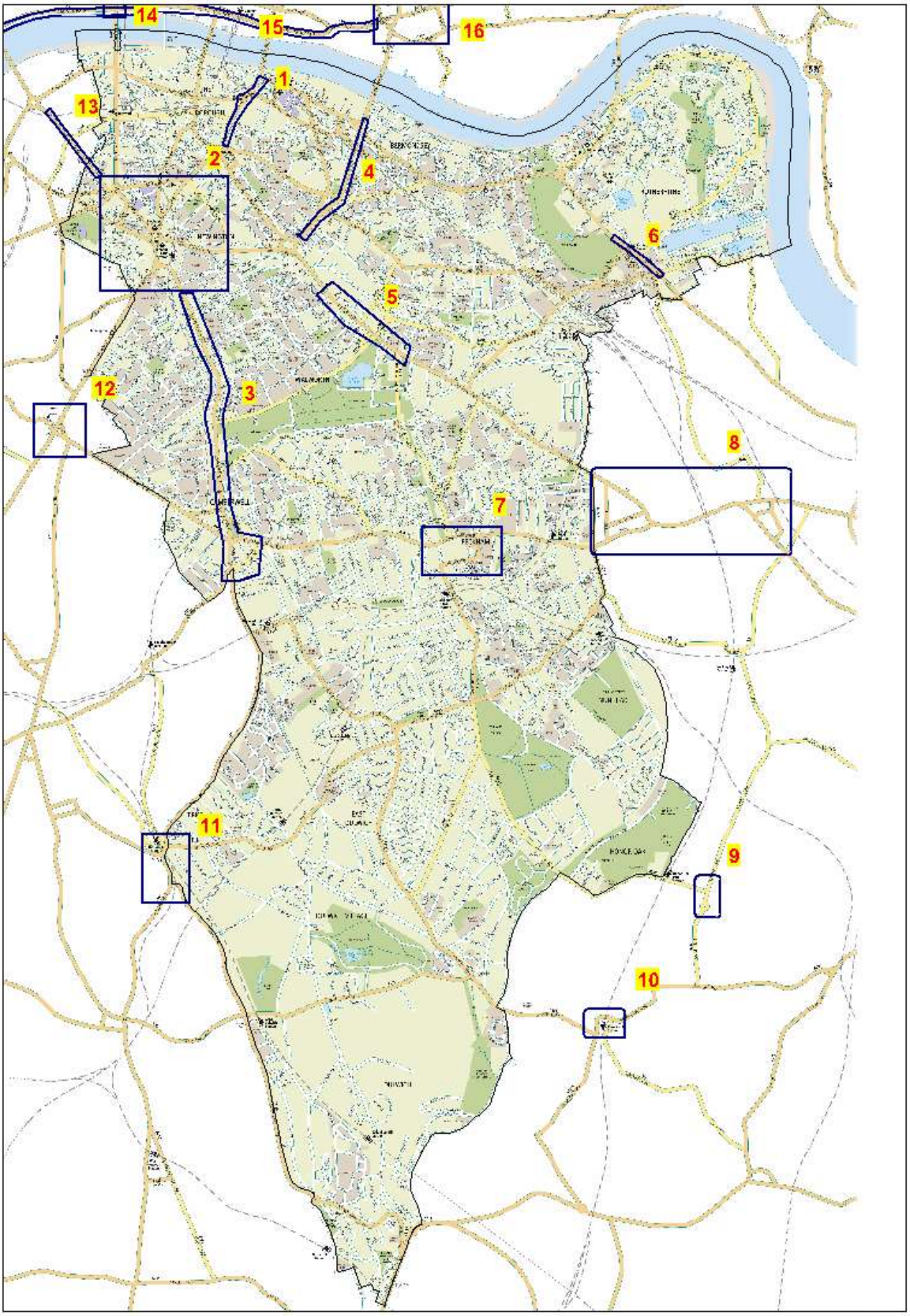


Figure 7 **London's Mayor Air Quality Focus Areas Map within and adjacent to the L.B. Southwark boundary**

Appendix 4 – Emission Sources

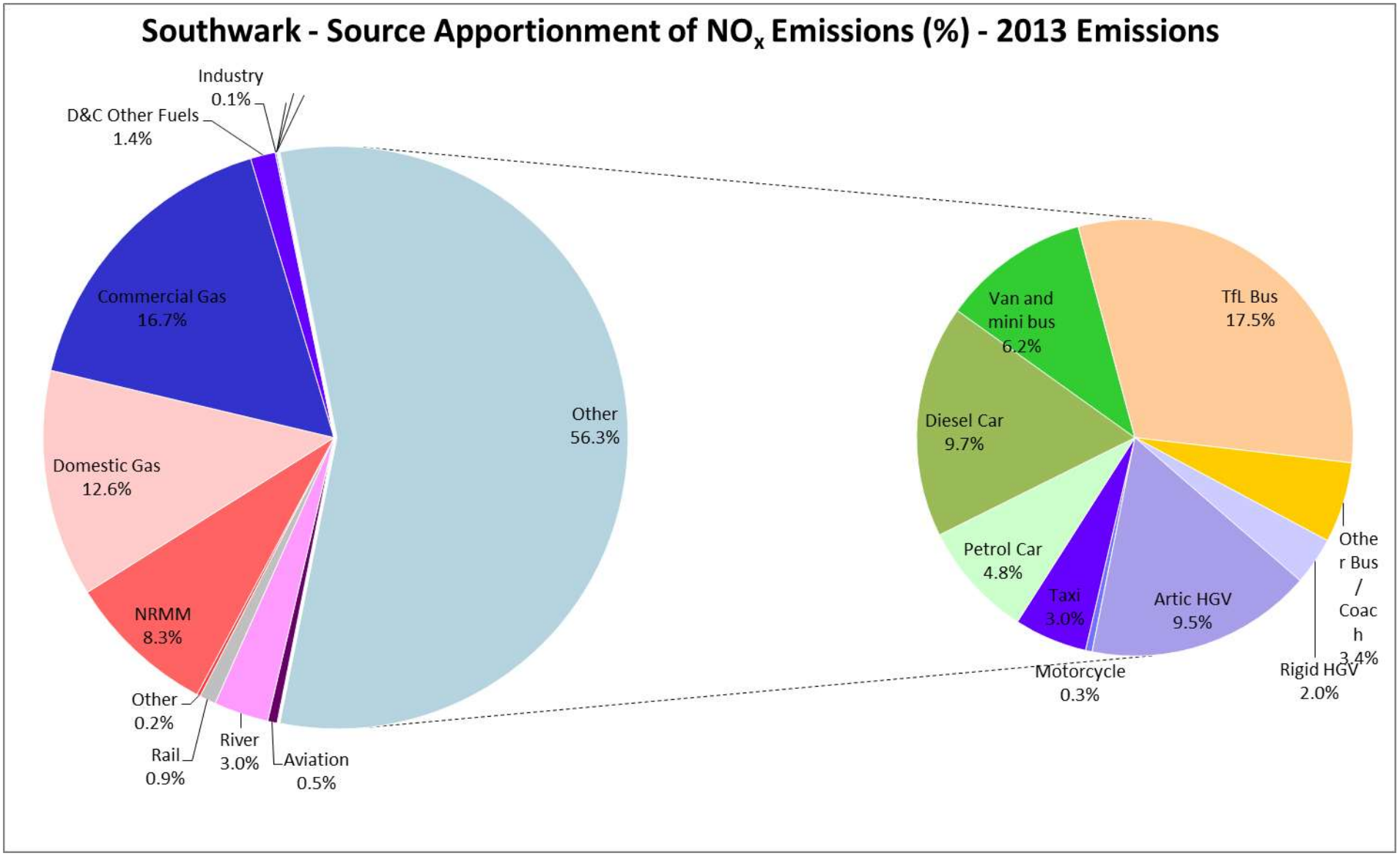
Introduction

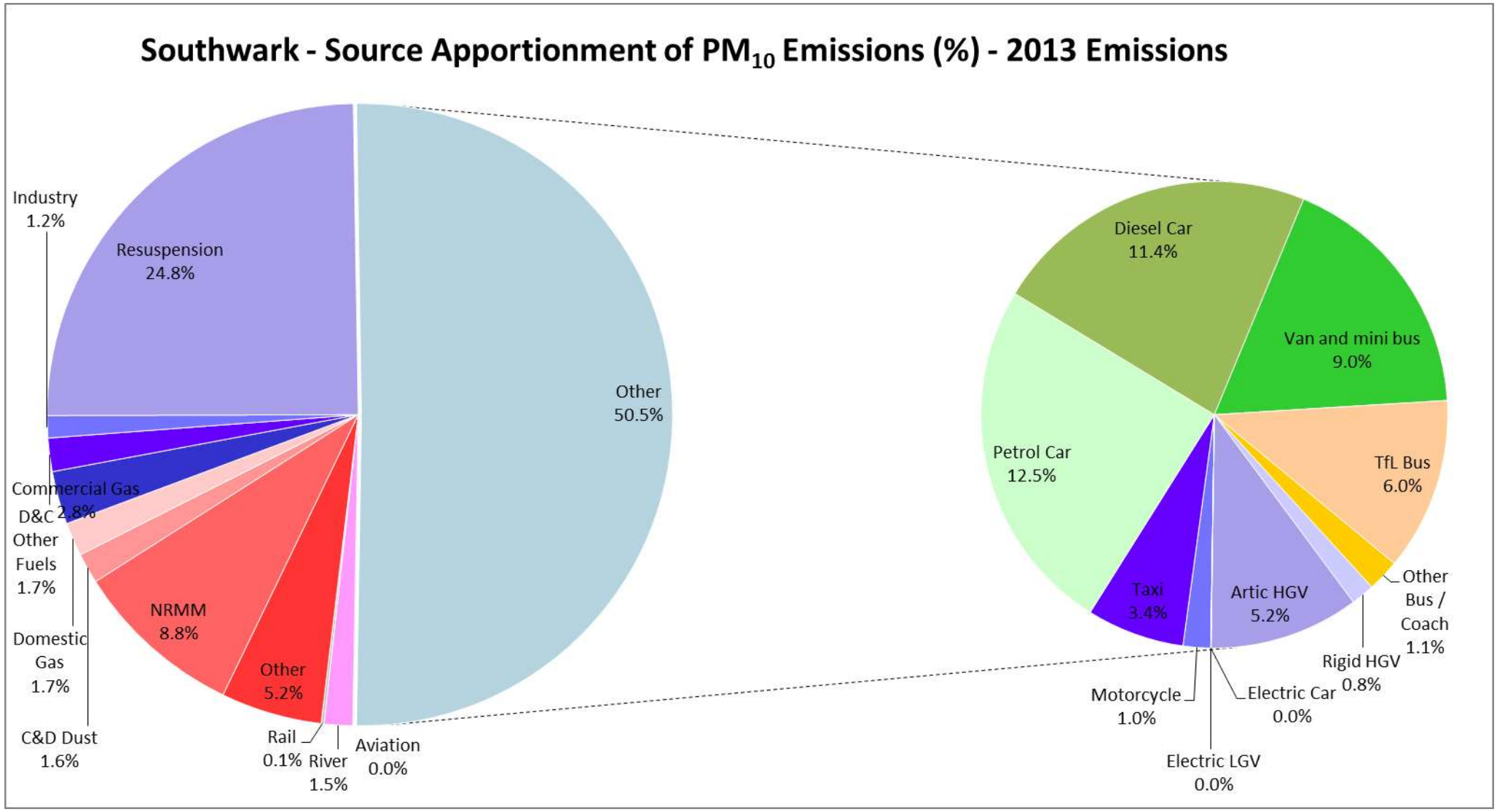
The GLA has produced the London Atmosphere Emissions Inventory (LAEI) for over a decade, the latest version was published in March 2016. The LAEI 2013 provides estimates in the Greater London area emissions for NO_2, PM_{10}, $PM_{2.5}$ & CO_2 for the base year 2013 and forward projections/predictions of pollutant levels for 2020, 2025 and 2030.

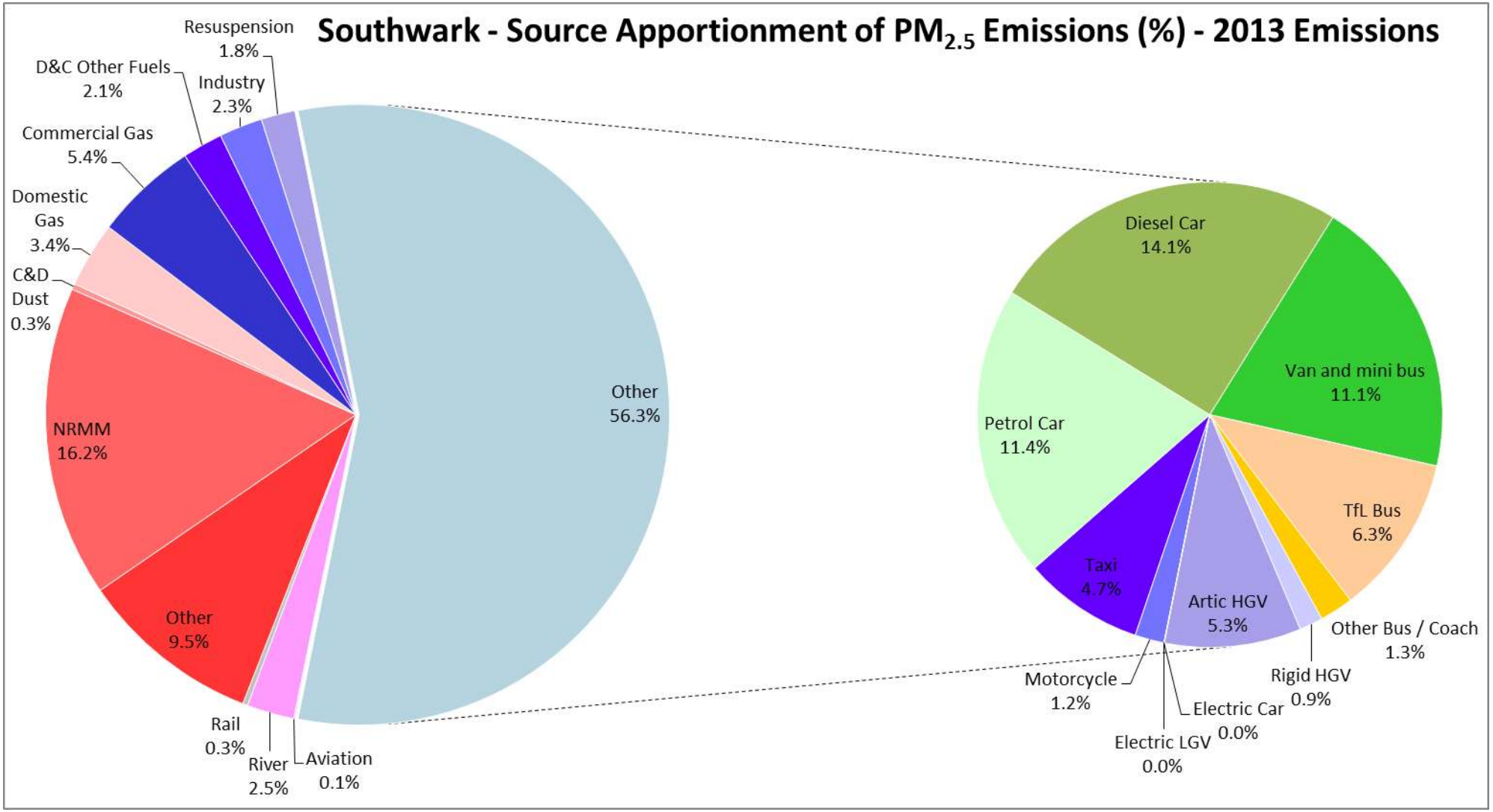
The LAEI can be downloaded from the GLA Datastore. The LAEI 2013 provides the following data.

- Supporting Information
- Grid Emissions Summary (in Excel. Mapinfo and Arc GISformat)
- Detailed Road Transport (in Excel. Mapinfo and Arc GISformat)
- Modelled Concentrations for the three pollutants for all the years
- Presentations Slides of the GLA LAEI 2013 Workshop on 14/04/2016

With the LAEI 2013 data the GLA has provided bespoke Borough by Borough information which utilises the information contained in the LAEI 2013. The information provides the concentration maps for 2013 and 2020 for NO_2, PM_{10} & $PM_{2.5}$ for all the London Boroughs and Excel Tools. The Excel Tools included a Source Apportionment Tool. The following pie charts show the source apportionment for NO_x, PM_{10} & $PM_{2.5}$ emissions in 2013 for the London Borough of Southwark. Within the source appointment tool, the emissions can be calculated for each 1km grid square within the borough.


Southwark - Source Apportionment of NOx Emissions (%) - 2013 Emissions
Industry 0.1%
D&C Other Fuels 1.4%
Commercial Gas 16.7%
Domestic Gas 12.6%
NRMM 8.3%
Other 0.2%
Rail 0.9%
River 3.0%
Aviation 0.5%
Other 56.3%
Van and mini bus 6.2%
TfL Bus 17.5%
Diesel Car 9.7%
Petrol Car 4.8%
Taxi 3.0%
Artic HGV 9.5%
Motorcycle 0.3%
Rigid HGV 2.0%
Other Bus / Coach 3.4%


Southwark - Source Apportionment of PM10 Emissions (%) - 2013 Emissions
Industry 1.2%
Resuspension 24.8%
Other 50.5%
Commercial Gas 2.8%
D&C
Other Fuels 1.7%
Domestic Gas 1.7%
C&D Dust 1.6%
NRMM 8.8%
Other 5.2%
Rail 0.1%
River 1.5%
Aviation 0.0%
Diesel Car 11.4%
Van and mini bus 9.0%
Petrol Car 12.5%
TfL Bus 6.0%
Other Bus / Coach 1.1%
Taxi 3.4%
Artic HGV 5.2%
Rigid HGV 0.8%
Motorcycle 1.0%
Electric Car 0.0%
Electric LGV 0.0%


Southwark - Source Apportionment of PM2.5 Emissions (%) - 2013 Emissions
Resuspension 1.8%
D&C Other Fuels 2.1%
Industry 2.3%
Commercial Gas 5.4%
Domestic Gas 3.4%
C&D Dust 0.3%
NRMM 16.2%
Other 9.5%
Rail 0.3%
River 2.5%
Aviation 0.1%
Other 56.3%
Diesel Car 14.1%
Van and mini bus 11.1%
TfL Bus 6.3%
Other Bus / Coach 1.3%
Rigid HGV 0.9%
Electric Car 0.0%
Electric LGV 0.0%
Motorcycle 1.2%
Artic HGV 5.3%
Taxi 4.7%
Petrol Car 11.4%

Appendix 5 - Glossary

AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQO	Air Quality Objective
BEB	Buildings Emission Benchmark
CAB	Cleaner Air Borough
CAZ	Central Activity Zone
GLA	Greater London Authority
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LLAQM	London Local Air Quality Management
NRMM	Non-Road Mobile Machinery
PM_{10}	Particulate matter less than 10 micron in diameter
$PM_{2.5}$	Particulate matter less than 2.5 micron in diameter
TEB	Transport Emissions Benchmark
TfL	Transport for London