Cambridge Environmental Research Consultants

Detailed air quality modelling and source apportionment

Reigate and Banstead Borough Council

Final report

Prepared for
Surrey Local Authorities

19th November 2019

CERC

Report Information

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1	04/04/19	Draft report
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Contents

1 Air quality contour plots

A detailed contour plot of annual mean NO_2 concentrations in Reigate and Banstead for the year 2017 is presented in Figure 1.1.

Figure 1.2 presents a contour plot of the modelled annual mean PM_{10} concentrations across Reigate and Banstead for 2017.

Figure 1.3 presents a contour plot of the modelled annual mean $PM_{2.5}$ concentrations across Reigate and Banstead for 2017.

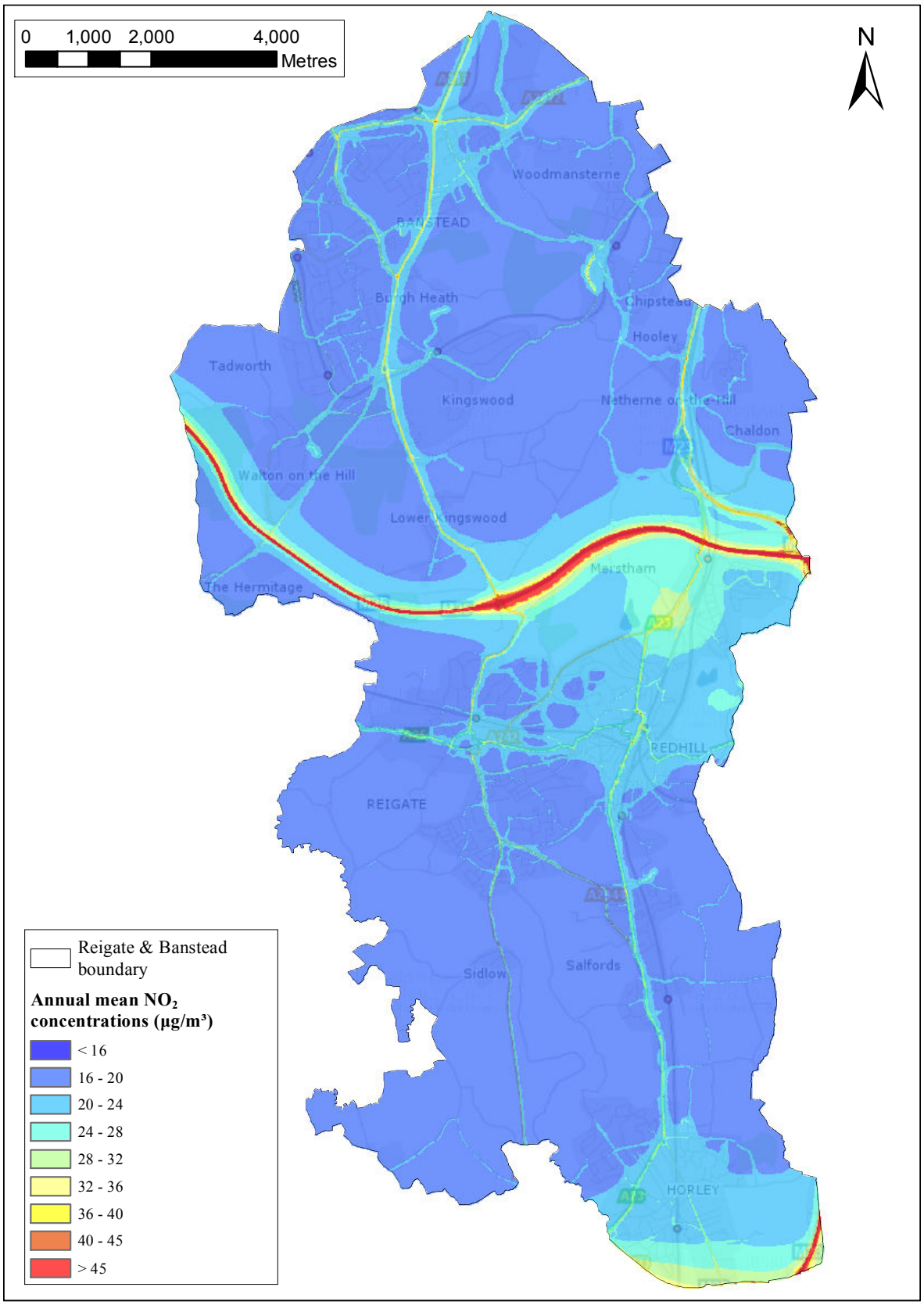

Figure 1.1: Annual mean NO_2 concentrations for Reigate and Banstead, 2017 (µg/m³)

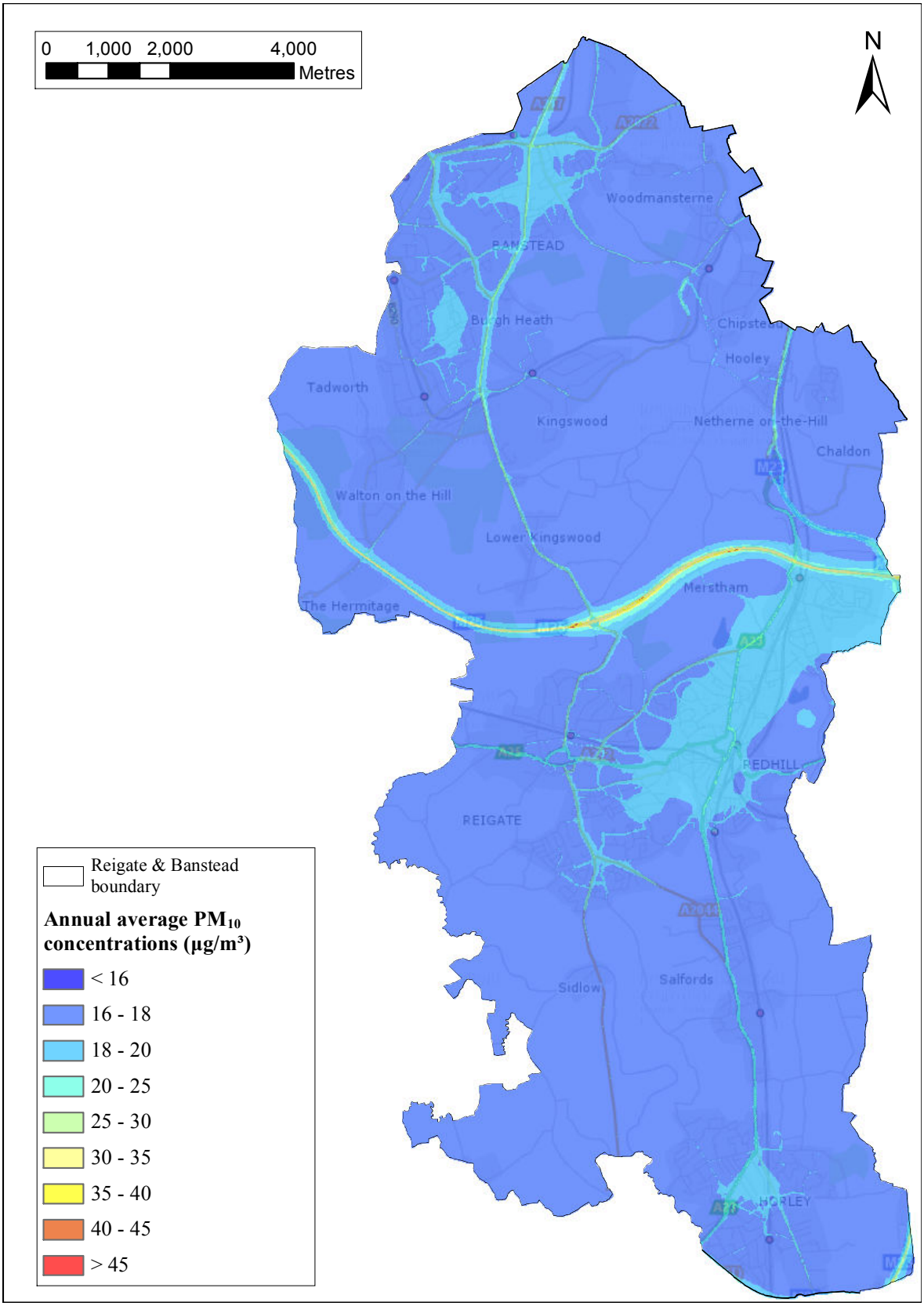

Figure 1.2: Annual mean PM_{10} concentrations for Reigate and Banstead, 2017 (µg/m³)

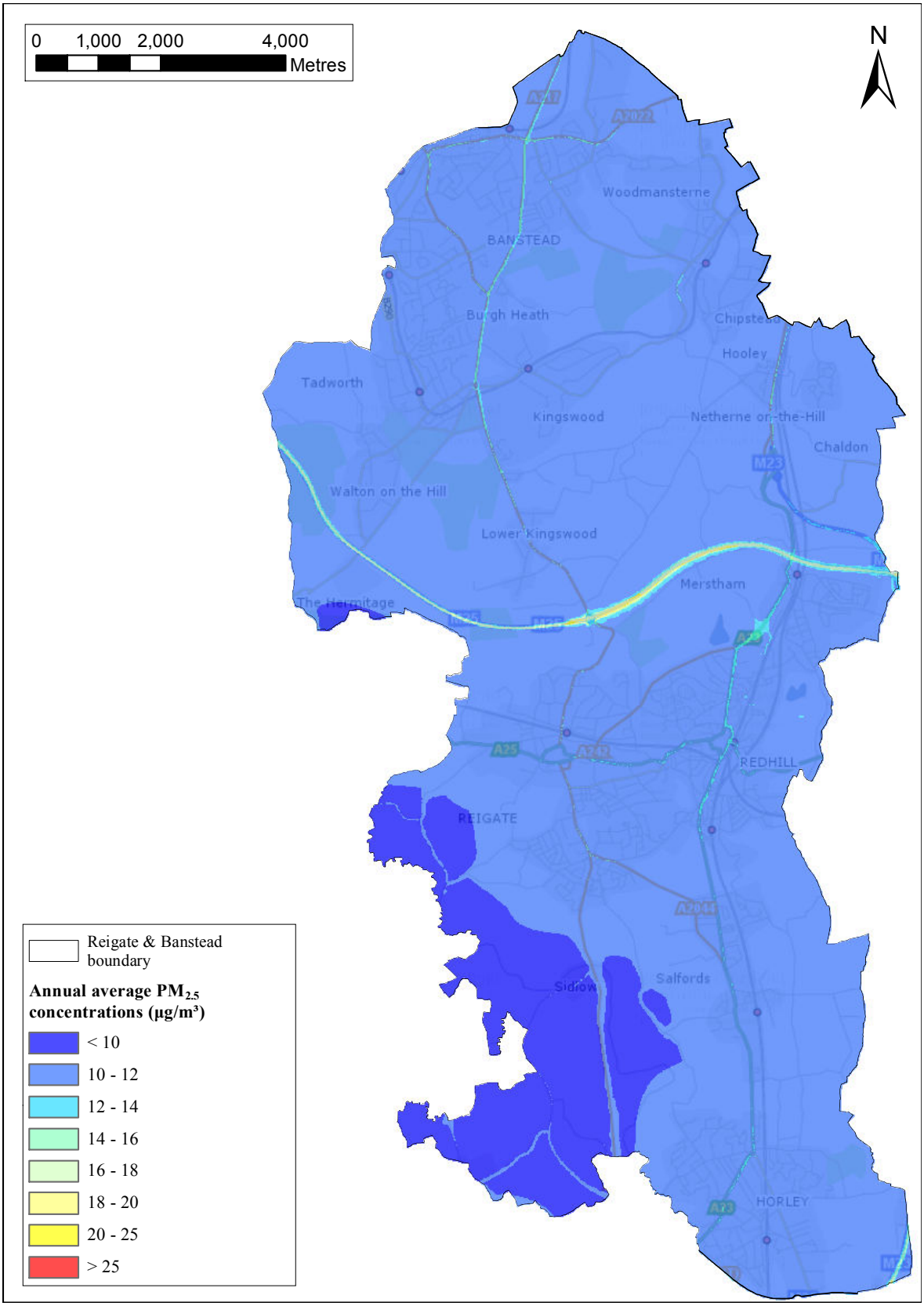

Figure 1.3: Annual mean $PM_{2.5}$ concentrations for Reigate and Banstead, 2017 (µg/m³)

2 Source apportionment

An overview of NO_x, PM_{10} and $PM_{2.5}$ source apportionment for Reigate and Banstead is presented in this section. The pollutants of interest are split into group type, vehicle category and non-exhaust concentrations for particulate matter. The source apportionment locations are detailed in Table 2.1.

Figure 2.1 presents the average NO_x concentrations found within Reigate and Banstead, for each group type. Road traffic sources are further split by vehicle category in Figure 2.2. Finally, a summary of NO_x source apportionment can be found in Table 2.2.

Figure 2.3 presents the average PM_{10} concentrations found within Reigate and Banstead, for each group type. Road traffic sources are further split by vehicle category in Figure 2.4. The majority of road traffic PM_{10} concentrations consist of non-exhaust concentrations, which are illustrated in Figure 2.5. Finally, a summary of PM_{10} source apportionment can be found in Table 2.3.

Figure 2.6 presents the average $PM_{2.5}$ concentrations found within Reigate and Banstead, for each group type. Road traffic sources are further split by vehicle category in Figure 2.7. The majority of road traffic $PM_{2.5}$ concentrations consist of non-exhaust concentrations, which are illustrated in Figure 2.8. Finally, a summary of $PM_{2.5}$ source apportionment can be found in Table 2.4.

Table 2.1: Source apportionment receptor locations throughout Reigate and Banstead

Receptor	XY	Address
RB009	525749, 149677	N/A
RB023	523613, 159906	N/A
RB034	524158, 152431	N/A
RB039	529211, 153572	N/A
RB050	525698, 152943	N/A
RB059	528602, 141789	N/A
RB102	530936, 144271	N/A
RB104	525204, 150252	N/A
RB106	523254, 160055	N/A
RB109	525385, 150178	N/A
RB110	529016, 153439	N/A
RB116	525022, 150317	N/A
RB117	525075, 150327	N/A
RB120	528195, 150421	N/A
RB124	529009, 153283	N/A
RB125	525590, 151655	N/A
RB126	525314, 159671	N/A
RB136	528812, 156473	N/A
RB137	528833, 156648	N/A
RB140	528122, 150799	N/A
RB145	527850, 150159	N/A
RB146	528760, 156277	N/A
RB147	528732, 156407	N/A
RB148	527736, 142710	N/A
RB149	527736, 142710	N/A
RB150	525397, 150867	N/A
RB151	528502, 142952	N/A
RBXXA	523484, 158378	Shawley Way
RBXXB	535012, 151821	Tandridge WI site

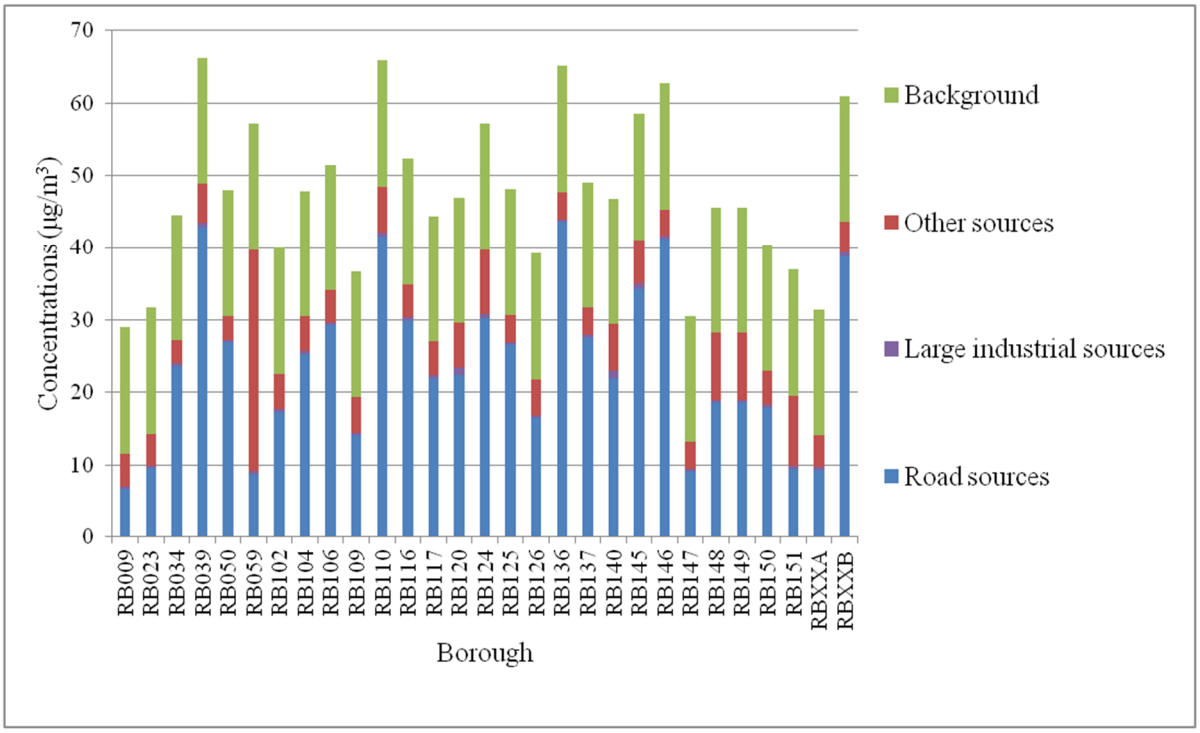

Figure 2.1: NO_x concentrations by major source group, Reigate and Banstead [1]

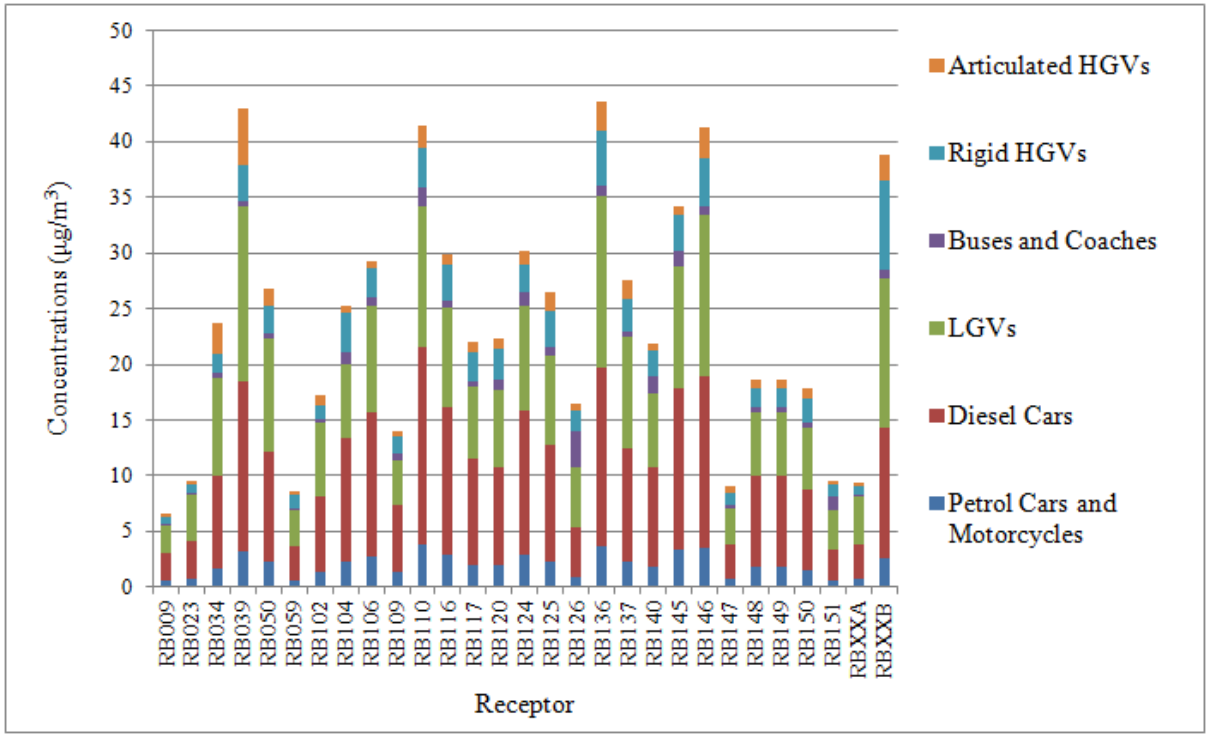

Figure 2.2: Road transport NO_x concentrations by vehicle category, Reigate and Banstead

[1] Other sources include: (1) combustion in commercial, institution and agricultural sectors, (2) combustion in industry, (3) combustion in energy production and transfer, (4) production processes, (5) extraction and distribution of fossil fuels, (6) solvent use, (7) other transport and machinery, (8) waste treatment and disposal, (8) agricultural, forests and land use change, (10) other sources and sinks.

Table 2.2: Summary of NO_x concentration source apportionment, Reigate and Banstead

NOx	Type of source apportionment									
	Source type				Vehicle type					
Receptor	Road sources	Other sources	Background	Large industrial sources	Petrol Cars & Motorcycles	Diesel Cars	LGVs	Buses & Coaches	Rigid HGVs	Articulated HGVs
RB009	6.6	4.5	17.4	0.4	0.5	2.5	2.4	0.2	0.7	0.3
RB023	9.6	4.4	17.4	0.3	0.7	3.5	4.1	0.1	0.9	0.3
RB034	23.7	3.1	17.4	0.4	1.7	8.3	8.8	0.4	1.7	2.8
RB039	42.9	5.3	17.4	0.6	3.2	15.2	15.8	0.4	3.3	5.0
RB050	26.9	3.3	17.4	0.4	2.2	10.0	10.2	0.5	2.4	1.6
RB059	8.7	30.6	17.4	0.5	0.6	3.0	3.3	0.2	1.2	0.4
RB102	17.3	5.0	17.4	0.4	1.4	6.8	6.6	0.2	1.3	0.9
RB104	25.3	4.8	17.4	0.4	2.3	11.0	6.7	1.0	3.6	0.7
RB106	29.3	4.4	17.4	0.3	2.8	12.9	9.6	0.8	2.7	0.6
RB109	14.1	4.9	17.4	0.4	1.3	6.0	4.1	0.6	1.5	0.6
RB110	41.5	6.4	17.4	0.6	3.8	17.7	12.6	1.8	3.5	2.0
RB116	30.0	4.6	17.4	0.4	2.9	13.2	8.9	0.7	3.2	1.0
RB117	21.9	4.7	17.4	0.4	2.0	9.5	6.4	0.5	2.6	0.9
RB120	22.4	6.1	17.4	1.1	1.9	8.9	7.0	0.9	2.7	1.0
RB124	30.2	9.0	17.4	0.6	2.8	12.9	9.4	1.2	2.5	1.3
RB125	26.6	3.7	17.4	0.4	2.2	10.5	7.9	0.8	3.3	1.8
RB126	16.5	5.1	17.4	0.3	0.9	4.4	5.4	3.3	1.9	0.6
RB136	43.6	3.8	17.4	0.3	3.7	16.1	15.4	0.8	4.9	2.7
RB137	27.6	3.8	17.4	0.3	2.3	10.2	9.9	0.5	3.0	1.7
RB140	21.9	6.4	17.4	1.1	1.9	8.8	6.7	1.6	2.3	0.6
RB145	34.3	6.0	17.4	0.8	3.3	14.6	10.9	1.4	3.3	0.8
RB146	41.2	3.7	17.4	0.4	3.5	15.4	14.4	0.8	4.4	2.7
RB147	9.1	3.8	17.4	0.3	0.7	3.1	3.3	0.2	1.2	0.6
RB148	18.6	9.3	17.4	0.4	1.8	8.2	5.8	0.4	1.7	0.7
RB149	18.6	9.3	17.4	0.4	1.8	8.2	5.8	0.4	1.7	0.7
RB150	17.9	4.7	17.4	0.4	1.6	7.1	5.6	0.5	2.1	1.0
RB151	9.5	9.7	17.4	0.4	0.6	2.7	3.6	1.3	1.0	0.3
RBXXA	9.4	4.4	17.4	0.3	0.7	3.1	4.4	0.1	0.8	0.3
RBXXB	38.8	4.2	17.4	0.6	2.5	11.8	13.4	0.8	7.9	2.3

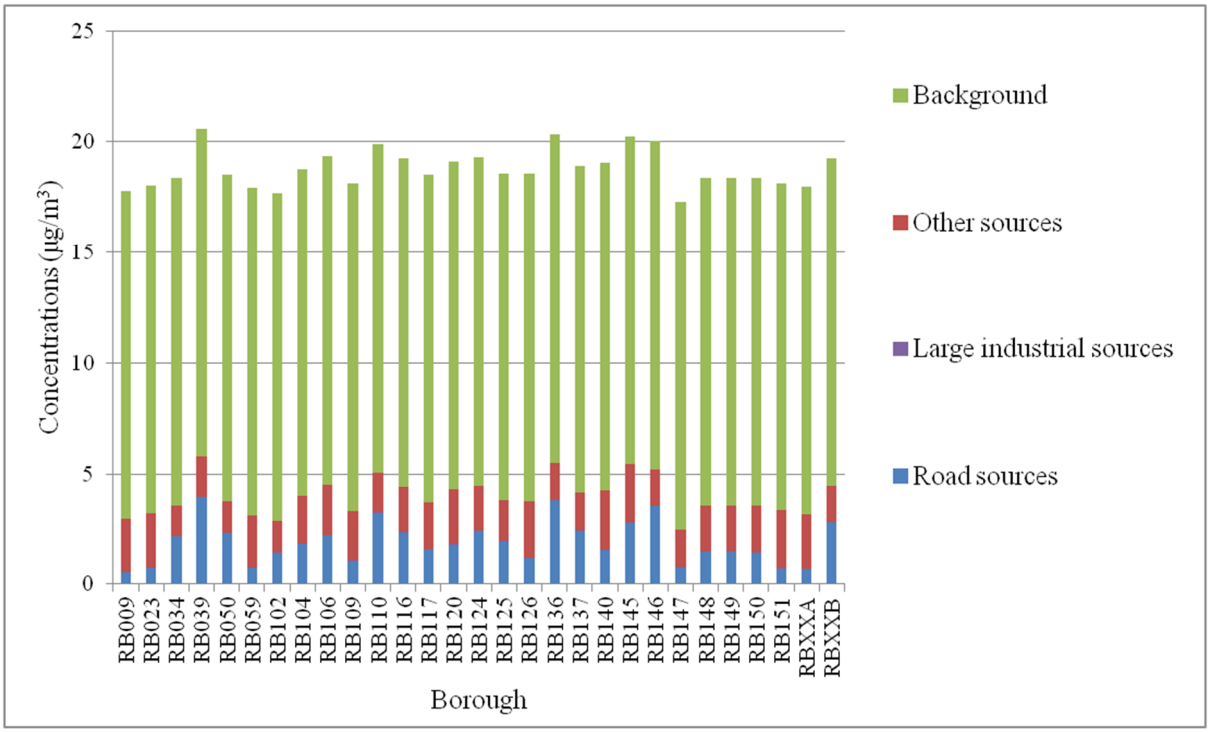

Figure 2.3: PM_{10} concentrations by major source group, Reigate and Banstead

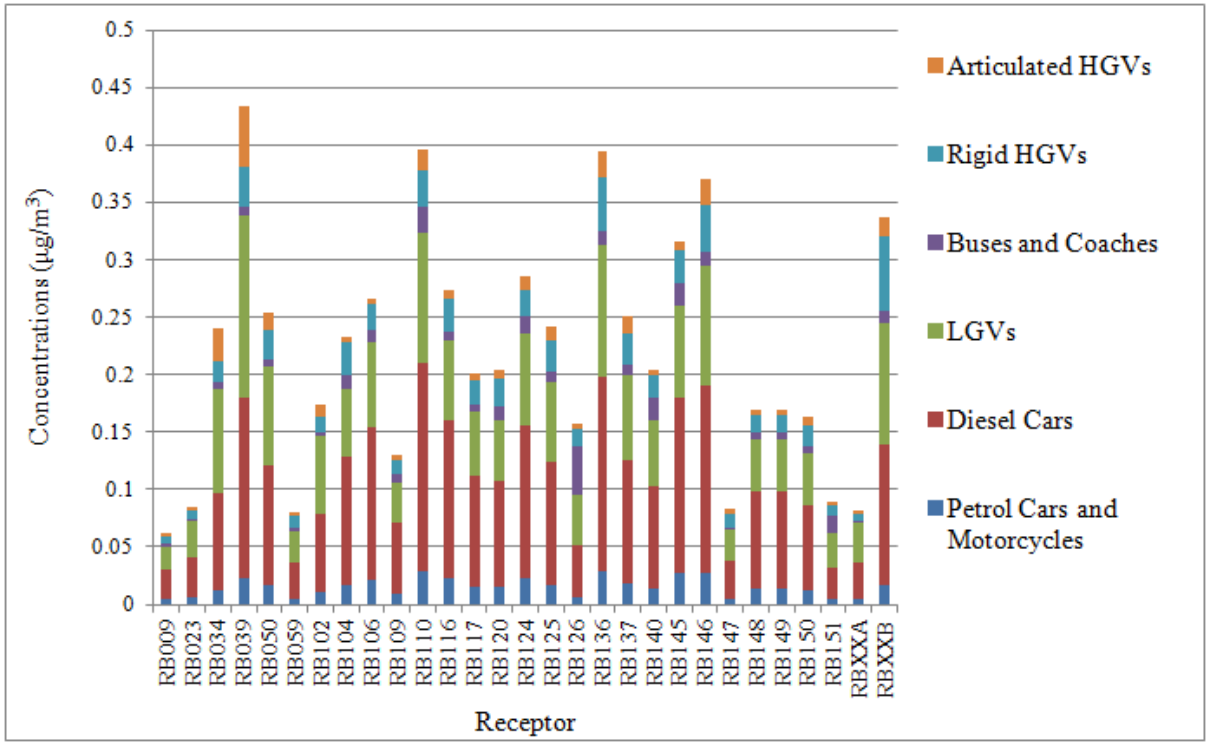

Figure 2.4: Road transport exhaust PM_{10} concentrations by vehicle category, Reigate and Banstead

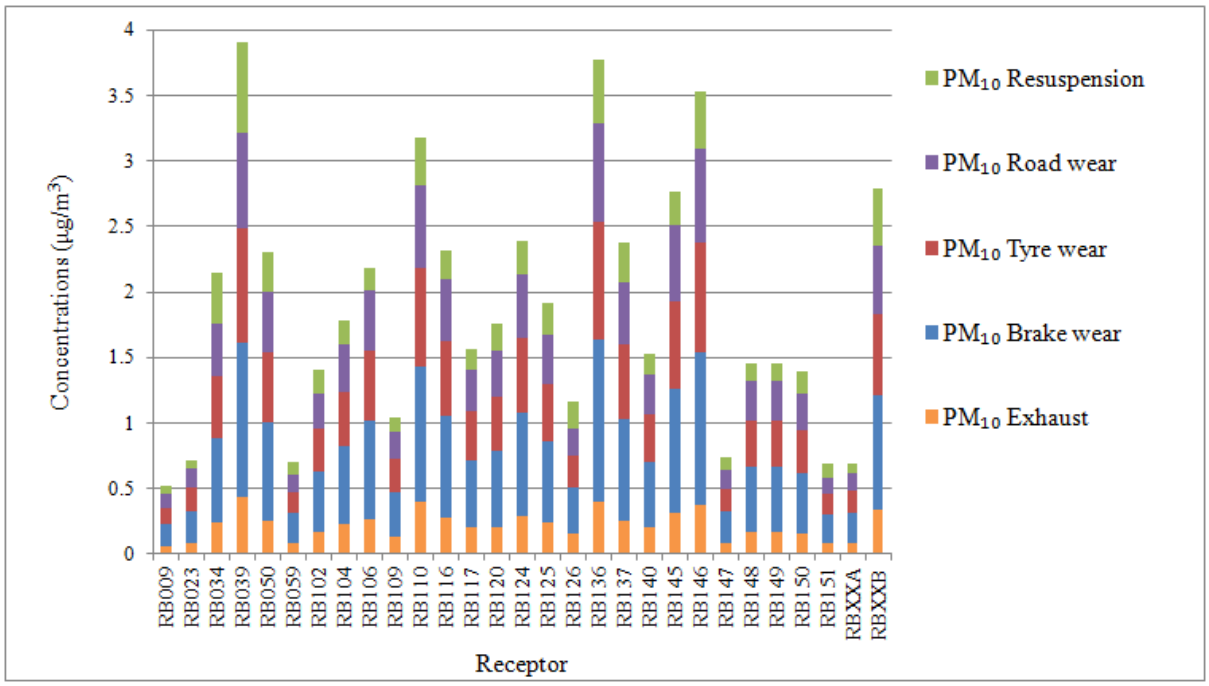

Figure 2.5: Road transport PM_{10} concentrations by exhaust and non-exhaust components, Reigate and Banstead

Table 2.3: Summary of PM_{10} concentration source apportionment, Reigate and Banstead

PM_{10}	Type of source apportionment													
	Source type				Road transport - exhaust by vehicle type						Road transport - non-exhaust			
Receptor	Road sources	Other sources	Background	Large industrial sources	Petrol Cars & Motorcycles	Diesel Cars	LGVs	Buses & Coaches	Rigid HGVs	Articulated HGVs	PM_{10} Brake wear	PM_{10} Tyre wear	PM_{10} Resuspension	PM_{10} Road wear
RB009	0.5	2.4	14.8	<0.1	<0.01	0.03	0.02	<0.01	<0.01	<0.01	0.2	0.1	<0.1	0.1
RB023	0.7	2.4	14.8	<0.1	<0.01	0.04	0.03	<0.01	<0.01	<0.01	0.2	0.2	<0.1	0.1
RB034	2.2	1.4	14.8	<0.1	0.01	0.08	0.09	<0.01	0.02	0.03	0.6	0.5	0.4	0.4
RB039	3.9	1.8	14.8	<0.1	0.02	0.16	0.16	<0.01	0.04	0.05	1.2	0.9	0.7	0.7
RB050	2.3	1.4	14.8	<0.1	0.02	0.10	0.09	<0.01	0.02	0.02	0.7	0.5	0.3	0.5
RB059	0.7	2.4	14.8	<0.1	<0.01	0.03	0.03	<0.01	0.01	<0.01	0.2	0.2	<0.1	0.1
RB102	1.4	1.4	14.8	<0.1	0.01	0.07	0.07	<0.01	0.01	<0.01	0.5	0.3	0.2	0.3
RB104	1.8	2.1	14.8	<0.1	0.02	0.11	0.06	0.01	0.03	<0.01	0.6	0.4	0.2	0.4
RB106	2.2	2.3	14.8	<0.1	0.02	0.13	0.07	0.01	0.02	<0.01	0.7	0.5	0.2	0.5
RB109	1.0	2.2	14.8	<0.1	<0.01	0.06	0.04	<0.01	0.01	<0.01	0.3	0.2	0.1	0.2
RB110	3.2	1.9	14.8	<0.1	0.03	0.18	0.11	0.02	0.03	0.02	1.0	0.8	0.4	0.6
RB116	2.3	2.1	14.8	<0.1	0.02	0.14	0.07	<0.01	0.03	<0.01	0.8	0.6	0.2	0.5
RB117	1.6	2.1	14.8	<0.1	0.02	0.10	0.06	<0.01	0.02	<0.01	0.5	0.4	0.2	0.3
RB120	1.8	2.5	14.8	0.1	0.01	0.09	0.05	0.01	0.02	<0.01	0.6	0.4	0.2	0.4
RB124	2.4	2.1	14.8	<0.1	0.02	0.13	0.08	0.02	0.02	0.01	0.8	0.6	0.3	0.5
RB125	1.9	1.8	14.8	<0.1	0.02	0.11	0.07	<0.01	0.03	0.01	0.6	0.4	0.2	0.4
RB126	1.2	2.5	14.8	<0.1	<0.01	0.05	0.04	0.04	0.02	<0.01	0.4	0.2	0.2	0.2
RB136	3.8	1.7	14.8	<0.1	0.03	0.17	0.11	0.01	0.05	0.02	1.2	0.9	0.5	0.8
RB137	2.4	1.7	14.8	<0.1	0.02	0.11	0.07	<0.01	0.03	0.01	0.8	0.6	0.3	0.5
RB140	1.5	2.6	14.8	0.1	0.01	0.09	0.06	0.02	0.02	<0.01	0.5	0.4	0.2	0.3
RB145	2.8	2.6	14.8	<0.1	0.03	0.15	0.08	0.02	0.03	<0.01	0.9	0.7	0.3	0.6
RB146	3.5	1.7	14.8	<0.1	0.03	0.16	0.10	0.01	0.04	0.02	1.2	0.8	0.4	0.7
RB147	0.7	1.7	14.8	<0.1	<0.01	0.03	0.03	<0.01	0.01	<0.01	0.2	0.2	0.1	0.1
RB148	1.5	2.1	14.8	<0.1	0.01	0.09	0.04	<0.01	0.02	<0.01	0.5	0.4	0.1	0.3
RB149	1.5	2.1	14.8	<0.1	0.01	0.09	0.04	<0.01	0.02	<0.01	0.5	0.4	0.1	0.3
RB150	1.4	2.1	14.8	<0.1	0.01	0.07	0.05	<0.01	0.02	<0.01	0.5	0.3	0.2	0.3
RB151	0.7	2.6	14.8	<0.1	<0.01	0.03	0.03	0.02	<0.01	<0.01	0.2	0.2	0.1	0.1
RBXXA	0.7	2.5	14.8	<0.1	<0.01	0.03	0.03	<0.01	<0.01	<0.01	0.2	0.2	<0.1	0.1
RBXXB	2.8	1.6	14.8	<0.1	0.02	0.12	0.11	0.01	0.06	0.02	0.9	0.6	0.4	0.5

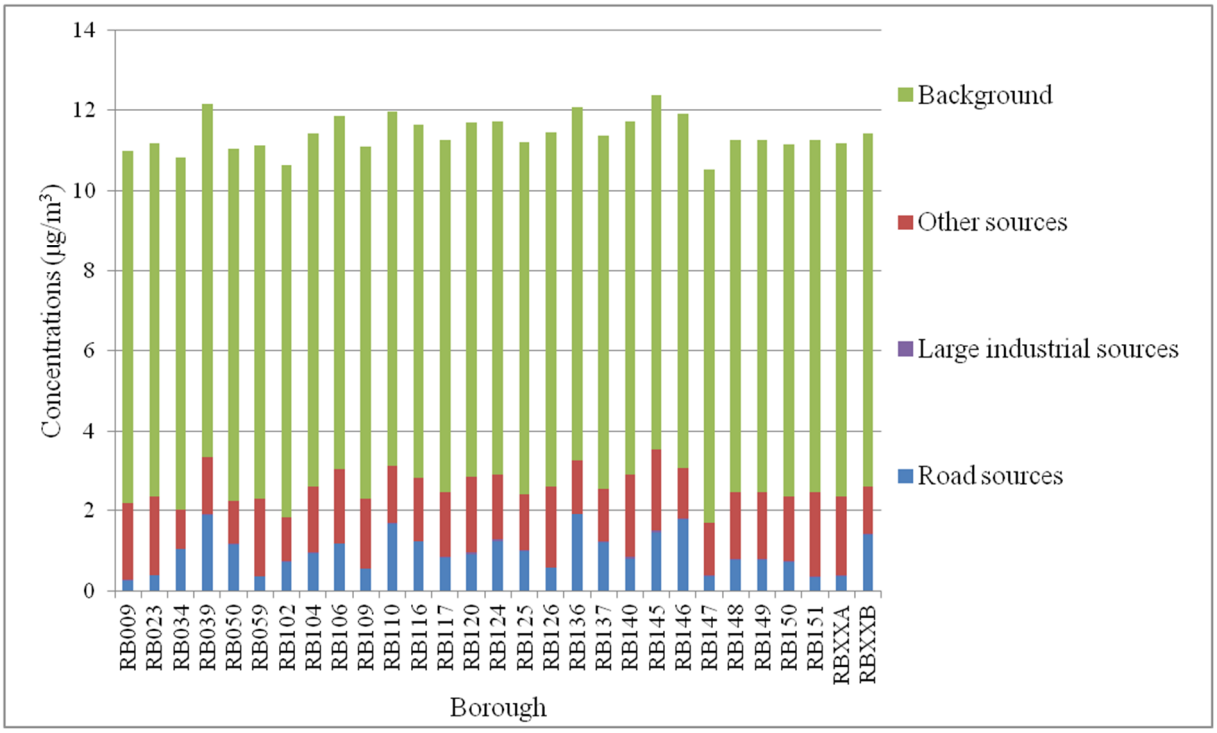

Figure 2.6: $PM_{2.5}$ concentrations by major source group, Reigate and Banstead

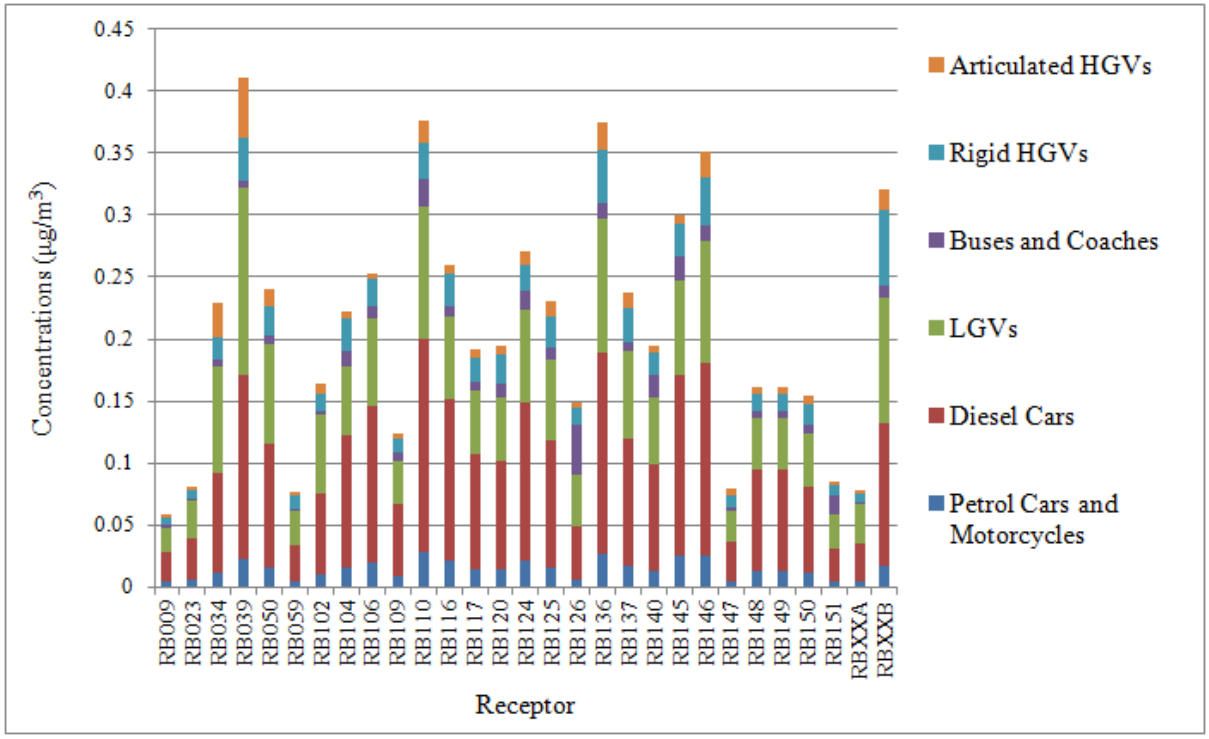

Figure 2.7: Road transport exhaust $PM_{2.5}$ concentrations by vehicle category, Reigate and Banstead

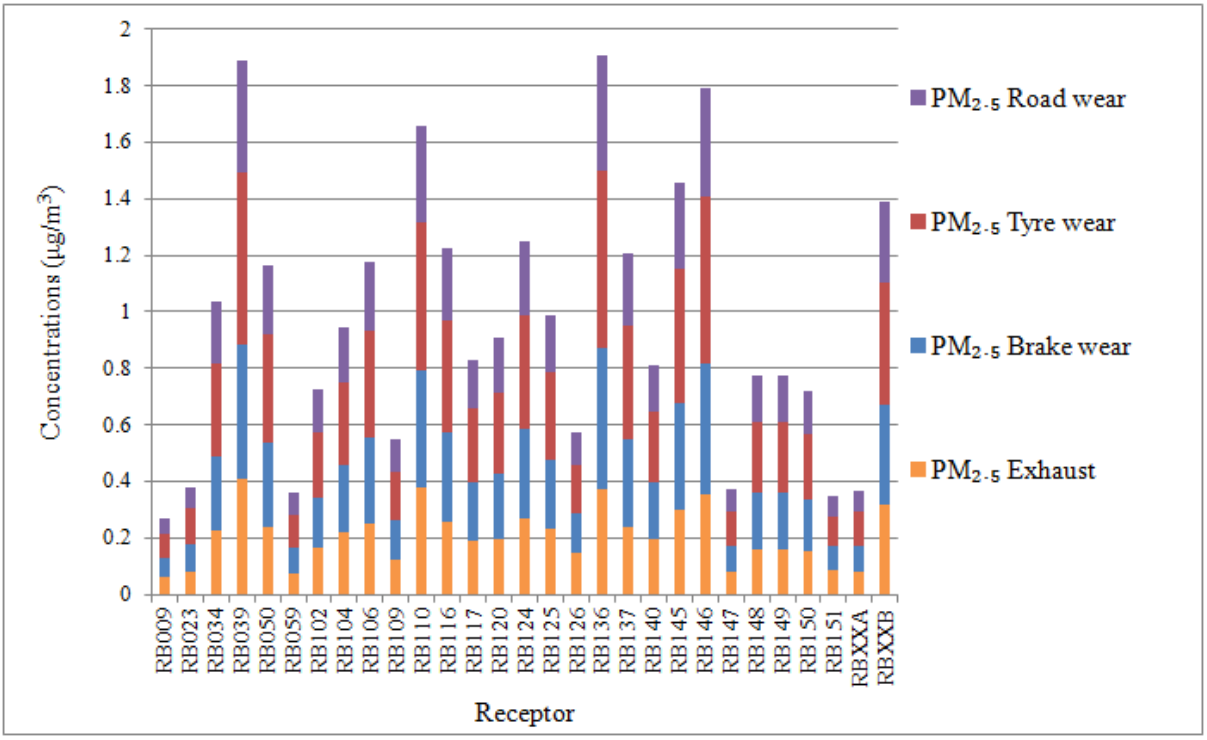

Figure 2.8: Road transport $PM_{2.5}$ concentrations by exhaust and non-exhaust components, Reigate and Banstead

Table 2.4: Summary of $PM_{2.5}$ concentration source apportionment, Reigate and Banstead

$PM_{2.5}$	Type of source apportionment												
	Source type				Road transport - exhaust by vehicle type						Road transport - non-exhaust		
Receptor	Road sources	Other sources	Background	Large industrial sources	Petrol Cars & Motorcycles	Diesel Cars	LGVs	Buses & Coaches	Rigid HGVs	Articulated HGVs	$PM_{2.5}$ Brake wear	$PM_{2.5}$ Tyre wear	$PM_{2.5}$ Road wear
RB009	0.3	1.9	8.8	<0.1	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
RB023	0.4	2.0	8.8	<0.1	<0.01	0.03	0.03	<0.01	<0.01	<0.01	<0.1	0.1	<0.1
RB034	1.0	1.0	8.8	<0.1	0.01	0.08	0.09	<0.01	0.02	0.03	0.3	0.3	0.2
RB039	1.9	1.4	8.8	<0.1	0.02	0.15	0.15	<0.01	0.03	0.05	0.5	0.6	0.4
RB050	1.2	1.1	8.8	<0.1	0.02	0.10	0.08	<0.01	0.02	0.01	0.3	0.4	0.2
RB059	0.4	1.9	8.8	<0.1	<0.01	0.03	0.03	<0.01	0.01	<0.01	<0.1	0.1	<0.1
RB102	0.7	1.1	8.8	<0.1	<0.01	0.07	0.06	<0.01	0.01	<0.01	0.2	0.2	0.1
RB104	0.9	1.6	8.8	<0.1	0.02	0.11	0.06	0.01	0.03	<0.01	0.2	0.3	0.2
RB106	1.2	1.9	8.8	<0.1	0.02	0.13	0.07	<0.01	0.02	<0.01	0.3	0.4	0.2
RB109	0.5	1.7	8.8	<0.1	<0.01	0.06	0.03	<0.01	0.01	<0.01	0.1	0.2	0.1
RB110	1.7	1.5	8.8	<0.1	0.03	0.17	0.11	0.02	0.03	0.02	0.4	0.5	0.3
RB116	1.2	1.6	8.8	<0.1	0.02	0.13	0.07	<0.01	0.03	<0.01	0.3	0.4	0.3
RB117	0.8	1.6	8.8	<0.1	0.01	0.09	0.05	<0.01	0.02	<0.01	0.2	0.3	0.2
RB120	0.9	1.9	8.8	<0.1	0.01	0.09	0.05	0.01	0.02	<0.01	0.2	0.3	0.2
RB124	1.2	1.6	8.8	<0.1	0.02	0.13	0.08	0.02	0.02	0.01	0.3	0.4	0.3
RB125	1.0	1.4	8.8	<0.1	0.02	0.10	0.07	<0.01	0.03	0.01	0.2	0.3	0.2
RB126	0.6	2.0	8.8	<0.1	<0.01	0.04	0.04	0.04	0.01	<0.01	0.1	0.2	0.1
RB136	1.9	1.3	8.8	<0.1	0.03	0.16	0.11	0.01	0.04	0.02	0.5	0.6	0.4
RB137	1.2	1.3	8.8	<0.1	0.02	0.10	0.07	<0.01	0.03	0.01	0.3	0.4	0.3
RB140	0.8	2.1	8.8	<0.1	0.01	0.09	0.05	0.02	0.02	<0.01	0.2	0.3	0.2
RB145	1.5	2.1	8.8	<0.1	0.03	0.15	0.08	0.02	0.03	<0.01	0.4	0.5	0.3
RB146	1.8	1.3	8.8	<0.1	0.03	0.15	0.10	0.01	0.04	0.02	0.5	0.6	0.4
RB147	0.4	1.3	8.8	<0.1	<0.01	0.03	0.03	<0.01	0.01	<0.01	<0.1	0.1	<0.1
RB148	0.8	1.7	8.8	<0.1	0.01	0.08	0.04	<0.01	0.01	<0.01	0.2	0.3	0.2
RB149	0.8	1.7	8.8	<0.1	0.01	0.08	0.04	<0.01	0.01	<0.01	0.2	0.3	0.2
RB150	0.7	1.6	8.8	<0.1	0.01	0.07	0.04	<0.01	0.02	<0.01	0.2	0.2	0.2
RB151	0.3	2.1	8.8	<0.1	<0.01	0.03	0.03	0.01	<0.01	<0.01	<0.1	0.1	<0.1
RBXXA	0.4	2.0	8.8	<0.1	<0.01	0.03	0.03	<0.01	<0.01	<0.01	<0.1	0.1	<0.1
RBXXB	1.4	1.2	8.8	<0.1	0.02	0.12	0.10	0.01	0.06	0.02	0.4	0.4	0.3

3 Mortality burden

Table 3.1 presents a mortality burden associated with NO_2 and $PM_{2.5}$ concentrations by Reigate and Banstead ward.

The range of values given for attributable fraction, life years lost and economic cost for each pollutant were derived from the minimum and maximum values for each of the individual pollutants. These were calculated using pairs of concentration response functions (CRFs) for $PM_{2.5}$ and NO_2 taken from four different studies; see Section 9 of main report for more information.

Total life years lost and total economic cost were derived from the combination of pollutants within each study.

Table 3.1: Summary of life years lost and economic cost resulting from NO_2 and $PM_{2.5}$ concentrations by Reigate and Banstead ward

Ward		NO_2				$PM_{2.5}$				Total life years lost	Total economic cost (£ Million)
Code	Name	Concentrations (µg/m³)	Attributable fraction	Life years lost	Economic cost (£ Million)	Concentrations (µg/m³)	Attributable fraction	Life years lost	Economic cost (£ Million)		
E05007329	Banstead Village	20.4	0.022-0.040	32-57	1.36-2.45	11.1	0.018-0.047	25-68	1.08-2.92	82-100	3.53-4.29
E05007330	Chipstead, Hooley & Woodmansterne	19.1	0.021-0.037	17-31	0.74-1.33	10.5	0.017-0.045	14-38	0.59-1.61	45-55	1.93-2.35
E05007331	Earlswood & Whitebushes	19.3	0.021-0.037	17-31	0.75-1.34	10.7	0.017-0.046	14-38	0.60-1.63	45-56	1.94-2.38
E05007332	Horley Central	24.0	0.026-0.046	32-56	1.35-2.41	11.1	0.018-0.047	21-57	0.91-2.46	78-89	3.32-3.81
E05007333	Horley East	21.1	0.023-0.041	11-19	0.45-0.81	10.7	0.017-0.046	8-20	0.32-0.87	26-31	1.13-1.32
E05007334	Horley West	19.6	0.021-0.038	17-31	0.75-1.34	10.8	0.017-0.046	14-38	0.60-1.61	45-55	1.94-2.36
E05007335	Kingswood with Burgh Heath	20.0	0.022-0.039	21-37	0.88-1.58	10.5	0.017-0.045	16-43	0.68-1.83	53-63	2.26-2.71
E05007336	Meadvale & St John's	19.4	0.021-0.038	14-25	0.60-1.08	11.2	0.018-0.048	12-32	0.51-1.37	37-46	1.58-1.97
E05007337	Merstham	26.9	0.029-0.052	31-55	1.31-2.35	11.4	0.018-0.049	19-51	0.82-2.20	74-82	3.16-3.52
E05007338	Nork	20.0	0.022-0.039	16-28	0.67-1.20	11.1	0.018-0.048	13-34	0.54-1.46	41-50	1.74-2.13
E05007339	Preston	19.1	0.021-0.037	5-9	0.22-0.39	11.2	0.018-0.048	4-12	0.19-0.51	14-17	0.58-0.73
E05007340	Redhill East	23.0	0.025-0.044	25-44	1.05-1.88	11.4	0.018-0.049	18-48	0.76-2.06	62-73	2.64-3.11
E05007341	Redhill West	21.4	0.023-0.041	17-31	0.74-1.32	11.3	0.018-0.049	13-36	0.58-1.55	44-54	1.90-2.29
E05007342	Reigate Central	19.9	0.021-0.039	17-30	0.72-1.29	10.9	0.017-0.046	14-37	0.58-1.56	44-53	1.87-2.28
E05007343	Reigate Hill	20.5	0.022-0.040	16-28	0.68-1.22	10.7	0.017-0.046	12-33	0.53-1.42	41-49	1.74-2.10
E05007344	Salfords & Sidlow	18.2	0.020-0.035	7-12	0.29-0.52	10.1	0.016-0.043	5-15	0.23-0.63	18-21	0.75-0.92
E05007345	South Park & Woodhatch	18.2	0.020-0.035	15-26	0.63-1.12	10.6	0.017-0.045	12-33	0.53-1.43	39-48	1.65-2.05
E05007346	Tadworth & Walton	20.0	0.022-0.039	21-37	0.89-1.59	10.7	0.017-0.046	16-42	0.67-1.80	53-63	2.25-2.68
E05007347	Tattenhams	19.3	0.021-0.037	18-32	0.75-1.35	11.0	0.017-0.047	15-40	0.63-1.71	46-58	1.98-2.46

*The pollutant concentrations presented are based on LSOA averaged concentrations and the attributable fractions and life years lost are calculated accordingly